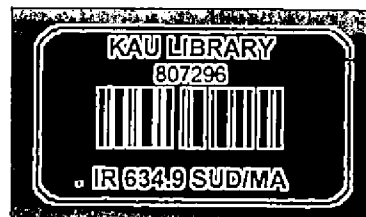


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MANUAL OF
FOREST TREE SEEDS OF KERALA



K. SUDHAKARA



**College of Forestry
Kerala Agricultural University
Thrissur – 680 656**

&

**Kerala Forest Department
Thiruvananthapuram - 695 014
2011**

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Final Report:

**DEVELOPMENT OF AN ONLINE MANUAL
FOR
THE FOREST TREE SEEDS
OF
KERALA**

(2-4-2007 TO 31-3-2011)

**COLLEGE OF FORESTRY
KERALA AGRICULTURAL UNIVERSITY
THRISSUR – 680 656**

**FUNDED BY
THE KERALA FOREST DEPARTMENT
UNDER THE
“KERALA FOREST DEVELOPMENT FUND”**

1. Title of the project: DEVELOPMENT OF AN ONLINE MANUAL FOR
THE FOREST TREE SEEDS OF KERALA
(Sanction No. 1. Order No. P3/1666/2006 dated 10-1-2007 and Letter No. P(3)-12072/2007 dt.
7-10-2009 of the CCF (D) Kerala Forest Dept., Thiruvananthapuram)

2. Location: College of Forestry
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Ashique Ali, U. (2-4-2007 to 24-8-2007), Anila, K. S. (11-9-2007 to 12-11-2008),
Veenadevi, K. R. (20-11-2008 to 31-12-2009), Felix Francis (25-11-2008 to 13-2-2009,
21-10-2009 to 29-12-2009, Rakhi Jayaprakash (4-10-2010 to 31-3-2011).

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Aneesh, K. S., Dhanya, P., Girija, K. K., Praveen, P., Shiran Kalappurackal, Sneha, C.,
Sreehari, V. S. etc.

5. BUDGET ALLOTMENT AND EXPENDITURE (UP TO 31-3-2011)

Item		Year (in lakh Rs.)		Total sanctioned	Year (in lakh Rs.)				Expend-iture (lakh Rs.)
		I	II		I	II	III	IV	
A. Full time project staff									
1. Research Assistant (B.Sc. Forestry/Agriculture/Botany) @ Rs. 5000/ pm consolidated – One	Salary	0.60	0.60	1.20	0.36314	0.42400	0.32640	0.22220	1.33574
2. Research Assistant (B.Sc. Computer Science) @ Rs. 5000/ pm consolidated – One	Salary	0.60	0.60	1.20	0	0	0		0
TA for the PI and TAs	TA	0.10	0.10	0.20	0.00922	0.02035	0.07126	0.03151	0.13234
B. Non – recurring contingencies									
C. Recurring contingencies									
D. Institutional charge									
Grand Total									
		2.53	2.20	4.73	1.07630	0.65661	0.70435	0.83515	3.27241

6. SUMMARY OF BUDGET AND EXPENDITURE (Rs. Lakhs)

	Salary	Contingencies		Institutional charges	Grand total
		Recurring	Non-recurring		
Allotment	2.60	1.00	0.70	0.43	4.73
Expenditure	1.46808	0.89959	0.60725	0.29749	3.27241

7. PROJECT DESCRIPTION

Objectives:

To develop a computerized interactive manual of tree seeds of Kerala in order to retrieve the following information:

- a. General information
- b. Tree seed identification using a key
- c. Seed and nursery technology, pests and diseases
- d. Ethnobotanical uses of tree seeds

This online manual which will be published in the internet and distributed through CD media will be a useful resource for obtaining up to date information about the forest tree seeds.

8. BACKGROUND

The seed represents the most critical phase in the life cycle of a plant. Housed within this unique, quiescent miniature plant is the germplasm, which represents the evolutionary continuum of the species.

Even though seed characteristics are quite stable, difficulties in seed identification are encountered. These are attributed to the limited number of characteristics (seed coat color, pattern, glume shape, etc.) that are available to differentiate between closely related groups. Other factors that also contribute to the problem are the small size of many seeds, the differences in maturity, the loss of certain seed parts during seed conditioning, and the difference in size and color of seeds which occurs from maturation under different soil and climatic conditions. Thus, the task of seed identification is challenging.

Presently, seeds are identified by experience, written descriptions or by comparing

the unknown seed with samples of known seeds or photographs of seeds in reference books (Martin and Barkley, 1961; Delorit. 1970; Reed, 1977; Friend, 1983). An unfamiliar seed for identification requires an extensive search through a seed collection and/or seed photographs requiring considerable time and cost. Gupta *et al.*, (2005) developed a Seed Identification Key using a computerized database based on Lucid software (<http://www.lucidcentral.com>) to identify prohibited and restricted seeds in Australia. The computer software Lucid allows development of comprehensive and interactive keys using both text and image data (University of Queensland, 2001).

The Western Ghats region is one among the mega diversity hotspots of the world. As early as 1904, Hooker had drawn his attention to the distinct flora of the Western Ghats, which he called the 'Malabar' floristic region. The Kerala state's 10,035 plant species comprise a disproportionately large 22% of India's total. So there is a multiplicity of species for identification.

The need for developing computerized software for identification and querying important information about forest tree seeds of Kerala assumes significance in this context. This software will save time and cost in identification of unknown and rare seeds and thus help the foresters and scientists working in the region. The related information on other seed handling problems like the pest and disease, nursery techniques, ethnobotanical uses etc., have also been fitted into a valuable data base and developed into a querying-in web portal.

OUTLINE OF THE TECHNICAL PROGRAMME

More than 175 seed specimens are already available in the College of Forestry seed herbarium; all these specimens have been photographed and digitized. In addition to this, some missing specimens have also been collected by various means and all these have been photographed. Also, the images of the trees have been collected to assist the identification key.

Out of these, 167 seed specimens have been arranged systematically based on their characters and a systematic key has been prepared by using software programming tools Visual C++ at front end and MS Access at rear end.

The application will allow the information search through comprehensive and interactive keys using family name, species name and text string. This system also

enables the distribution of information to a wider audience via CD and Internet (Web uploading as a Portal which is open - ended).

1. Building the key involved the following steps:

- Entering species name, Family and text

2. Each species have been described in the following way:

- Species description
- Images

3. Display filter

The display is controlled in such a way that facilitates better user interaction with the application. All the unnecessary characters were filtered out initially and can be assessed for specialized users such as research workers, NGOs etc.

The species description include Nomenclature (Scientific name, Vernacular name and Common name), Synonyms, Family and Subfamily, Origin, Distribution, Description, Flowering season, Fruiting season, Flowers, Fruits and Fruit type, Seeds, Seed dimension (Seed length, Seed width, Seed thickness), Seed weight, Seed dispersal, Seed Collection, Transportation of seeds, Seed processing, Seed storage, Viability period, Seed emptiness, Seed pre treatment, Germination type, Germination percentage, Germination period, Nursery technique, Propagation (Method of propagation, Vegetative propagation), Pests, Diseases, Medicinal properties, Uses, Wood properties. The list of literature referred to has also been included. One is struck at the lack of information on several aspects of these species. Painstaking effort is needed to collect information on these missing items and document them.

4. Imaging seeds of the species:

The photographs as well as the morphological character of the species have been taken using high quality digital cameras. A ruler with a mm scale has been placed along the length of the seed to track the actual seed size. Small seeds and seeds with fine hairs and/or pappus images have been captured using image analyser. In exceptional cases where the photos could not be taken due to lack of specimens, photos have been downloaded using the internet search facilities.

5. Development of online manual:

Final authoring has been carried out using application development tool Visual C++ and MS Access (for CD media) and PHP, MySQL, Adobe Dreamweaver, Flash and Photoshop (for Web version). A web site will be set up exclusively for the online tree seed manual.

PRACTICAL/SCIENTIFIC UTILITY

The Online manual for the forest tree seeds will be packaged in a CD or published in the Internet, facilitating its distribution to a wider audience. A step-by-step procedure can also be easily developed to enable the seed analyst to easily understand and operate the online manual. This online manual will allow trained as well as untrained personnel to successfully identify unknown seeds quickly and learn about the various seed and nursery technology problems including pests and diseases and ethnobotanical uses. Hence, this online manual will have application in all seed laboratories, central nurseries and industries, resulting in considerable savings in time and cost. This manual can be more widely used by forest scientists, students, etc., as a professional and educational tool.

- The software will allow the development of comprehensive and interactive keys using both text and image data.
- The identification key can be illustrated with multimedia and enhanced with hypertext mark-up languages.
- This system also enables the distribution of information to a wider audience via CD and Internet (Web uploading as a Portal which is open - ended).

Results and Discussion

The selected 167 species and their families are listed below: The descriptive details are given separately.

Sl. No.	Scientific Name	Common name	Family
1	<i>Acacia auriculiformis</i>	Australian wattle	Leguminosae
2	<i>Acacia catechu</i>	Cutch tree	Leguminosae
3	<i>Acacia chundra</i>	Lal Khair	Leguminosae
4	<i>Acacia dealbata</i> Link	Silver wattle	Leguminosae
5	<i>Acacia ferruginea</i>	Safed Khair	Leguminosae
6	<i>Acacia leucophloea</i>	Cassia flower, Gand Babul	Leguminosae
7	<i>Acacia mangium</i>	Black wattle	Leguminosae
8	<i>Acacia mearnsii</i>	Black wattle	Leguminosae
9	<i>Acacia melanoxylon</i>	Australian Black wood	Leguminosae
10	<i>Acacia nilotica</i>	Indian gum arabic tree	Leguminosae
11	<i>Acacia planifrons</i>	Umbrella thorn	Leguminosae
12	<i>Acrocarpus fraxinifolius</i>	Red cedar	Leguminosae
13	<i>Acronychia pedunculata</i>	Laka Wood	Rutaceae
14	<i>Actinodaphne malabarica</i>	Kambilivirinji	Lauraceae
15	<i>Adenanthera pavonina</i>	Red wood	Leguminosae
16	<i>Aegle marmelos</i>	Bael tree	Rutaceae
17	<i>Ailanthus excelsa</i>	Ardusi, Mahanim	Simaroubaceae
18	<i>Ailanthus triphysa</i>	Maharuk	Simaroubaceae
19	<i>Alangium salvifolium</i>	Sage-leaved alangium	Alangiaceae
20	<i>Albizia amara</i>	Oonjal	Leguminosae
21	<i>Albizia chinensis</i>	Siran, The Sau tree.	Leguminosae
22	<i>Albizia lebbek</i>	East Indian Walnut	Leguminosae
23	<i>Albizia odoratissima</i>	Kala Siris	Leguminosae
24	<i>Albizia procera</i>	White siris	Leguminosae
25	<i>Aleurites moluccana</i>	Indian walnut	Euphorbiaceae
26	<i>Alnus nepalensis</i>	Indian alder	Betulaceae
27	<i>Aphanamixis polystachya</i>	Rohituka tree	Meliaceae
28	<i>Alstonia scholaris</i>	Devils tree	Apocynaceae
29	<i>Alstonia venenata</i>	Anali Venga	Apocynaceae
30	<i>Anacardium occidentale</i>	The Cashew nut tree	Anacardiaceae
31	<i>Annona reticulata</i>	Bullocks heart	Annonaceae
32	<i>Annona squamosa</i>	Custard apple	Annonaceae
33	<i>Anogeissus latifolia</i>	Dhavada	Combretaceae
34	<i>Antiaris toxicaria</i>	Upas tree	Moraceae
35	<i>Aporosa lindleyana</i>	Vetti	Euphorbiaceae
36	<i>Artocarpus communis</i>	Bread fruit tree	Moraceae
37	<i>Artocarpus heterophyllus</i>	Jackfruit tree	Moraceae
38	<i>Artocarpus hirsutus</i>	Wild jack fruit	Moraceae
39	<i>Azadirachta indica</i>	Neem tree	Meliaceae
40	<i>Baccaurea courtallensis</i>	Mootilpazham	Euphorbiaceae
41	<i>Bambusa bambos</i>	Spiny bamboo	Poaceae (Graminae)
42	<i>Barringtonia acutangula</i>	Indian oak	Lecythidaceae
43	<i>Bauhinia malabarica</i>	Kachnar	Leguminosae
44	<i>Bauhinia racemosa</i>	Kanchan	Leguminosae

45	<i>Bischofia javanica</i>	Bishop wood	Euphorbiaceae
46	<i>Bombax ceiba</i>	Silk cotton tree	Bombacaceae
47	<i>Bombax insigne</i>	Semul	Bombacaceae
48	<i>Bridelia retusa</i>	Muljane	Euphorbiaceae
49	<i>Butea monosperma</i>	Flame of the forest	Leguminosae
50	<i>Caesalpinia coriaria</i>	Dividivi	Leguminosae
51	<i>Caesalpinia sappan L.</i>	Sappan wood	Leguminosae
52	<i>Calamus brandisii Becc.</i>	---	Arecaceae / Palmae
53	<i>Calamus hookerianus Becc.</i>	---	Arecaceae / Palmae
54	<i>Calamus latifolius Roxb.</i>	---	Arecaceae / Palmae
55	<i>Calamus pseudotenuis</i>	---	Arecaceae / Palmae
56	<i>Calamus rotang</i>	Rattan, Cane	Arecaceae / Palmae
57	<i>Calamus thwaitesii</i>	---	Arecaceae / Palmae
58	<i>Calamus travancoricus</i>	Cane	Arecaceae / Palmae
59	<i>Callistemon lanceolatus</i>	Bottle Brush.	Myrtaceae
60	<i>Calophyllum inophyllum</i>	Alexandrian laurel	Clusiaceae
61	<i>Calophyllum polyanthum</i>	Spar tree, Poon	Clusiaceae
62	<i>Carallia brachiata</i>	Vallabham	Rhizophoraceae
63	<i>Cassia fistula</i>	Indian laburnum	Leguminosae
64	<i>Cassia javanica</i>	The java pink cassia	Leguminosae
65	<i>Cassia siamea</i>	Yellow cassia	Leguminosae
66	<i>Casuarina litorea</i>	Iron wood	Casuarinaceae
67	<i>Ceiba pentandra</i>	White silk cotton	Bombacaceae
68	<i>Chloroxylon swietenia</i>	Satin wood	Flindersiaceae
69	<i>Chukrasia tabularis</i>	Chittagong wood	Meliaceae
70	<i>Cinnamomum camphora</i>	Formosa camphor tree	Lauraceae
71	<i>Cleistanthus collinus</i>	Odugu	Euphorbiaceae
72	<i>Cochlospermum religiosum</i>	Buttercup tree	Cochlospermaceae
73	<i>Cullenia exarillata</i>	Vedi Pila	Bombacaceae
74	<i>Dalbergia latifolia</i>	Rosewood	Leguminosae
75	<i>Dalbergia paniculata</i>	Pinekanni	Leguminosae
76	<i>Dalbergia sissoides</i>	Rose wood	Leguminosae
77	<i>Dalbergia sissoo</i>	Sissoo	Leguminosae
78	<i>Delonix regia</i>	Royal poinciana	Leguminosae
79	<i>Dendrocalamus strictus</i>	Solid bamboo	Poaceae (Graminae)
80	<i>Dillenia pentagyna</i>	Toothed dillenia	Dilleniaceae
81	<i>Diospyros ebenum</i>	Ebony persimmon	Ebenaceae
82	<i>Dysoxylum malabaricum</i>	Purple cone flower	Meliaceae
83	<i>Elaeocarpus serratus</i>	The wild olive tree	Elaeocarpaceae
84	<i>Erythrina indica</i>	Indian Coral tree	Leguminosae
85	<i>Eucalyptus camaldulensis</i>	River red gum	Myrtaceae
86	<i>Eucalyptus globulus</i>	Blue gum	Myrtaceae
87	<i>Eucalyptus grandis</i>	Red gum, Flooded gum	Myrtaceae
88	<i>Eucalyptus tereticornis</i>	Mysore gum	Myrtaceae
89	<i>Ficus religiosa</i>	Peepal tree	Moraceae
90	<i>Gliricidia sepium</i>	Mother of cocoa	Leguminosae

91	<i>Gmelina arborea</i>	White teak	Verbenaceae
92	<i>Grevillea robusta</i>	Silver oak	Proteaceae
93	<i>Grewia tiliifolia</i>	Chadachi, Dhaman	Tiliaceae
94	<i>Haldina cordifolia</i>	Haldu	Rubiaceae
95	<i>Hardwickia binata</i>	Anjan	Leguminosae
96	<i>Holoptelea integrifolia</i>	Indian elm	Ulmaceae
97	<i>Hopea parviflora</i>	Iron wood of Malabar	Dipterocarpaceae
98	<i>Hydnocarpus pentandra</i>	Marotti oil tree	Flacourtiaceae
99	<i>Jacaranda mimosifolia</i>	Brazilian rosewood	Bignoniaceae
100	<i>Knema attenuata</i>	Chora - payin	Myristicaceae
101	<i>Kydia calycina</i>	Kydia	Malvaceae
102	<i>Lagerstroemia microcarpa</i>	Benteak	Lythraceae
103	<i>Lagerstroemia parviflora</i>	Benteak	Lythraceae
104	<i>Lagerstroemia speciosa</i>	Queen of flowers	Lythraceae
105	<i>Macaranga peltata</i>	Vatta	Euphorbiaceae
106	<i>Mallotus philippensis</i>	Kamala tree	Euphorbiaceae
107	<i>Mangifera indica</i>	Mango	Anacardiaceae
108	<i>Melia azedarach</i>	Persian lilac	Meliaceae
109	<i>Melia dubia</i>	Malabar Neem Wood	Meliaceae
110	<i>Melicope lunu-ankenda</i>	Kanala	Rutaceae
111	<i>Mesua ferrea</i>	Iron wood tree	Guttiferae
112	<i>Michelia champaka</i>	Champak	Magnoliaceae
113	<i>Mimusops elengi</i>	Asian bullet wood	Sapotaceae
114	<i>Morinda citrifolia</i>	Noni, Indian Mulberry	Rubiaceae
115	<i>Muntingia calabura</i>	Chinese cherry, Couplin	Tiliaceae
116	<i>Myristica fragrans</i>	Nutmeg tree	Myristicaceae
117	<i>Myristica malabarica</i>	False nutmeg	Myristicaceae
118	<i>Neolamarckia cadamba</i>	Bur-flower tree, Kadam.	Rubiaceae
119	<i>Ochlandra ebracteata</i>	Reed	Poaceae (Graminae)
120	<i>Ochlandra scriptoria</i>	Reed	Poaceae (Graminae)
121	<i>Ochlandra setigera</i>	Reed	Poaceae (Graminae).
122	<i>Ochlandra travancorica</i>	Travancore reed bamboo	Poaceae (Graminae).
123	<i>Ochlandra travancorica</i>	Elephant grass	Poaceae (Graminae).
124	<i>Ochlandra wightii</i>	Reed	Poaceae
125	<i>Oroxylum indicum</i>	Indian trumpet tree	Bignoniaceae
126	<i>Palaquium ellipticum</i>	Pali	Sapotaceae
127	<i>Paraserianthes falcataria</i>	White Albizia.	Leguminosae
128	<i>Peltophorum pterocarpum</i>	Copper pod	Leguminosae
129	<i>Persea macrantha</i>	Machilus	Lauraceae
130	<i>Phyllanthus emblica</i>	Indian Gooseberry	Euphorbiaceae
131	<i>Pongamia pinnata</i>	Indian beech	Fabaceae (Leguminosae)
132	<i>Prosopis juliflora</i>	The mesquite	Leguminosae
133	<i>Pseudoxytenanthera ritcheyi</i>	--	Poaceae (Graminae)
134	<i>Pterocarpus dalbergioides</i>	Andaman padauk	Leguminosae
135	<i>Pterocarpus marsupium</i>	Indian kino tree, Bijasal	Leguminosae
136	<i>Pterygota alata</i>	The Buddha's coconut tree	Sterculiaceae.

137	<i>Santalum album</i>	Sandal wood	Santalaceae
138	<i>Sapindus trifoliata</i>	Soap nut tree	Sapindaceae
139	<i>Saraca asoca</i>	Ashoka	Leguminosae
140	<i>Schleichera oleosa</i>	Kusum	Sapindaceae
141	<i>Semecarpus anacardium</i>	Marking nut tree	Anacardiaceae
142	<i>Spondias pinnata</i>	Indian hog plum	Anacardiaceae
143	<i>Sterculia urens</i>	Karaya	Sterculiaceae
144	<i>Stereospermum chelonoides</i>	Padiri	Bignoniaceae
145	<i>Strychnos nux-vomica</i>	Strychnine tree	Loganiaceae
146	<i>Strychnos potatorum</i>	Clearing nut tree	Loganiaceae
147	<i>Swietenia macrophylla</i>	Honduras mahogany	Meliaceae
148	<i>Swietenia mahagoni</i>	Small-leaved mahogany	Meliaceae
149	<i>Syzygium cumini</i>	Indian black berry	Myrtaceae
150	<i>Tamarindus indica</i>	Tamarind tree	Leguminosae (Fabaceae)
151	<i>Tectona grandis</i>	Teak	Verbenaceae
152	<i>Terminalia arjuna</i>	Arjun	Combretaceae
153	<i>Terminalia bellirica</i>	Belliric myrobalan	Combretaceae
154	<i>Terminalia catappa</i>	Indian almond	Combretaceae
155	<i>Terminalia chebula</i>	Chebulic myrobalan	Combretaceae
156	<i>Terminalia crenulata</i>	Indian laurel	Combretaceae
157	<i>Terminalia paniculata</i>	Kindal	Combretaceae
158	<i>Thespesia populnea</i>	Tulip tree	Malvaceae
159	<i>Thyrsostachys oliveri</i>	Latti Bamboo	Poaceae (Graminae)
160	<i>Toona ciliata</i>	Red cedar, Toon	Meliaceae
161	<i>Vateria indica</i>	White damar	Dipterocarpaceae
162	<i>Vateria macrocarpa</i>	Indian copal tree	Dipterocarpaceae
163	<i>Vitex altissima Linn.</i>	Tall chaste tree	Verbenaceae
164	<i>Wrightia tinctoria</i>	Pala indigo	Apocynaceae
165	<i>Xylia xylocarpa</i>	Indian iron tree	Leguminosae
166	<i>Zanthoxylum rhetsa</i>	Indian ivy-rue	Rutaceae
167	<i>Zizyphus mauritiana</i>	Ber	Rhamnaceae

DEVELOPING THE ON-LINE SEED MANUAL INTERACTIVE CD-ROM

An interactive CD ROM titled “AN ONLINE MANUAL FOR THE FOREST TREE SEEDS OF KERALA version 1.” will be published by programming using Macromedia Director (version MX 2004), Adobe Flash (version CS3 Professional) and Adobe Photoshop (version CS3 Professional). The CD ROM runs automatically on loading in any system running Windows autorun. It allows users to query detailed

information about forest species currently being found in our state, based on characters mentioned above. A family based search is also possible. It also includes a criterion based search page wherein one can search and find information based on specific characteristics. An on-line identification facility based on a picture gallery of the species is also included. Most of the pictures have been taken at the College of Forestry itself. Otherwise some of the pictures obtained from the internet search facility have also been included.

WEB PORTAL

For the web part of the on-line seed manual, a dynamic web portal (dynamic website that runs active server pages) was set up by renting out appropriate domains and web space. The URL for the web version of the on-line seed manual is <http://www.treeseeds.kau.edu>. The server side programming was done using PHP and presented through HTML, Adobe Flash and Adobe Photoshop. The data hosted in this site was developed in the Seed Technology laboratory of the College of Forestry through literature search under this project and is being updated with information on new tree species also.

The portal comprise of three modules:

Module I : General Information

Description: A click and query system that will help a user to search information about forest tree seeds of Kerala and retrieve general description about them. The data includes:

- *Scientific name*
- *Family*
- *Text*

- *Photograph of the species*

The user can get details of any forest tree species out of the 167 included in this database if he knows the scientific name or family of the species. If he wants information on the species having any particular character e.g., “drupe”, “capsule”, “orthodox”, “recalcitrant”, “dormancy”, “pretreatment” etc., the particular keyword or index can be typed in the space provided after clicking ‘Text’. These species can be scrolled one after another in alphabetical order along with their characters. If he wants information on all the species, he can click the icon “none” in which case the species will appear one after another in alphabetic order.

Once the user clicks a particular species, important information like Scientific name, Vernacular name and Common name, Synonyms, Family and Subfamily, Fruit type, Germination type, Germination percentage, Germination period and Method of propagation will appear on the main screen. The other details like Origin, Distribution, Description, Silviculture, Flowering season, Fruiting season, Flowers, Fruits and Seeds, Seed dimension (Seed length, Seed width, Seed thickness), Seed weight, Seed dispersal, Seed Collection, Transportation of seeds, Seed processing, Seed storage, Viability period, Seed emptiness, Seed pre treatment, Nursery technique can be filtered in depending on requirement.

Prospective Users: General users such as the general public and students etc. who doesn't possess/ require advanced knowledge about the forest tree seeds of Kerala

Module II: Forest Tree Seed identification

Description: A computerized Forest Tree Seed identification key which uses programming and data analysis for helping users in identifying a seed/ fruit. The user

should have prior information about the descriptive characters given in the different fields. These are already listed above.

Prospective Users: Scientists, practising foresters with some background knowledge of forest tree seeds/ fruits of Kerala and identification.

Module III: Utilization

An interactive section which enables the user to select tree species according to his/her requirements

- **Description:** An easy to use query system wherein user will key in his requirements as key words, and the system will help him select tree species.

Prospective Users: General public who are often perplexed by the innumerable number of species, scientists, practicing foresters etc.

The information will be organized into a data base of MS Access and programmed using Visual C++. The Web site will be built using PHP as a programming language and MySQL at the rear end for data storage.

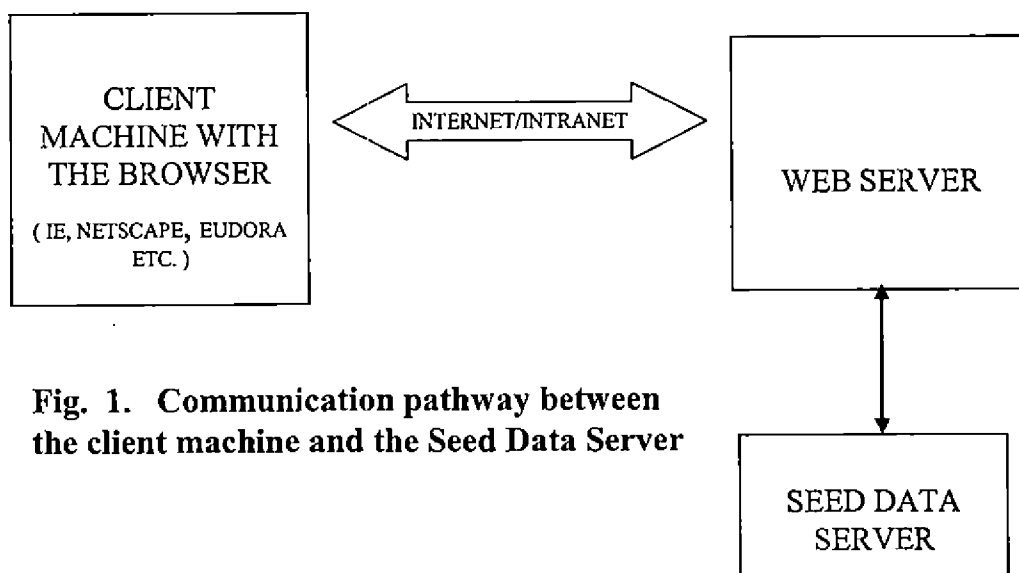


Fig. 1. Communication pathway between the client machine and the Seed Data Server

References:

Delorit, R. J. (1970). *An Illustrated Taxonomy Manual of Weed Seeds*. Distributed by Agronomy Publications, River Falls, Wisconsin, USA.

Friend, E. (1983). *Queensland Weed Seeds*. Miscellaneous Publication 81013. Queensland Department of Primary Industries, Brisbane, Australia

Gupta, M. L., George, D. L. and Basnet, B. B. 2005. Seed Identification using a computerized database. *Seed Science and Technology*, 33: 647- 654.

Martin, A. C. and Barkley, W. D. (1961). *Seed Identification Manual*, University of California Press, Berkeley, USA.

Reed, C. F. (1977). *Economically Important Foreign Weeds – Potential problems in the United States*, Agricultural Handbook No. 498. Agricultural Research Service, US Department of Agriculture, Washington, USA.

University of Queensland (2001) *Quick-start Guide to Lucid Professional, Version 2.0. A System for Building and Distributing Identification and Diagnostic Keys*. Centre for Pest Information Technology and Transfer. The University of Queensland, Brisbane, Australia.

APPENDIX

Acacia auriculiformis

Nomenclature:

Scientific name: *Acacia auriculiformis* A. Cunn. ex Benth.

Vernacular name: Acacia (Malayalam); Pencil Maram (Tamil) (Chacko *et al.*, 2002).

Common name: Australian wattle, Australian acacia, Australian babul, Tan wattle (Chacko *et al.*, 2002). Golden shower (Bose *et al.*, 1998).

Family: Leguminosae

Subfamily: Mimosoideae

Origin: Savannas of Papua New Guinea, Northern Australia and Queensland (Ram Parkash and Drake Hocking, 1986).

Distribution: Altitude: from sea level up to 700 m (Ram Parkash and Drake Hocking, 1986). Native of North Australia and Queensland. As it grows on very poor soils, it is planted mostly, in the dry regions of India as a shade tree and soil cover crop (FRI, 1983; Chacko *et al.*, 2002). Successfully raised in Orissa, Karnataka, UP and Maharashtra (Ram Parkash and Drake Hocking, 1986).

Description: Tall evergreen tree, reaching a height of 30 m and a breast height diameter of 60 cm. Trunk is often branched with slightly angular branchlets-dark brown and smooth (Chacko *et al.*, 2002; Bose *et al.*, 1998). Crown is thin and dull green (Ram Parkash and Drake Hocking, 1986).

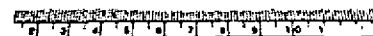
Flowering season: Flowers are produced at intervals from March to December, most profuse in September to November (Bose *et al.*, 1998).



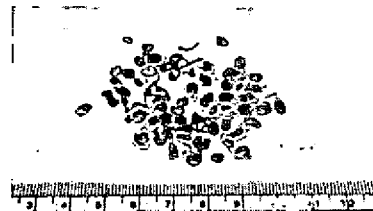
Habit



A branch with fruits



Fruits



Seeds

Fruitingseason: February to March (FRI, 1983; Bose *et al.*, 1998; Chacko *et al.*, 2002). December to January (Chacko *et al.*, 2002).

Flowers: Small, yellow, scented, in slender axillary spikes towards the end of branches, 4-6 cm long, stamens numerous (CSIR, 1948).

Fruits: Fruit is a pod, 1.2 cm wide, hard, almost woody and much twisted in irregular coils, initially green but turn brown on ripening (Bose *et al.*, 1998; Chacko *et al.*, 2002).

Fruit type: Pod.

Seeds: Shining black with orange yellow coloured aril (Bose *et al.*, 1998; Chacko *et al.*, 2002).

Seed dimension:

Seed length: 0.6 cm (Chacko *et al.*, 2002).

Seed width: 0.5 cm (Chacko *et al.*, 2002).

Seed thickness: 0.15 cm (Chacko *et al.*, 2002).

Seed weight: 30,800 (Rai, 1999) to 71,600 seeds/kg (Doran and Turnbull, 1997).

Seed dispersal: Wind (Ram Parkash *et al.*, 1998).

Seed Collection: Ripe pods are collected from the tree during December-February by lopping off the branches when the pods turn brown (Chacko *et al.*, 2002; Srivastava *et al.*, 2006).

Transportation of seeds: Pods are packed in cloth bags and transported (Chacko *et al.*, 2002).

Seed processing: Ripe pods are sun-dried for 5-9 days until they open out to release seeds. The seeds are well dried before storage (Chacko *et al.*, 2002).

Seed storage: Orthodox. Retain their viability up to 2 years under cool dry conditions in air-tight bottles, tins and earthen-ware pots. The seeds are liable to be attacked by ants (Rai, 1999; Chacko *et al.*, 2002). Seeds can also be stored safely with good germination percentage for 8 months in gunny bags or in air-tight plastic containers (Chaturvedi and Das, 2004). For long-term storage, the seeds should be thoroughly air-dried and kept without scarification (Sur *et al.*, 1987).

Viability period: Seeds remain viable for more than one year under normal conditions in sealed tin (Chacko *et al.*, 2002). Viability decreases with an increase in the storage period; and use of storage media help to increase the percentage of seed viability (Khomane and Bhosale, 2003).

Seed emptiness: Low (Chacko *et al.*, 2002).

Seed pre treatment: Seeds are treated by immersing in hot water (80°C) for 10 min and then soaking in tap water for 24 hrs, volume of water being about 20 times that of the seeds (Chacko *et al.*, 2002; Girase *et al.*, 2002; Sinhababu *et al.*, 2007). The water should then be taken off the fire and left to cool. Seeds soaked in acid for 30 min, nicking the seeds, nicking and soaking (30 min) in acid, immersing seeds in hot water

for 1-5 min and soaking seeds in acid for 20-30 min etc. also give good germination. Mechanical scarification (rubbing polish paper) and iodine treatments are also quite effective in improving germination percentage (Sur *et al.*, 1987; Marunda, 1990; Khan, 2001; Girase *et al.*, 2002). Hot water treatment influences the height growth of seedlings (Chaturvedi and Das, 2004). Seeds soaked in conc. sulfuric acid (20-70 ml/100 g of seeds) for 30 min and stirring in 50 ml acid/100 g seed for 40 min give 83.3% and 85.0% germination respectively (Natarajan and Rai, 1988).

Germination type: Epigeal (Chacko *et al.*, 2002).

Germination percentage: 98.5 (Chacko *et al.*, 2002). 68% (Shiuli Mahmud *et al.*, 2005).

Germination period: 3 to 7 days (Chacko *et al.*, 2002). Germination period and germinative energy are reduced with increasing salinity and the germination trends are also changed (Rashid *et al.*, 2004).

Nursery technique: Pre-treated seeds are sown in plastic trays filled with vermiculite or sown in raised nursery beds and watered regularly twice a day. The germinated seeds are potted in polybags of size 20 x 10 cm filled with potting mixture. Seeds can also be sown directly in containers such as polythene bags, root trainers, etc., filled with soil or compost based potting media. Seedlings become ready for planting in three months (Chacko *et al.*, 2002). Soil, sand and FYM at a volumetric ratio of 2:1:2 is the best medium for *A. auriculiformis* seedlings

(Sharma *et al.*, 2004). For large-scale seedling production, polybags of 23 x 15 cm are recommended as the optimal size for raising quality seedlings of *A. auriculiformis* (Riadh *et al.*, 1997).

Propagation:

Method of propagation: Direct sowing or transplanting of seedling (Ram Parkash and Drake Hocking, 1986).

Vegetative propagation: In vitro propagation: The shoot tips from 12- to 16-day-old seedlings are excised and cultured in Murashige and Skoog medium, supplemented with different concentration of 6 benzylamino purine and naphthylene acetic acid. 25-30 multiple shoots will be proliferated. The micro shoots 3-4 cm long are excised and rooted in non-sterile sand. The roots will be initiated after 15-21 days (Asha Karki and Radha Niroula, 2000). Epicormic shoots from pollarding give 90% and those from branch cuttings give 70. The commercial preparation 'Seradix' No. 3 (containing 0.8% IBA) give the best results (Simsiri, 1991).

Pests: Powder post beetles (*Sinoxylon anale* and *Sinoxylon* sp.), the leucaena psyllid (*Heteropsylla cubana*), the coffee borer (*Zeuzera coffeae*) and flat-headed borers (*Sternocera aequisignata* and *S. ruficornis*) (Hutacharearn and Choldumrongkul, 1989). The strawberry thrip (*Scirtothrips dorsalis*), cause bunchy top (loss of apical dominance and development of a large number of side shoots from the axils of the condensed stem) (Ashwath and Houston, 1990).

Diseases: *Colletotrichum gloeosporioides*, *Fusarium semitectum*, *Phoma* sp. are the field fungi recorded on seeds (Mohan and Sharma, 1988; Chacko *et al.*, 2002). Pink disease (*Corticium salmonicolor*) causes wilting and dieback of the main shoot beyond the point of infection at any place on the stem, where the affected area is characterized by pink encrustations and canker development (Florence and Balasundaran, 1991). Powdery mildew disease is also reported (Bhat and Hegde, 1991).

Medicinal properties: Methanol extracts of *Acacia auriculiformis* exhibit antibiotic effects (Pennacchio *et al.*, 2005).

Uses: It is an avenue tree. Bark contains tannin. Wood is used for paper

manufacture, yield excellent charcoal that glows well and burns without smoke, used as fuel wood and low cost furniture etc. (Chacko *et al.*, 2002). Under specific conditions, unbleached pulp prepared from the wood is suitable for making writing and printing paper (CSIR, 1948).

Wood properties: Wood has specific gravity of 0.6-0.75 and calorific value of 4,800-4,900 kcal/kg (NSA, 1980). Sapwood and heartwood are distinct. Sapwood yellowish white and heartwood dark brownish in colour. Moderately hard and moderately heavy wood with medium coarse texture. Diffuse porous wood with fairly distinct growth rings (Anoop *et al.*, 2005).

References:

- Anoop, E.V., Finto Antony, Bhat, K.V., Lisha Davis, A. and Luckins C. Babu. 2005. Anatomical key for the identification of important timbers of Kerala. Kerala State Council for Science, Technology and Environment, Thiruvananthapuram. pp.9.
- Asha Karki and Radha Niroula. 2000. In vitro propagation of *Acacia auriculiformis* A. cunn. ex benth. Bio technology applications for reforestation and biodiversity conservation Proceedings of the 8th International Workshop of BIO-REFOR, Kathmandu, Nepal, November 28-December 2, 1999. pp. 68-70.
- Ashwath, N. and Houston, K. 1990. Thrips cause bunchy top in *Acacia auriculiformis*. Nitrogen Fixing Tree Research Reports. 8: 95-97.
- Bhat, M.N. and Hegde, R.K. 1991. Foliar disease of some forest nurseries and plantations in Karnataka new records. Indian Journal of Forestry. 13(4): 349-350.
- Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 19.

Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 30-31.

Chaturvedi, O.P. and Das, D.K. 2004. Effects of seed drying, storage and pretreatments on the germination and growth of *Acacia auriculiformis* and *Acacia nilotica* seedlings: Indian Journal of Forestry. 27(1): 75-81.

CSIR. 1948. The Wealth of India, Vol. I. A Dictionary of Raw materials and industrial products, Publication and Information Directorate, New Delhi.

Doran Je and Turnbull, J.W. 1997. Australian Trees and Shrubs: Species for land reclamation and farm planting in the tropics, ACLAR Monograph No.24, 384P.

Florence, E.J.M. and Balasundaran, M. 1991. Occurrence of pink disease on *Acacia auriculiformis* in Kerala. Indian Forester. 117(6): 494-496.

FRI. 1983. Troup's The Silviculture of Indian Trees. Vol. IV. The Controller of Publications, Delhi.

Girase, U.S., Jambhale, N.D. and Suryawanshi, Y.B. 2002. Germination and seed dormancy studies in *Acacia* species. Seed Research. 30(1): 39-42.

Hutacharem, C. and Choldumrongkul, S. 1989. A note on the insect pests of multipurpose tree species in Thailand. Journal of Tropical Forest Science. 2(1): 81-84.

Khan, 2001. Effect of iodine vapour treatment of seeds of some forest trees in the Western Maharashtra. Advances in Plant Sciences. 14(2): 467-470.

Khomane, B.V. and Bhosale, L.J. 2003. Effect of storage medium on viability of seed in some fuelwood species. International Journal of Forest Usufructs Management. 4(1): 55-58.

Marunda, C.T. 1990. Effects of seed pretreatments on the development of *Acacia auriculiformis* and *A. holosericea* seedlings. ACIAR Proceedings Series. (28): 33-36.

Mohanan, C. and Sharma, J.K. 1988. Diseases of exotic acacias in India. Journal of Tropical Forestry, 4: 357-361.

N.A.S. 1980. Firewood crops. Shrub and tree species for energy production. National Academy of Sciences, Washington, DC.

Natarajan, N. and Rai, R.S.V. 1988. Studies on maximisation of germination in *Acacia auriculiformis*. Indian Journal of Forestry. 11(4): 304-306.

- Pennacchio, M., Kemp, A.S., Taylor, R.P., Wickens, K.M., and Kienow, L. 2005. Interesting biological activities from plants traditionally used by Native Australians. *Journal of Ethnopharmacology*. 96(3): 597-601.
- Rai, S.N. 1999. Nursery and planting techniques of forest trees in Tropical South East Asia. Eastern Press, Bangalore, India.
- Ram Parkash, M.A., Chaudhri, D.C. and Negi, S.S. 1998. Plantation and nursery technique of forest trees. International Book Distributors. Dehra Dun, India.
- Ram Parkash and Drake Hocking. 1986. Some favourite trees for fuel and fodder. Society for promotion of waste lands development, New Delhi. pp.12-16.
- Rashid, M.M., Hoque, A.K.F. and Iftexhar, M.S. 2004. Salt tolerances of some multipurpose tree species as determined by seed germination. *Journal of Biological Sciences*. 4(3): 288-292.
- Riadh, S.M., Hossain, M.K., and Akhter, S. 1997. Effect of polybag size on initial growth of *Acacia auriculiformis* and *Chikrassia tabularis* seedlings in the nursery. *Pakistan Journal of Forestry*. 45(1): 1-8.
- Sharma, R.S., Kothari, R.M., and Ramamurthy, V. 2004. The role of potting media in raising *Acacia auriculiformis* plantlets in nursery: *Indian Journal of Forestry*. 27(1): 51-55.
- Shiuli Mahmud, Hoque, A.T.M.R., and Mohammed Mohiuddin. 2005. Germination behavior and initial growth performance of eight multipurpose tree species. *International Journal of Agriculture and Biology*. 7(4): 539-542.
- Simsiri, A. 1991. Vegetative propagation of *Acacia auriculiformis*. *ACIAR Proceedings Series*. (35): 36-38.
- Sinhababu, A., Banerjee, A., and Kar, R.K. 2007. Seed germination and seedling growth in some selected fast growing fuelwood plants. *Indian Forester*. 133(4): 534-546.
- Srivastava, R.K., Manisha Thapliyal, Ombir Singh and Nawa Bahar. 2006. Forest seeds, Information Booklet. Forest Research Institute, Dehra Dun.
- Sur, K., Lahiri, A.K. and Basu, R.N. 1987. Improvement of germinability of some forest tree seeds by acid scarification and hydration-dehydration treatments. *Indian Agriculturist*. 31(2): 115-122.

Acacia catechu

Nomenclature:

Scientific name: *Acacia catechu* (L.f.) Willd.

Vernacular name: Khair (Marathi and Hindi); Sundra, Kadiram (Tamil) (Bose *et al.*, 1998). Karinnali, Khadiram (Malayalam) (CSIR, 1948).

Common name: Cutch tree (Bose *et al.*, 1998), Khair

Synonyms: *Acacia sundra*; *Acacia wallichiana*; *Acacia catechuoides* Wall; *A. polycantha* Willd., *Mimosa catechu* L.f. (Sasidharan, 2004).

Family: Leguminosae

Subfamily: Mimosoideae

Origin:

Distribution: Throughout the greater parts of India, except in the humid regions; found in the dry type of forest in the highland away from water resources. Common throughout the sub-Himalayan tract from Punjab to Assam, ascending to an altitude of 1200 m, generally gregarious on islands and on the banks of rivers at their entrance into the plains. It is quite common in the Aravally Hills and in Western Peninsular region, particularly in the drier parts, Bihar, Madhya Pradesh, Gujarat, Rajasthan and Tamil Nadu; also in China (Brandis, 1921; Bose *et al.*, 1998).

Description: A moderate sized deciduous tree, with a light feathery crown, the branchlet slender, thorny, glabrous, brown

or purple, shining (Brandis, 1921; CSIR, 1948).

Flowering season: May, July to August (Bose *et al.*, 1998). June to August (CSIR, 1948).

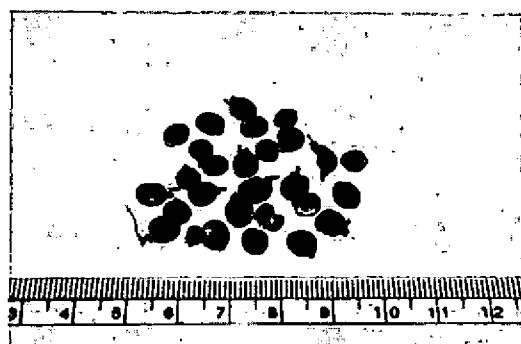
Fruiting season: September to October and are fully ripen by January (CSIR, 1948).

Flowers: White flowering spikes, 5-8.75 cm long, pale yellow flowers in cylindrical spikes (CSIR, 1948).

Fruits: Pods are 5-10 cm long, broad, straight, flat, dark brown, shiny and with a triangular beak at the apex and narrowed at the base. Pods are glabrous, flat and oblong (CSIR, 1948).



A branch with fruits



Seeds

Fruit type: Pod.

Seeds: 0.5 - 0.625 cm, broadly ovate or orbicular dark greenish brown, smooth, shining, moderately hard, with a hard testa. Electron microscopic studies show a characteristic spermoderm pattern on seeds (Vyas and Sharma, 1998).

Seed dimension:

Seed length

Seed width

Seed thickness

Seed weight: 40,000/kg (Srivastava *et al.*, 2006).

Seed dispersal: Wind dispersal (Ram Parkash *et al.*, 1998).

Seed collection: Seeds dispersed by wind are collected from ground (Ram Parkash *et al.*, 1998).

Transportation of seeds:

Seed processing: Pods are dried in the sun for a few days, then beaten with sticks and seeds separated by shaking and winnowing (Ram Parkash *et al.*, 1998).

Seed storage: Before storage, the seeds are dried in open shade in sealed plastic container with silica gel (Archana Sharma and Tiwari, 1999). Seeds do not store well for more than 6-8 months (Ram Parkash *et al.*, 1998).

Viability period: 6-8 months (Ram Parkash *et al.*, 2004).

Seed emptiness:

Seed pre treatment: Soak the seeds in boiled water for 6 hrs. Soaking in plain water for 4-6 hrs also gives good results (Edwards and Naithani, 1999). A seed pretreatment with 5% CMC (carboxy methyl cellulose) medium enhance germination in *Acacia catechu* and increase root and shoot growth (Harsh and Ojha, 2000). Seed soaking in 60% H₂SO₄ for 10 min stimulate seed germination (Archana Sharma and Wadhwa, 2000). Treating seeds with GA₃ and a higher temperature (25 rather than 20°C) stimulate seed germination (Ranjana Bhagat, 1994). Seeds stored for a period of three or five months, treated with acid and germinated at 30°C brought significantly maximum increase in germination within first six days (Atul *et al.*, 2002). Iodine treatments are effective in improving germination percentage (Khan, 2001). Seeds soaked in Niagara (ethyl hydrogen-1-propyl phosphonate) 500 ppm give 96.6% germination and result in increased length, width and area of the cotyledons and the fresh and dry wt. of the hypocotyl 5 days after germination compared with untreated control seedlings (Singh *et al.*, 1985).

Germination type: Epigeous. Small-sized seeds show higher germination (Neeraj Khara and Singh, 2005) and water stress conditions cause inhibition of seed germination (Saxena *et al.*, 1998).

Germination percentage: 60 to 80 at 30°C (Girase *et al.*, 2002; Khullar *et al.*, 1991).

Germination period: 30 days (Khullar *et al.*, 1991).

Nursery technique: Sowing is done in nursery beds in February-March, spacing 20 cm x 2 cm; about 1.5 cm deep. Beds are weeded and watered regularly, spacing of seedlings 5 cm apart in lines (Ram Parkash *et al.*, 1998). Sand + clay + farmyard manure (FYM) (1:1:2) medium give good germination and Sand+clay+FYM (1:1:1) give good establishment (Atul *et al.*, 2002). Foliar spray of phosphoric acid (0.3%), DAP (2%) and urea (1-3%) increase the growth and dry weight of seedlings (Chaplot and Mahnot, 2001).

Propagation:

Method of propagation: By seeds.

Vegetative propagation: Air layering (Raman Nagpal and Sunil Puri, 1986). Softwood cuttings treated with 100 mg/litre IBA give 50% success rate (Nilum *et al.*, 1995).

Pests: An unidentified pest causes heavy infestation of seeds (Wali ur Rehman, 1993). *Microtermes mycophagus* is reported from plantations (Verma, 1989).

Diseases: Heart rot caused by *Fomes badius* and root rot caused by *Ganoderma lucidum* and *Polyporus gilvus*. Species should be grown in group mixtures with non-susceptible species (Bakshi, 1957). Infection after pollarding by *Ganoderma endochroum* (Neil, 1990). *Ganoderma lucidum* also infect young plantations (Bakshi, 1974).

Medicinal properties: Bark is useful in passive diarrhoea, decoction is given internally in leprosy, cooling and digestive, applied externally to ulcers. Katha has long

been used in Indian Medicine. It is regarded as astringent, cooling and digestive, used in relaxed conditions of the throat, mouth and gums, also in cough and diarrhoea. Externally it is employed as an astringent and as a cooling application to ulcers, boils and eruptions of the skin (CSIR, 1948). Chewing affects predominantly the central and autonomic nervous systems, produce a sense of well-being, euphoria, warm sensation of the body, sweating, salivation, palpitation, heightened alertness and increased capacity to work (Chu NaiShin, 2002).

Uses: Wood is used for house post, agrl. implements, wheels, tool handles, etc. Catechin is extracted from the wood. Cutch or dark catechu is mainly used in dyeing cotton and silk and in calico-printing. Cutch is used in the dyeing of ship sails and mail-bags (CSIR, 1948).

Wood properties: Sapwood is yellowish white, heartwood dark or light red, very hard and durable. Weight 1,009 kg/m³. The wood sometimes is lustrous, with quite a smooth feel, without characteristic odour or taste, heavy to very heavy, straight grained, medium to coarse-textured (CSIR, 1948). Pores moderate sized and large, often subdivided, occasionally in radial groups of 2 or 3, and surrounded by narrow rings are soft tissue, which are often joined and form interrupted concentric bands; they are frequently filled with a white substance, are fairly uniformly distributed, and are distinctly marked on a longitudinal section. Medullary rays short, moderately broad, numerous, bent where they touch the pores (Gamble, 1922).

References:

- Archana Sharma and Tiwari, K.P. 1999. Seed germination and seedling growth in *Acacia catechu* Willd. as affected by seed storage in different containers. *Vaniki Sandesh*. 23(4): 9-17.
- Archana Sharma and Wadhera, S.L. 2000. Pre-treatments for hastening seed germination and seedling growth in *Acacia catechu* Willd. *Vaniki Sandesh*. 24(4): 11-13.
- Atul, Shivesh Sharma and Punam. 2002. Effect of tree age class and storage on germination behaviour of some important forest tree species of North-Western Himalayas. *Indian Forester*. 128(6): 660-666.
- Bakshi, B.K. 1957. Fungal diseases of Khair (*Acacia catechu* Willd.) and their prevention. *Indian Forester*. 83 (1): 41-46.
- Bakshi, B.K. 1974. Control of root disease in plantations in reforested stands (with special reference to Khair, Sissoo, Eucalyptus etc.). *Indian Forester*. 100: 77-78.
- Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 19.
- Brandis, D. 1921. Indian Trees. An account of Trees, shrubs, woody climbers, bamboos and palms indigenous or commonly cultivated in the British Indian Empire. Constable and Company Limited, London. pp.183.
- Chaplot, P.C. and Mahnot, S.C. 2001. Effect of nutrient spray on growth of *Acacia senegal* and *Acacia catechu* seedlings raised in nursery. *Advances in Horticulture and Forestry*. 8: 243-246.
- Chu NaiShin. 2002. Neurological aspects of areca and betel chewing. *Addiction Biology*. 7(1): 111-114.
- CSIR. 1948. The Wealth of India, Vol. I. A Dictionary of Raw materials and industrial products, Publication and Information Directorate, New Delhi.
- Edwards, D.G. and Naithani, S.C. 1999. Seed and Nursery Technology of forest trees. New Age, New Delhi.
- Gamble, J.S. 1922. A manual of Indian timbers. London Sampson Low, Marton and Company Ltd, Calcutta, India.
- Girase, U.S., Jambhale, N.D. and Suryawanshi, Y.B. 2002. Germination and seed dormancy studies in *Acacia* species: *Seed Research*. 30(1): 39-42.
- Harsh, N.S.K. and Ojha, B.M. 2000. A possible pretreatment for seeds of tropical tree species. *Seed Science and Technology*. 28(2): 513-516.

- Khan, M.R. 2001. Effect of iodine vapour treatment of seeds of some forest trees in the Western Maharashtra. *Advances in Plant Sciences*. 14(2): 467-470.
- Khullar, P., Thapliyal, R.C., Beniwal, B.S., Vakshasya, R.K. and Ashok Sharma. 1991. *Forest Seed*. ICFRE, New Forest, Dehra Dun. pp. 373.
- Neeraj Khera and Singh, R.P. 2005. Germination of some multipurpose tree species in five provenances in response to variation in light, temperature, substrate and water stress. *Tropical Ecology*. 46(2): 203-217.
- Neil, P.E. 1990. Experience with *Indigofera teysmanni* in Nepal. *Nitrogen Fixing Tree Research Reports*. 8: 143-144.
- Nilum, Sunil Puri and Verma, R.C. 1995. Vegetative propagation of *Acacia catechu*, *Dalbergia sissoo* and *Prosopis cineraria* by cuttings. *International Tree Crops Journal*. 8(2/3): 139-149.
- Raman Nagpal and Sunil Puri. 1986. Effect of auxins on air-layers of some agro-forestry species. *Indian Journal of Forestry*. 9: 232-236.
- Ram Parkash, M.A., Chaudhri, D.C. and Negi, S.S. 1998. *Plantation and nursery technique of forest trees*. International Book distributors. Dehra Dun, India.
- Ranjana Bhagat. 1994. Effect of temperature on the germination of *Acacia catechu* seeds treated with gibberellic acid (GA3). *Advances in Plant Sciences*. 7(1): 173-176.
- Sasidharan, N. 2004. *Forest trees of Kerala*. Kerala Forest Research Institute. Peechi, Kerala.
- Saxena, A.K., Rao, O.P. and Singh, B.P. 1998. Germination responses in nine multipurpose tree species on moisture gradient. *Range Management and Agroforestry*. 19(1): 69-73.
- Singh, S.S., Sharma, B.N. and Paliwal, G.S. 1985. Effect of Niagara and GA3 on seed germination, early seedling growth, and cotyledonary expansion of *Acacia catechu* Willd. *Indian Journal of Forestry*. 8: 41-46.
- Srivastava, R.K., Manisha Thapliyal, Ombir Singh and Nawa Bahar. 2006. *Forest seeds*, Information Booklet. Forest Research Institute, Dehra Dun.
- Verma, S.C. 1989. Termite pests of forestry and agriculture in Haryana, India. *Indian Journal of Forestry*. 12(1): 1-6.
- Vyas, M.B. and Sharma, K.C. 1998. Spermoderm patterns in some Mimosaceae. *Feddes Repertorium*. 109(1/2): 67-72.
- Wali ur Rehman. 1993. Studies on seed insect pests of forest trees. *Pakistan Journal of Forestry*. 43(1): 27-31.

Acacia chundra

Nomenclature:

Scientific name: *Acacia chundra* (Roxb. ex Rottl.) Willd.

Vernacular name: Karnali, Kannali (Malayalam) (CSIR, 1948). Kempu (Kannada); Karangali (Tamil).

Common name: LalKhair

Synonyms: *A. catechu* var. *sundra*

Family: Leguminosae

Subfamily: Mimosoideae

Origin:

Distribution: India, Sri Lanka, Burma; India - Peninsular India; Western Ghats - All over foothills and plains, < 1000m; Districts - Nasik, Ratnagiri, Savanthwadi (Mah.); Uttarakannada, Hassan (Karn.); Palghat (Kerala); Tamil Nadu; Goa (<http://ces.iisc.ernet.in>)"

Description: Small to medium sized tree (CSIR, 1948; <http://ces.iisc.ernet.in>).

Flowering season: June to August.

Fruiting season: January to March.

Flowers: Flowers yellowish white in axillary spikes (CSIR, 1948).

Fruits: Pods are compressed, dark brown when ripe containing 4-6 seeds (Purkayastha, 1996).

Fruit type: Pod.

Seeds: Seeds 3-8, about 5 mm dia., broadly ovate, compressed, dark greenish brown, smooth, shining with a hard testa (<http://forest.ap.nic.in>).

Seed dimension:

Seed length:

Seed width:

Seed thickness:

Seed weight: 30,000 to 38,000 (<http://forest.ap.nic.in>).



A twig with flowers



A branch with fruits

Seed dispersal:

Seed collection: Pods are collected by lopping branches (<http://forest.ap.nic.in>).

Transportation of seeds:

Seed processing: Dried in the sun, beaten with a stick to separate the seeds and winnowed (<http://forest.ap.nic.in>).

Seed storage:**Viability period:****Seed emptiness:**

Seed pre treatment: Soaking the seeds in cooling boiled water for 6 hrs (<http://forest.ap.nic.in>).

Germination type: Epigeal.

Germination percentage: 40 to 80 (<http://forest.ap.nic.in>).

Germination period: 5 - 7 days (<http://forest.ap.nic.in>).

Nursery technique: Seeds are sown in February to March with 2 seeds in each

polybag. Weeding and watering is done regularly. Germination commences in a week. The seedlings are planted out in June-July. One seedling is retained per bag (<http://forest.ap.nic.in>).

Propagation:

Method of propagation: By seeds.

Vegetative propagation:

Pests:**Diseases:**

Medicinal properties: The heartwood and bark are reported to be useful in irritation of the throat, cough, diarrhoea, chronic ulceration, leprosy and wounds. It is used in the treatment of skin diseases (Punjani et al., 2002).

Uses: Wood is used for posts, beams and for agricultural implements. The heartwood yields a red gum.

Wood properties: The heartwood is deep red or dark reddish brown.

References:

CSIR. 1948. The Wealth of India, Vol. I. A Dictionary of Raw materials and industrial products, Publication and Information Directorate, New Delhi.

<http://ces.iisc.ernet.in>

<<http://forest.ap.nic.in>> last visited in November, 2009.

Punjani, B.L. and Kumar, V. 2002. Folk medicinal plants used for skin disorders in the tribal pockets of Sabarkantha district, Gujarat. *Journal of Natural Remedies*. 2(1): 84-87.

Purkayastha, S.K. 1996. A manual of Indian timbers. Sri Bhumi Publishing Company, Calcutta.

Acacia dealbata

Nomenclature:

Scientific name: *Acacia dealbata* Link

Vernacular name: Wattle (Malayalam);
Wattle (Tamil) (Chacko *et al.*, 2002).

Common name: Silver green wattle,
Silver wattle (Chacko *et al.*, 2002; Bose
et al., 1998).

Synonyms: *Acacia decurrens* var.
dealbata (Link) F. Muell. ex Maiden,
Racosperma dealbata (Link) Pedley
(Chacko *et al.*, 2002).

Family: Leguminosae

Subfamily: Mimosoideae

Origin: Native of Australia.

Distribution: Planted extensively in
Nilgiris, Kumaon hills, Simla, Darjeeling
and Shillong (Chacko *et al.*, 2002). Though
a native of Australia, it is naturalised in
Meghalaya and Niligiris in India (Bose *et al.*,
1998).

Description: It is a slender evergreen tree
attaining a 12 m height and breast height
diameter of 38 cm. It is fast growing and
adapted to cool climates (FRI, 1983; Chacko
et al., 2002). Crown is elongated, oval and
dense (Bose *et al.*, 1998).

Flowering season: February to June (Bose
et al., 1998).

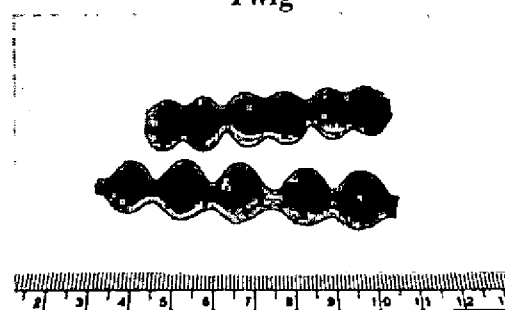
Fruiting season: March to April (Chacko *et al.*,
2002). June (Khullar *et al.*, 1991).

Flowers: Flower heads globose, 4-6 mm
diameter, yellow, fragrant, in profuse
axillary and terminal panicles (Bose *et al.*,
1998).

Fruits: Oblong, 4-8 cm long, flat reddish
brown, often curved or coiled (Bose *et al.*,
1998). Pods are straight or curved,
flattened, 5.0-7.5 cm long, slightly
constricted between the seeds (CSIR, 1948).



Twig



Fruits

Fruit type: Pod.

Seeds: Longitudinal, funicle as long as
seeds (Bose *et al.*, 1998).

Seed dimension:

Seed length:No information (Chacko *et al.*, 2002).

Seed width:No information (Chacko *et al.*, 2002).

Seed thickness:

Seed weight: 50,000 (Kindt *et al.*, 1997; Chacko *et al.*, 2002) to 83,000 seeds/kg (FRI, 1983;Kullar *et al.*, 1991; Chacko *et al.*, 2002).

Seed dispersal: Ants and birds.

Seed Collection: Collect the pods from the trees by beating with a stick (FRI, 1983; Chacko *et al.*, 2002). Seeds are usually collected in the month of June.

Transportation of seeds: Seeds can be packed in cotton / jute / polythene bags and transported (Chacko *et al.*, 2002).

Seed processing: The pods are sun dried and seeds extracted by trampling or beating with a stick. The seeds are cleaned of pod fragments and debris by winnowing (FRI, 1983; Chacko *et al.*, 2002).

Seed storage: Orthodox (Kindt *et al.*, 1997; Chacko *et al.*, 2002). Seeds can be stored in closed aluminium / plastic containers (Chacko *et al.*, 2002).

Viability period: Seeds retain viability for more than a year in sealed tins under ambient temperatures (Chacko *et al.*, 2002).

Seed emptiness: No information (Chacko *et al.*, 2002).

Seed pre treatment: Seeds are immersed in hot water (80°C) for a minute and then in cold water for 24 hrs (Chacko *et al.*, 2002). Seeds may also be treated with concentrated sulfuric acid for 2 min (Ram Parkash *et al.*, 1998).

Germination type: Epigeal (FRI, 1983; Chacko *et al.*, 2002).

Germination percentage: 70 to 100 (Carlowitz, 1991; Chacko *et al.*, 2002). 68% (Khullar *et al.*, 1991).

Germination period: No information (Chacko *et al.*, 2002). 90 days (Kullar *et al.*, 1991).

Nursery technique: The pretreated seeds are sown in plastic trays filled with vermiculite and watered. When the seedlings are 4 to 5 cm high, they are potted in polythene bags of size 20 x 10 cm filled with soil (Chacko *et al.*, 2002).

Propagation:

Method of propagation: Direct sowing or planting out entire, 5-8 cm tall nursery raised seedlings with a ball of earth or in polythene bags, in July or in pits 30 cm³ spaced 1.8 x 1.8 m to 2.7 x 2.7 m (Ram Parkash *et al.*, 1998).

Vegetative propagation:Rooting of cuttings. Root suckers (Dietrich Brandis, 1921).

Pests: A total of 97 species from 36 families including Cerambycidae, Curculionidae, Chrysomelidae, Psyllidae and Geometridae are reported from the species (Bashford,

1997). A species of *Psylla* affect the seeds (Berg *et al.*, 1982).

Diseases: Low (Mohan and Sharma, 1991; Chacko *et al.*, 2002). *Glomerella cingulata* is the most destructive disease of seedlings in nurseries. Seeds are infected along the hilum from the suture of the seed-pods. Mycelia are not only found on the seed surface but also affect the parenchyma and embryo inside; hard seeds (of sp.gr. >1.3) are, however, not invaded. Hot-water treatment for 5 min. at 70°C. is an effective control method. Attack on nursery stock can be controlled by spraying with Dithane or Bordeaux mixture + EMP (ethyl mercuric phosphate) ca. 12 times between late May and mid-Sept., spraying in July being particularly important (Hashimoto, 1968). *Icerya purchasi* cause severe damage (Watson and Malumphy, 2004).

References:

- Bashford, R. 1997. Records of insects associated with *Acacia dealbata* Link. in Tasmania. Australian Entomologist. 24(3): 109-115.
- Berg MA van den, Van den Berg MA and Den Ber MA den. 1982. Hemiptera attacking *Acacia dealbata* Link., *Acacia decurrens* Willd., *Acacia longifolia* (Andr.) Willd., *Acacia mearnsii* De Willd. and *Acacia melanoxylon* R. Br. in Australia. Phytophylactica. 14: 47-50.
- Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 20.
- Carlowitz, P.G.V. 1991. Multipurpose Trees and Shrubs: Sources of Seeds and Inoculants. International Council for Research in Agroforestry, Nairobi, Kenya.
- Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 32-33.
- CSIR. 1948. The Wealth of India, Vol. I. A Dictionary of Raw materials and industrial products, Publication and Information Directorate, New Delhi.

Medicinal properties: Suitable for pharmaceutical purpose and has been used as a remedy in bronchial diseases.

Uses: It is used in farms for windbreaks and erosion control. It is also planted as an ornamental tree. The wood is excellent for pulping, can be used for making furniture and as a fuel (Chacko *et al.*, 2002). Flowers are used for the preparation of mimosa perfume, which resembles ylang-ylang, though slightly coarse. The bark is used for tanning (Bose *et al.*, 1998). The tree yields a viscous gum of high quality which closely resemble gum arabic (CSIR, 1948).

Wood properties: Wood is moderately hard and light red. Pores moderate sized, often in short linear groups surrounded by pale rings. Medullary rays short, fine and moderately broad, well marked on a radial section (Gamble, 1922).

Dietrich Brandis. 1921. Indian Trees. An account of Trees, shrubs, woody climbers, bamboos and palms indigenous or commonly cultivated in the British Indian Empire. Constable and Company Limited, London. pp.269.

FRI. 1983. Troup's The Silviculture of Indian Trees. Vol. IV. The Controller of Publications, Delhi.

Gamble, J.S. 1922. A manual of Indian timbers. London Sampson Low, Marton and Company Ltd, Calcutta, India.

Hashimoto, H. 1968. Studies on the control of the anthracnose of *Acacia dealbata* caused by *Glomerella cingulata* Stonem. In Bull. Fukuoka ken For. Exp. Sta. 1968 No. 20, pp. 29.

Khullar, P., Thapliyal, R.C., Beniwal, B.S., Vakshasya, R.K. and Ashok Sharma. 1991. Forest Seed. ICFRE, New Forest, Dehra Dun. pp. 373.

Kindt, R., Muasya, S., Kimotho, J and Waruhiu. 1997. Tree Seed Suppliers Directory: Sources of Seeds and Microsymbionts. International Centre for Research in Agroforestry (ICRAF), Nairobi, Kenya.

Mohanan, C. and Sharma, J.K. 1991. Seed pathology of forest tree species in India – Present status, practical problems and future prospects. Commonwealth Forestry Review, 70: 113-151.

Ram Parkash, M.A., Chaudhri, D.C. and Negi, S.S. 1998. Plantation and nursery technique of forest trees. International Book distributors. Dehra Dun, India.

Watson, G.W. and Malumphy, C.P. 2004. *Icerya purchasi* Maskell, cottony cushion scale (Hemiptera: Margarodidae), causing damage to ornamental plants growing outdoors in London. British Journal of Entomology and Natural History. 17(2): 105-109.

Acacia ferruginea

Nomenclature:

Scientific name: *Acacia ferruginea* DC.

Vernacularname: Karivelam (Malayalam); Velvelam (Tamil); khaiger (Gujarati); khaiger, kanta chira, kaigu, banni, ansandra (Hindi) (Orwa *et al.*, 2009).

Commonname: Safed Khair (Khullar *et al.*, 1991)

Synonyms: *Mimosa ferruginea* (DC.) Roxb.

Family: Leguminosae

Subfamily: Mimosoideae

Origin:

Distribution: Found in Gujarat and parts of Andhra Pradesh, and moderately common in Deccan, Maharashtra and Karnataka (CSIR, 1948).

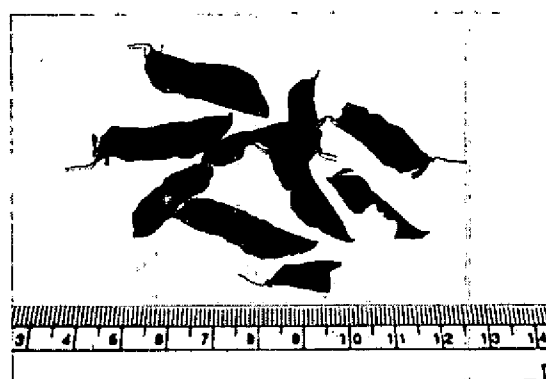
Description: Normally a small, drought-resistant, deciduous tree, not more than 12 m tall and 50 cm DBH. Commonly attaining 35 cm DBH with a bole rarely straight for more than 2-3 m. Branches slender, armed with conical prickles; spine persist on bole until it reaches about 15 cm DBH. Twigs are zigzag at nodes, glabrous, green or reddish. Primary roots are long, thin, tapering, yellow to brown (Orwa *et al.*, 2009).

Floweringseason: March-April (Sen Gupta, 1937).

Fruitingseason: November to February (Khullar *et al.*, 1991).

Flowers: Flowers pale yellow in numerous lax axillary spikes, which are often panicles at the end of branches. Corolla white, glabrous, 2-3 times as long as the calyx (CSIR, 1948; Orwa *et al.*, 2009).

Fruits: Glabrous, 7-18 x 2-2.5 cm, contain a dry sweetish pulp, dark brown and pinnately dehiscent, 3-7 seeded (CSIR, 1948; Orwa *et al.*, 2009).



Fruits

Fruittype: Pod.

Seeds: 4 to 7 seeded, 0.5-0.7 x 0.35-0.5 cm, flat, ovate, oblong, distinctly stalked, greenish to brown and tardily dehiscent (CSIR, 1948; Orwa *et al.*, 2009).

Seeddimension:

Seed length:

Seed width:

Seed thickness:

Seed weight: 5,900 seeds/kg (Sen Gupta, 1937;Khullar *et al.*, 1991).

Seed dispersal:

Seed collection:

Transportation of seeds:

Seed processing: Ripe pods are collected from the trees, dried and seeds extracted, cleaned and stored (<http://forest.ap.nic.in>).

Seed storage: Storage is best effected in earthen pots (<http://forest.ap.nic.in>).

Viability period: 12 to 16 months (<http://forest.ap.nic.in>).

Seed emptiness:

Seed pre treatment: Not required (Khullar *et al.*, 1991).

Germination type: Epigeal.

Germination percentage: 90% (Khullar *et al.*, 1991), 85 to 96% at 30°C temperature (Girase *et al.*, 2002).

Germination period: 30 days (Khullar *et al.*, 1991).

Nursery technique: After germination, it is transplanted to polythene bags. Larger seeds show better germination capacity than smaller ones. Since the growth is very slow, 1.5 year seedlings are planted in the field (Vanangamudi and Natarajan, 2006). The one month old uniform seedlings inoculated with 109 bacteria/g of peat of phosphobacterium (*Pseudomonas striata*), *Azospirillum* or *Rhizobium* spp. before transplanting in the nursery show best volume response (Prakash *et al.*, 1998). Foliar spraying of saplings with bioregulator Mixtalol 4 ppm at 45 and 90 days after sowing improves the growth (Chaplot and Mahnot, 2004).

Propagation:

Method of propagation: Direct sowing (Khullar *et al.*, 1991).

Vegetative propagation:

Pests: The 'cylinder piston gall' of *Lobopteromyia* sp. on leaves (Rohfritsch, 1972).

Diseases:

Medicinal properties: The bark and the pods possess astringent properties (CSIR, 1948). The bark is bitter and traditionally used as hot anthelmintic, cure itching, leucoderma, astringent, ulcers, stomatitis, and diseases of the blood. The extract of leaves is astringent, styptic, stops suppuration, enriches the blood, useful in liver complaints, disease of the eye, dysentery, gonorrhoea, gleet, burns and scalds, beneficial to the alimentary and urinary tracts. The gum is demulcent, emollient, and nutrient. The pods and the extract from them are astringent and demulcent. A decoction of the bark of this plant, together with the *Tamarindus indica* and a few other trees is used as a gargle in sore-mouth (Kirtikar and Basu, 2003).
Fodder: Leaves are lopped for fodder.
Alcohol: The bark is steeped in jaggery and then distilled, yielding intoxicating liquor. Plants are used by tribals of Dadra and Nagar Haveli, India to catch fish (Sharma and Singh, 2001). Seeds contain 2.6% oil (Saha *et al.*, 1993). Leaf extract possess larvicidal activity against *Culex quinquefasciatus* (Vahitha *et al.*, 2002).

Uses: The wood is mostly used in cartwheels, posts, beams and agricultural implements. The wood is very heavy and the tree yields a gum (Sharma and Singh, 2001; Orwa *et al.*, 2009).

Wood properties: The sapwood is wide, white or yellowish white and the heartwood, which is sharply differentiated from the

sapwood, is olive brown. It is very hard and heavy wood with straight to interlocked grain and coarse texture. Timber: Wood is very heavy (1,120-1,168kg/m³), straight grained and very coarse-textured. Sapwood is thick; yellowish white. Heartwood is olive-brown, turning darker with age. It can be seasoned well with considerable care.

References:

- Chaplot, P.C., and Mahnot, S.C. 2004. Effects of bioregulators on growth of *Acacia ferruginea* and *A. leucophloea* seedlings raised in nurseries. *Journal of Tropical Forest Science*. 16(4): 472-474.
- CSIR. 1948. The Wealth of India, Vol. I. A Dictionary of Raw materials and industrial products, Publication and Information Directorate, New Delhi.
- Girase, U.S., Jambhale, N.D. and Suryawanshi, Y.B. 2002. Germination and seed dormancy studies in *Acacia* species. *Seed Research*. 30(1): 39-42.
- <<http://forest.ap.nic.in>> last visited in November, 2009.
- Khullar, P., Thapliyal, R.C., Beniwal, B.S., Vakshasya, R.K. and Ashok Sharma. 1991. *Forest Seed*. ICFRE, New Forest, Dehra Dun. pp. 373.
- Kirtikar, K.R and Basu, B.D. 2003. *Indian medicinal Plants*, Oriental enterprises, Deharadun, 2nd edition, Vol.4, 1298-1300.
- Orwa, C, A Mutua, Kindt R, Jamnadass R, S Anthony. 2009. *Agroforestry Database: a tree reference and selection guide version 4.0* (<http://www.worldagroforestry.org/sites/treedbs/treedatabases.asp>)
- Prakash, M.S., Ponnambalam, A., and Sushamani, K.1998. Effect of biofertilizers on initial growth of eight forest tree species. *Sylva Plus*. 6(1): 16-18.
- Rohfritsch, O. 1972. A study of a gall of *Lobopteromyia* sp. on *Acacia* (*A. ferruginea* D.C.). *Marcellia*, 37: 139-149.
- Saha, S. K., Kulkarni, A.S., Khotpal, R.R. and Bhakre, H.A. 1993. Composition and lipid classes of some seed oils of Vidarbha region. *Indian Journal of Pharmaceutical Sciences*. 55(1): 45-47

Sen Gupta, J.N. 1937. Seed weights, plant percents, etc. for forest plants in India. Indian Forest Records (New Series) Silviculture, 2:180 pp. manager of publications, Delhi.

Sharma and Singh. 2001. Plants used for stupefying fish by tribals of Dadra and Nagar Haveli (U.T.). Journal of Economic and Taxonomic Botany. 2001. 25(1): 221-224.

Vanangamudi, K. and Natarajan. 2006. Advances in Seed science and technology (Vol I): Recent trends in seed technology and management.

Vahitha, R., Venkatachalam, M.R., Murugan, K. and Jebanesan, A. 2002. Larvicidal efficacy of *Pavonia zeylanica* L. and *Acacia ferruginea* D.C. against *Culex quinquefasciatus* Say. Elsevier Science Ltd. 82: 203-204.

Acacia leucophloea

Nomenclature:

Scientific name: *Acacia leucophloea* (Roxb.) Willd.

Vernacular name: Pattacharaya maram, Vellavelam (Malayalam) (Sasidharan, 2004); Velvayalam (Tamil), Safed kikar (Hindi), Safed babul (Bengali) (Bose *et al.*, 1998)

Common name: Cassic flower, Gand Babul

Synonyms: *Acacia alba* Willd., *Acacia microcephala* Grah., *Mimosa alba*, *M. leucophloea* Roxb.

Family: Leguminosae

Subfamily: Mimosoideae

Origin: Native to Bangladesh, India, Indonesia, Myanmar, Nepal, Pakistan, Sri Lanka, Thailand, Vietnam (CSIR, 1948; Orwa *et al.*, 2009).

Distribution: In India, found in plains of Punjab and in the dry tracts in dry deciduous forests (CSIR, 1948; Orwa *et al.*, 2009).

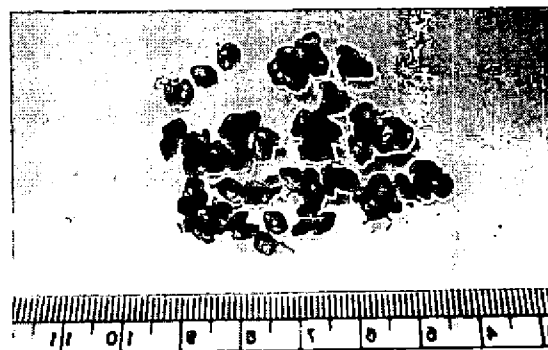
Description: A moderate to large thorny tree. Trunk stout, dividing into several large diameter branches. Open-grown specimens have a characteristic wide umbrella-like crown (CSIR, 1948; Orwa *et al.*, 2009).

Flowering season: August to October (Bose *et al.*, 1998).

Fruiting season: March-April (Khullar *et al.*, 1991). November to February (Bose *et al.*, 1998).

Flowers: Flowers conspicuous, light-yellow to cream or nearly white in colour, 7 mm across, 2-3 in a cluster in pendunculate glomerules aggregated in terminal or axillary panicles, 5-merous, corolla 1.2-2 mm long (CSIR, 1948; Bose *et al.*, 1998; Orwa *et al.*, 2009).

Fruits: Yellow, green or brown in colour, flat and fairly straight, slightly caved 10-20 cm long, 5-10 mm wide, sessile narrow, ligulate containing 10-20 smooth, oblong seeds, dark brown in colour, 6 x 4 mm in size (CSIR, 1948; Bose *et al.*, 1998; Orwa *et al.*, 2009).



Seeds

Fruit type: Pod.

Seeds: Seeds about 10 per pod (CSIR, 1948; Bose *et al.*, 1998), have 21-25% protein, 41.81 - 55.78% carbohydrate contents, fat content of 2.56 - 5.32%, fibre content varies from 2.75 to 5.21%, and ash content from 3.25 to 5.29 % (Tomar *et al.*, 1996). In addition, have crude protein value of 26.5 g/100 DM, crude lipid 5.13 g/100 mg; crude fibre, 6.78 g/100 mg; ash 4.12 g/100 mg; and total crude carbohydrates 57.5 g/100

mg. The seeds are a rich source of minerals such as calcium, magnesium, phosphorus, iron and manganese. The predominant seed protein fractions were globulins and albumins. The essential amino acids, cystine, methionine, tyrosine and phenylalanine, are low and threonine, valine, isoleucine and lysine are fairly high compared with the FAO/WHO/UNO amino acid recommended pattern. The lipids contain high amounts of unsaturated fatty acids in which linoleic acid (51.1%) is the major (Vijayakumari *et al.*, 1994). Seed surface show a characteristic rugulate type of spermoderm pattern for all species (Vyas and Sharma, 1998).

Seed dimension:

Seed length:

Seed width:

Seed thickness:

Seed weight: 45,000-50,000/Kg (Srivastava *et al.*, 2006).

Seed dispersal:

Seed collection: Ripe pods are collected from the trees, before they split and disperse, dried, seeds extracted, cleaned and stored (Vanangamudi and Natarajan, 2006).

Transportation of seeds:

Seed processing:

Seed storage: Seeds show orthodox storage behaviour and can be stored in room temperature (Srivastava *et al.*, 2006).

Viability period: 1-2 years (Srivastava *et al.*, 2006).

Seed emptiness:

Seed pre treatment: Seeds are heated with water (20 times of volume of the seed) to boiling and then leaving seed in water till cold; or soaking in conc. H₂SO₄ for 10 to 30 minutes after which the acid is removed and cold water is added. In *A. leucocephala* iodine treatments are also quite effective in improving germination percentage (Khan, 2001). Pelleting of seeds with diammonium phosphate (30 g kg⁻¹ of seed), commercial micronutrients mixture (19.7 g kg⁻¹ of seed), Rhizobium (50 g kg⁻¹ of seed), Sevin [carbaryl] (2 g kg⁻¹ of seed) and *Trichoderma viride* (4 g kg⁻¹ of seed) enhance germination and seedling vigour under adverse soil conditions (Mani *et al.*, 1999).

Germination type: Epigeous.

Germination percentage: 52-80% and it increase with increasing seed weight (Swaminathan and Sivagnanm, 1999).

Germination period: 30 days (Khullar *et al.*, 1991).

Nursery technique: Pre treated seeds are sown in primary beds. Shade is provided and excess watering should be avoided. When two pairs of leaves appear, it is transplanted to polythene bags (Vanangamudi and Natarajan, 2006). Or mature pods, collected from the trees are scarified with acids and sown in plastic pots filled with a mixture of red soil, sand and farmyard manure (Swaminathan and Sivagnanm, 1999). Inoculation of *Glomus deserticola* enhance nutrient uptake (Jitendra Panwar and Anil Vyas, 2002). Application

of DAP [diammonium phosphate] (3%) and urea (3%) and phosphoric acid increased the growth in terms of shoot height, diameter at collar, root length, and root and shoot weight per plant (Mahnot and Chaplot, 1999).

Propagation:

Method of propagation: Direct sowing and entire planting (Khullar *et al.*, 1991).

Vegetative propagation:

Pests: Seeds are attacked by *Bruchidius andrewesi* (Verma, 1989; Orwa *et al.*, 2009). *Viscum acaciae* is parasitic to *Acacia leucophloea* (Sanjai and Balakrishnan, 2001).

Diseases: *Hapalophragmiopsis ponderosa* cause galls (Dharmadhikar and Jite, 1992). *Fomes badius* cause heart rot (Jamaluddin *et al.*, 1985).

Medicinal properties: The bark is bitter, astringent and cooling and it is used in bronchitis and biliousness (Bose *et al.*, 1998). Bark is also used for oral ulcers, vomiting, internal and external haemorrhages, dental caries, stomatitis and intermittent fevers. The tree yields a gum which is used in indigenous medicine. The gum is demulcent, and used as an emulsifying agent (CSIR, 1948).

Uses: The bark yields a fibre and it is used in the preparation of spirits, for making fishing nets and coarse cordage. It is reported to act as a clarifying and flavouring agent. **Food:** The germinated seeds are cooked and eaten as a vegetable. They contain crude protein 27% dry matter. The

other major nutrient contents are crude lipid 5%, crude fibre 7%, ash 4% and total crude carbohydrates, 58%. The seeds are a rich source of minerals such as calcium, magnesium, phosphorus, iron and manganese. The predominant seed protein fractions are globulins and albumins. The essential amino acids, cystine, methionine, tyrosine and phenylalanine, have been found to be low and threonine, valine, isoleucine and lysine fairly high compared with the FAO/WHO/UNO amino acid recommended pattern. The lipids contain high amounts of unsaturated fatty acids in which linoleic acid (51%) is the major fatty acid. **Fodder:** *A. leucophloea* is an important dry-season fodder and pasture tree throughout its range. Leaves, tender shoots and pods are eagerly consumed by goats, sheep and cattle. Leaves contain 15% crude protein and 19% crude fibre. However, due to hydrocyanic acid toxicity *A. leucophloea* should not be used as a sole feed. **Fuel:** It is appreciated as firewood and is suitable for charcoal production (CSIR, 1948; Orwa *et al.*, 2009). The HCN content of the green pods is 1208 mg/kg, dry pods 2022 mg/kg, green leaves 200 mg/kg and dry leaves 700 mg/kg (Vihan and Panwar, 1987). Commodities produced from the wood include poles, farming implements, carts, wheels, turnery, indoor construction timbers, flooring and furniture.

Wood properties: Wood is moderately heavy and hard, density 720-890 kg/m³ at 15% moisture content. Sapwood is yellowish white, heartwood brick red and it is used for agricultural implements, oil mills, carts and cart wheels. It is also used as fuel. Its wood is strong, heavy, seasons well and takes a good polish. The brick-red

heartwood is very beautiful and is used to make decorative furniture. The pale yellow sapwood is perishable. The utilization of this species is limited because its wood has

irregular interlocked grain, a rough texture and is difficult to work (CSIR, 1948; Orwa *et al.*, 2009).

References:

Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 21.

CSIR. 1948. The Wealth of India, Vol. I. A Dictionary of Raw materials and industrial products, Publication and Information Directorate, New Delhi.

Dharmadhikar, M.S. and Jite, P.K. 1992. In vitro culture of *Acacia leucophloea* Willd galls infected with *Haplophragmiopsis ponderosa* (Syd. & Butl.) Thirum. Biovigyanam. 18(1): 59-61.

Jamaluddin, Soni, K.K. and Dadwal, V.S. 1985. Some observations on heart rot in hard wood species of Madhya Pradesh. Journal of Tropical Forestry. 1: 152-155.

Jitendra Panwar and Anil Vyas. 2002. Biochemical changes in *Acacia leucophloea* by arbuscular mycorrhizal fungi. Indian Journal of Microbiology. 42(3): 249-250.

Khan, M.R. 2001. Effect of iodine vapour treatment of seeds of some forest trees in the Western Maharashtra. Advances in Plant Sciences. 14(2): 467-470.

Khullar, P., Thapliyal, R.C., Beniwal, B.S., Vakshasya, R.K. and Ashok Sharma. 1991. Forest Seed. ICFRE, New Forest, Dehra Dun. pp. 374.

Mahnot, S.C. and Chaplot, P.C. 1999. Nutrient spray influences *Albizia lebbeck* and *Acacia leucophloea* saplings growth in nurseries. Advances in Horticulture and Forestry. 6: 167-170.

Mani, G., Ponnuswamy, A.S., and Vanangamudi, K. 1999. Performance of seed pelletization in *Acacia leucophloea* (Roxb.) under different soil types. Tropical Agricultural Research and Extension. 2(1): 30-32.

Orwa C, A Mutua, Kindt R, Jamnadass R, S Anthony. 2009. Agroforestry Database: a tree reference and selection guide version 4.0

Sanjai, V.N. and Balakrishnan, N.P. 2001. *Viscum acaciae* Danser (Viscaceae) - a new record for India. Journal of Economic and Taxonomic Botany. 25(1): 18-20.

Sasidharan, N. 2004. Forest Trees of Kerala. Kerala Forest Research Institute, Peechi, Kerala, India.

Srivastava, R.K., Manisha Thapliyal, Ombir Singh and Nawa Bahar. 2006. Forest seeds, Information Booklet. Forest Research Institute, Dehra Dun.

Swaminathan, C. and Sivagnanm, K. 1999. Influence of locations on seed germination in *Acacia leucophloea* Willd. Range Management and Agroforestry. 20(1): 112-114.

Tomar, A.K., Khan, M.A., Tomar, G.S. and Kumar, S. 1996. Forest leguminous trees a source of human nutrition. Journal of Tropical Forestry. 12(4): 189-194.

Vanangamudi, K. and Natarajan. 2006. Advances in Seed science and technology (Vol I): recent trends in seed technology and management.

Verma, B.R. 1989. Observations on three parasites of bruchids on leguminous host plants. Bulletin of Entomology New Delhi. 30(2): 246-247.

Vijayakumari, K., Siddhuraju, P. and Janardhanan, K. 1994. Nutritional assessment and chemical composition of the lesser known tree legume, *Acacia leucophloea* (Roxb.) Willd. Food Chemistry. 50(3): 285-288.

Vyas, M.B. and Sharma, K.C. 1998. Spermoderm patterns in some Mimosaceae. Feddes Repertorium. 109(1/2): 67-72.

Vihan, V.S. and Panwar, H.S. 1987. A note on toxicity of *Acacia leucophloea* (Rajma) in sheep. Indian Journal of Animal Research. 21: 53-55.

Acacia mangium

Nomenclature:

Scientific name: *Acacia mangium* Willd.

Vernacular name: Mangium (Malayalam); Mangium, Mangium wattle, mange, forest mangrove (Duke, 1983; PIER, 2003; Chacko *et al.*, 2002).

Common name: Black wattle, Brown salwood, Mangium (Chacko *et al.*, 2002; Bose *et al.*, 1998).

Synonyms: *Racosperma mangium* (Willd.) Pedley (Chacko *et al.*, 2002).

Family: Leguminosae

Subfamily: Mimosoideae

Origin: Native to Queensland, Australia, Molluccan Islands, Papua New Guinea, and Indonesia.

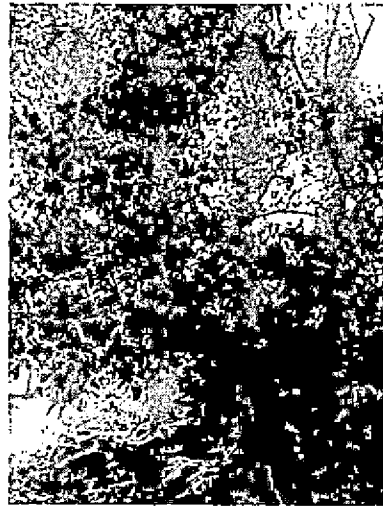
Distribution: It has been introduced in India; Nepal; South American states; Bangladesh; Philippines; Malaysia and in many other tropical countries for plantation. It was introduced into Kerala during early 1980s (Awang and Taylor, 1993; Bose *et al.*, 1998; Chacko *et al.*, 2002; PIER 2003).

Description: Fast growing moderate sized evergreen tree attaining a height of 25 to 35 m and breast height diameter 60 cm (Awang and Taylor, 1993; Chacko *et al.*, 2002).

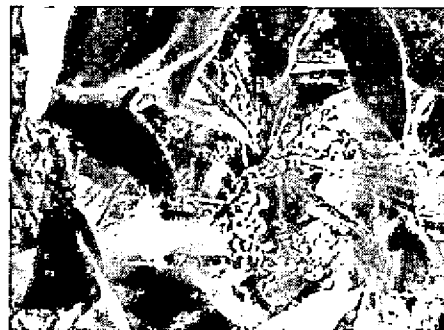
Flowering season: October to January (Bose *et al.*, 1998).

Fruiting season: January to April (Chacko *et al.*, 2002).

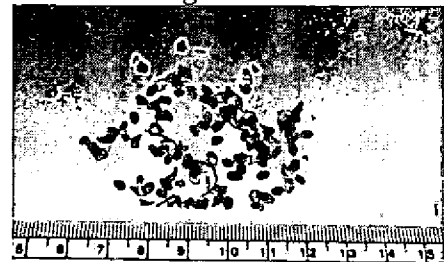
Flowers: Small, pentamerous, white, cream or light yellow in loose axillary spikes up to 10 cm long solitary or paired in the upper axils. Calyx 0.6-0.8 mm long, with short obtuse lobes, the corolla twice as long as the calyx (Duke, 1983; Bose *et al.*, 1998).



Habit



A twig with fruits



Seeds

Fruits: Initially straight 8 mm long and green, glabrous, later twisted, inter twined and become irregularly coiled and blackish brown when ripe with depressions between the seeds (Duke, 1983; Bose *et al.*, 1998; Chacko *et al.*, 2002).

Fruit type: Pod.

Seeds: Seeds are smaller, lustrous, black, ellipsoid, ovate or oblong, 3.5-2.5 mm, the orangish funicle forming a fleshy aril beneath the seed, black in colour and with a hard seed coat (Duke, 1983).

Seed dimension:

Seed length: 3-5 mm (Awang and Taylor, 1993; Chacko *et al.*, 2002).

Seed width: 2-3 mm (Awang and Taylor, 1993; Chacko *et al.*, 2002).

Seed thickness:

Seed weight: 1,03,000 seeds/kg (Chacko and Pillai, 1995).

Seed dispersal: Birds.

Seed collection: Ripening pods change in colour from green to brown (Awang and Taylor, 1993; Chacko *et al.*, 2002) and are collected from the tree. Seeds collected from 9-yr-old trees give 68% germination, but all seedling parameters are better for seeds from 6 yr old trees (Rohayat and Mindawati, 1997).

Transportation of seeds: Pods are packed in cloth bags and transported (Chacko *et al.*, 2002).

Seed processing: Ripe pods are spread in the sun for 5 to 9 days until they open out to

release seeds. The seeds are dried well before storage (Chacko *et al.*, 2002).

Seed storage: Seeds are orthodox in nature, retain viability up to two years under cool dry conditions in airtight bottles, tins, and earthenware pots (Chacko *et al.*, 2002). The use of storage media help to increase the percentage of seed viability (Khomane and Bhosale, 2003).

Viability period: Seeds are viable for one year or more under natural conditions in sealed tin (Chacko *et al.*, 2002).

Seed emptiness: No information (Chacko *et al.*, 2002).

Seed pre treatment: Soaking in hot water for (80°C) two minutes followed by tap water for 24 hrs (Chacko *et al.*, 2002). Seed lethal temperature is around 150°C, while a temperature of 76°C cannot break seed dormancy (Saharjo and Watanabe, 1997). Soaking the seeds in boiling water until the water turns cold for 24 hrs increase seed germination. Treatment in boiling water, without posterior immersion in ambient water result in good germination by overcoming seed coat hardness (Smiderle *et al.*, 2005). Treatment with concentrated sulfuric acid also break seed coat dormancy, but result in abnormal growth of seedlings (Dayan and Reaviles, 1996). Germination value, germination energy and germination relative index are high in seeds inundated with hot water (Swaminathan and Swarnapirria, 2001).

Germination type: Epigeal (Chacko *et al.*, 2002).

Germination percentage: 53 (Chacko and Pillai, 1995).

Germination period: 3 to 30 days (Chacko and Pillai, 1995). Germination percentage and germination values differ between tree ages. Increased moisture stress reduce germination. Germination is higher in seeds exposed to light than those kept in the dark. High temperature fluctuation rather than light per se promote seed germination (Hashim Md Noor and Wathern, 2003).

Nursery technique: Pre treated seeds are sown in plastic trays filled with vermiculate or in nursery beds and watered regularly. The germinated seeds are potted in polythene bags of size 20 x 10 cm filled with compost or soil based potting mixture. Seeds can also be sown directly in containers such as polythene bags, root trainers, etc. using appropriate potting media (Chacko *et al.*, 2002). The slow release fertilizer Fertimel (which contains N, P, K, Ca, Mg, S and trace elements), significantly improve the growth of seedlings in the nursery (Masano and Mawazin, 1995). Cowdung without NPK fertilizer at a soil/cowdung ratio of 3:1 is also effective in increasing growth. NPK fertilizer alone is less effective on the growth of the seedlings (Paul and Hossain, 1997). Seedling growth increase with P dose, but the 400 g m⁻³ dosage is sufficient since the seedlings produced under this regime have a root shoot ratio of 0.50, which is a good quality indicator (Daniel *et al.*, 1997). Kocide 80 AS (Spin Out (copper hydroxide) applied to the inner wall of a seedling container is effective in preventing container induced root deformation (circling and kinked roots)

and increasing plant growth (Hendromono *et al.*, 1995).

Propagation:

Method of propagation: Direct sowing or entire planting.

Vegetative propagation: In vitro multiple shoot proliferation using nodal explants using MS medium supplemented with BA ([benzyladenine] 3 mg/litre) and NAA (0.1 mg/litre) (Bhaskar and Subhash, 1996). Coppice shoots dipped into IBA solution (6000 ppm for 5 s) and growing in a medium of river sand give 50-70% rooting (Akbar, 1993). But it is quite difficult to propagate by cuttings obtained from mature material (Poupard *et al.*, 1994).

Pests: No information (Chacko *et al.*, 2002). There are problems with leaf insects (Duke, 1983). Pinhole beetles of 3 species (*Xyleborus perforans*, *X. semiopacus* [*Xylosandrus crassiusculus*] and an unidentified *Xyleborus* sp.) are observed on logs (Brazo, 1995). Carpenter ants (*Camponotus* sp.) form galleries in the heartwood of young trees. Wood borers of the genus *Xystrocera* may be a problem. Seedlings may be defoliated by *Hypomeces squamosus*. Scale insects and mealy bugs may also be problematic with young plants (NAS, 1983).

Diseases: Twenty five fungi and a bacterium are recorded on seeds. *Epicoccum* sp., *Alternaria* sp., *Phomopsis* sp., *Cylindrocladium* sp., are the important field fungi recorded (Mohanand Anil Chandran, 2001; Chacko *et al.*, 2002).

Botryodiplodia theobromae, *Fusarium moniliforme* and *F. oxysporum* are the most prevalent fungi causing seed rot, seedling diseases and mortality, wilt, growth suppression, and stem deformation. *Pseudomonas* sp. and *Xanthomonas* sp. also commonly cause various seedling diseases, including dieback. *Colletotrichum gloeosporioides*, *Fusarium moniliforme*, *F. oxysporum* and *Phoma* sp. are seed transmitted as they were isolated from embryos. However, *Botrytis* sp., *Cephalosporium* sp., *Curvularia tuberculata*, *Macrophomina phaseolina* are found only on the seed coat. *Trichoderma* sp., when mixed with fertilizers, improve seedling growth and minimize seed-borne diseases (Abdelmonem and Rasmi, 2005). Brown root rot caused by *Phellinus noxius*; and laminated root rot (caused by an unidentified fungus) (Almonicar, 1992).

References:

- Abdelmonem, A.M. and Rasmi, M.R. 2005. Survey of seed-borne diseases of woody trees in Egypt. Proceedings of the ISTA Forest Tree and Shrub Seed Committee Workshop, Prague Pruhonice, Czech Republic. 9-17.
- Almonicar, R.S. 1992. Two types of root rot diseases affecting *Acacia mangium*. Nitrogen Fixing Tree Research Reports. 10: 94-95.
- Akbar, A. 1993. Selection of cuttings material and medium for vegetative propagation of *Acacia mangium*. Duta Rimba., 19: 155-156, 33-39.
- Awang, K. and Taylor, D. (eds.) 1993. *Acacia mangium*: Growing and utilization. MPTS Monograph series No.3 Winrock International and FAO, Bangkok, Thailand.
- Bhaskar, P. and Subhash, K. 1996. Micropropagation of *Acacia mangium* Willd. through nodal bud culture. Indian Journal of Experimental Biology. 34: 590-591.
- Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 22.

Medicinal properties:

Uses: Wood is suitable for light structural works, and for pulp and paper. Round shoots are browsed by buffaloes and cattle. Wood is used for furniture and cabinets, mouldings and door and window components (Chacko *et al.*, 2002).

Wood properties: The sapwood and the heartwoods have distinct colours. The sapwood is often white or yellowish white and the heartwood is yellowish brown to golden brown when fresh, to dull brown on long exposure. The wood is hard, dense and relatively straight-grained. The green wood density ranges from 400-480 kg/m³, air-dry density ranges from 500-600 kg/m³ (Logan and Balodis 1982;Peh and Khoo 1984; Ong 1985;Wang *et al.* 1989;Razali and Kuo 1991).

- Brazo, R.D. 1995. Pests related to pruning branches of *Acacia mangium*. Nitrogen Fixing Tree Research Reports. 13: 16-17.
- Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 34-35.
- Chacko, K.C. and Pillai, P.K.C. 1995. Effects of some presowing treatments on the germination of *Acacia mangium* seeds. Bangladesh Journal of Forest science, 24: 70-73.
- Daniel, O., Vitorino, A.C.T., Alovisei, A.A., Mazzochin, L., Tokura, A.M., Pinheiro, E.R. and Souza, E.F.de.1997. Phosphorus application to *Acacia mangium* Willd. seedlings. Revista Arvore. 21(2): 163-168.
- Dayan, M.P. and Reaviles, R.S. 1996. Germination test standards for *Acacia mangium*. Sylvatrop. 4(2): 1-6.
- Duke, J.A. 1983. Handbook of Energy Crops. unpublished. Available:
- Hashim Md Noor and Wathern, P. 2003. Germination characteristics of selected tropical pioneer tree species. Part 1: Effects of light and simulated moisture stress. Malaysian Forester. 66(3/4): 228-234.
- Hendromono, Masano, and Alrasyid, H. 1995. The effect of Kocide 80 AS sprayed onto containers on the development of roots and shoots of *Acacia mangium* and *Acacia auriculiformis* seedlings. Buletin Penelitian Hutan. (591): 1-10.
- Khomane, B.V. and Bhosale, L.J. 2003. Effect of storage medium on viability of seed in some fuelwood species. International Journal of Forest Usufructs Management. 4(1): 55-58
- Logan, A.F. and Balodis, V. 1982. Pulping and papennaking characteristics of plantation-grown *Acacia mangium* from Sabah. Malay. Forester 45: 217-236.
- Masano and Mawazin. 1995. Effect of Fertimel fertilizer on the growth of *A. mangium* seedlings. Buletin Penelitian Hutan. (590): 27-39.
- Mohanan, C. and Anil Chandran. 2001. Micropropagation associated with seeds of tropical forest species and their management for optimum seed germination and seedling health. Journal of tropical forestry (in press).
- NAS (National Academy of Sciences). 1983. Mangium and other acacias of the humid tropics. National Academy Press, Washington, DC.
- Ong, S.H. 1985. Physical and mechanical properties of *Acacia mangium* timber from Ulu Kukut in Sabah. Forest Research Centre, PRC Pub. no. 23, Sandakan.

Paul, S.P. and Hossain, A.T.M.E. 1997. Effect of cowdung and chemical fertilizers on the growth of *Acacia mangium* seedlings. *Bangladesh Journal of Forest Science*. 25(1/2): 49-52.

Peh, T. B. and Khoo, K. C. 1984. Timber properties of *Acacia mangium*, *Gmelina arborea* and *Paraserianthes falcataria* and their utilization aspect. *Malaysian Forester*, 47 (3-4): 285-303.

PIER (Pacific Islands Ecosystems at Risk). 2003. Invasive Plant Species: *Acacia mangium*.

Poupard, C., Chauviere, M., Monteuis, O. 1994. Rooting *Acacia mangium* cuttings: effects of age, within shoot position and auxin treatment. *Silvae Genetica*, 43(4): 226-231

Razali, A.K. and H.S. Kuo . 1991. Properties of particleboards manufactured from fastgrowing plantation species. *Proc. Regional Syrnop. Recent Developments in Tree Plantations of Humid/Subhumid Tropics of Asia*. Universiti Pertanian Malaysia, Pub., Serdang: 685-691.

Rohayat, N. and Mindawati, N. 1997. Seed germination capacity and seedling quality using seeds harvested from some different aged *Acacia mangium*. *Buletin Penelitian Hutan*. (610): 51-58.

Saharjo, B.H. and Watanabe, H.1997. The effect of fire on the germination of *Acacia mangium* in a plantation in South Sumatra, Indonesia. *Commonwealth Forestry Review*. 76(2): 128-131.

Smiderle, O.J., Mourao Junior, M. and Sousa, R. de.C.P.de. 2005. Pre-germinative treatments in acacia seeds. *Revista Brasileira de Sementes*. 27(1): 78-85.

Swaminathan, C., and Swarnapirra, R. 2001. Improving germination in two Australian acacias. *Journal of Tropical Forest Science*. 13(2): 364-368.

Wang. Q., Sasaki, H. and Razali, A.K. 1989. Properties of tropical fast-growing timbers from plantation thinnings in Sabah, Malaysia. *Wood Research and Technical Note No. 25*: 45-51.

Acacia mearnsii

Nomenclature:

Scientific name: *Acacia mearnsii* de Wilde

Vernacular name: Chavukku, Seekai (Tamil) (Chacko *et al.*, 2002).

Common name: Black wattle (Chacko *et al.*, 2002).

Synonyms: *Acacia decurrens* (Wendl.) Willd. var. *mollis* Lindl., *Acacia mollissima* Willd. (Chacko *et al.*, 2002; Duke, 1983).

Family: Leguminosae

Subfamily: Mimosoideae

Origin: Australia (Ram Parkash and Drake Hocking, 1986).

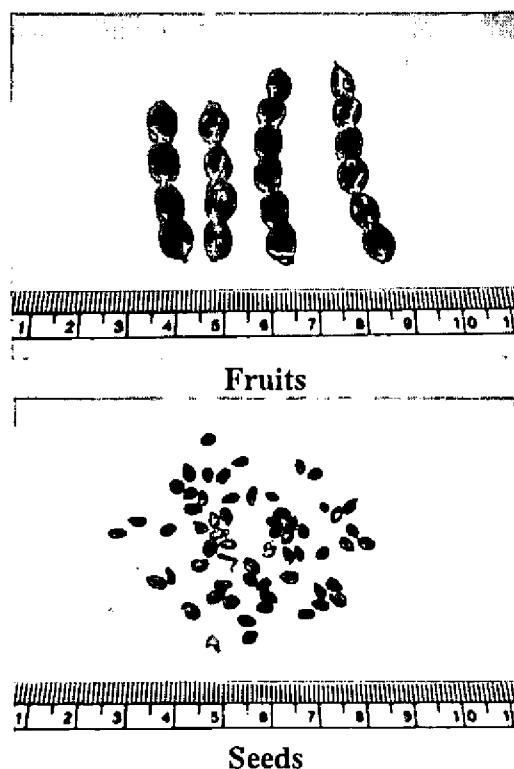
Distribution: Native to Southeast Australia (Victoria to New South Wales and southern Queensland) and Tasmania. Introduced and cultivated widely for afforestations. In India it is grown in Nilgiri and Palni hills (Duke, 1981; Ram Parkash and Drake Hocking, 1986).

Description: Medium sized evergreen tree upto 27m height and 47 cm diameter; crown conical or rounded. Foliage is dark green. All parts except flowers are usually pubescent or puberulous; stems without spines or prickles (Chacko *et al.*, 2002; Ram Parkash and Drake Hocking, 1986; Duke, 1981).

Flowering season: January to February.

Fruiting season: November (Khullar *et al.*, 1991).

Flowers: Flowers in pale yellowish globose heads, fragrant, borne in panicles or racemes, on peduncles 2-6 mm long distributed in terminal or axillary position (CSIR, 1948; Duke, 1981).



Fruits: Grey-puberulous, or sometimes glabrous, almost moniliform, hard, dehiscent, usually 3-10 cm long, 0.5-0.8 cm wide, with 3-14 joints (Duke, 1981).

Fruit type: Pod.

Seeds: Smooth black, elliptic or compressed ovoid, seeds, 3-5 mm long, 2-3.5 mm wide; caruncle conspicuous; areole 3.5 mm long, 2 mm wide (Duke, 1981).

Seed dimension:

Seed length: 0.42 cm (Chacko *et al.*, 2002).

Seed width: 0.29 cm (Chacko *et al.*, 2002).

Seed thickness: 0.18 cm (Chacko *et al.*, 2002).

Seed weight: 45,000 seeds/kg (Kindt *et al.*, 1997; Chacko *et al.*, 2002); 85,000 seeds/kg (Carlowitz, 1991; Chacko *et al.*, 2002).

Seed dispersal:

Seed collection: Collect pods from the tree by lopping off the branches in the month of November (Chacko *et al.*, 2002; Srivastava *et al.*, 2006).

Transportation of seeds: Pods collected in cotton / polythene / gunny bags are packed and transported (Chacko *et al.*, 2002).

Seed processing: Sun dry the pods until they dehisce and extract the unreleased seeds by beating with a stick (Chacko *et al.*, 2002).

Seed storage: Orthodox (CABI, 1998; Kindt *et al.*, 1997; Chacko *et al.*, 2002). Seeds are dried before storage and stored in sealed tins or polythene bags for more than a year (Chacko *et al.*, 2002).

Viability period: Under ambient room temperatures, seeds are viable for one year (Chacko *et al.*, 2002). 1-2 years (Srivastava *et al.*, 2006).

Seed emptiness: Low (Chacko *et al.*, 2002).

Seed pre treatment: Soak the seeds in cold water for 48 hrs or in hot water for about 3 min followed by cold water soaking for 24

hrs (Kindt *et al.*, 1997; Chacko *et al.*, 2002). Autoclaving the seeds for 20 and 25 min are enough to break the dormancy (giving 90% germination) and simultaneously to disinfect the seeds. Periods less than 20 min are not efficient in disinfestation although they promote high rates of germination (Martins Corder *et al.*, 1999). Seeds exposed to constant dark conditions show better germination percentage (Kulkarni *et al.*, 2007). Soaking seeds in hot water for 12-24 hrs or stirring in concentrated H₂SO₄ for 1 hr. Steeping of seeds in hot water for 5 min is sufficient to break dormancy (Gupta and Thapliyal, 1974). Mechanical scarification, hot water treatments, scarification with sandpaper, and photoperiod treatment for 12 hrs give 98%, 82-86%, 58.75-80% and 72.36% germination respectively (Martins Corder *et al.*, 1999; Roversi *et al.*, 2002).

Germination type: Epigeal (Chacko *et al.*, 2002).

Germination percentage: 50 to 83 (Carlowitz, 1991; Chacko *et al.*, 2002).

Germination period: 30 days (Khullar *et al.*, 1991); 2 to 10 days (Chacko *et al.*, 2002).

Nursery technique: The pre-treated seeds are sown in plastic trays containing vermiculite and watered regularly. When the seedlings are about 4 to 5 cm high, they are transplanted to the polythene bags of size 20 x 10 cm filled with soil or compost based potting mixture and maintained under shade (Chacko *et al.*, 2002). Combined vermicompost+gypsum treatment increase growth, biomass and growth index of seedlings, when compared to individual

treatment of fertilizer (Rajan and Mariappan, 2003). Vermicomposts should be applied at 56-112 cm³ to produce quality seedlings (Caldeira *et al.*, 1999). Phosphorus utilization efficiency decrease with increasing P fertilizer doses and inoculations with *G. deserticola* and *Rhizobium* sp. (Udaiyan *et al.*, 1997).

Propagation:

Method of propagation: By seeds and root suckers (CSIR, 1948).

Vegetative propagation:
Micropropagation of *Acacia mearnsii*: Nodal explants are taken from 30 day old micropropagated plantlets and pretreated 3 and 9 month old seedlings. It is then induced to form multiple shoots by culturing on MS medium supplemented with 2.0 mg benzyladenine/litre. Rooting is achieved on MS medium supplemented with 1.0 mg IBA/litre. Plantlets are acclimatized in transparent plastic containers under greenhouse conditions with a 90% success rate (Beck *et al.*, 1998). Vegetative propagation is possible using 10-15 cm cuttings with leaves. Mist spray, constant heat of 28°C, and auxin mixtures of IBA and NAA appear essential to good rooting. Bud-grafting can be highly successful. Propagation by cutting is almost impossible without mist. Air layering is more promising (Duke, 1983). Rooting of cuttings from the lower branches of trees kept in Hoagland solution containing added ZnSO₄, H₃BO₃, caffeic acid, Vitamin B, amino acids and sucrose; application of

an auxin mixture by the quick-dip method (Zeijlemaker, 1976).

Pests: The cracks and crevices of the bark are home for many insects, the very rare butterfly Tasmanian hair streak butterfly lays eggs in these cracks. *Melanterius maculatus*, seed eating weevil cause reduction in seed number. Larvae feed on developing seeds and adults feed on the green pods and pinnules (Milton *et al.*, 2003). Kotochalia [Acanthopsyche] junodi (Wattle bag worm) in plantations (Hepburn, 1973).

Diseases: Moderate (51%). Twelve species of fungi are recorded. *Cylindrocladium parvum*, *Gonatobotryum* sp., *Pestalotia* sp., are important ones (Mohanan and Anil Chandran, 2001; Chacko *et al.*, 2002). Susceptible to root collar girdling (Neville, 1987).

Medicinal properties: It is used as a styptic and astringent. Alkaloid content is less than 0-02% styptics or astringents (Duke, 1981).

Uses: The bark is one of the richest vegetable tanning material known to the tanning industry. The timber is a valuable by-product and the tree yields a gum (CSIR, 1948). Used as a source of tannin, fuelwood, charcoal, poles, props, green manure and windbreaks. The wood has a calorific value (dry) of 4600 kcal/kg and ash content of about 1.5%. It is dense, with specific gravity about 0.75, and yields a high-quality charcoal (NAS, 1980). Wattle bark contains 30-45% (dry basis) high-quality tannins and is the most widely used tannin material in the world which are particularly effective on hard leathers for shoes and saddles. They

give better colour to leather than other tannins, do not precipitate in acid solution, and penetrate hides faster (NAS,1980). Plantations are grown for kraft pulping and papermaking (Muneri, 1997).

Wood properties: The sapwood is white, which gradually emerges into light red

heartwood. It is hard and heavy. The wood is excellent as fuel wood and charcoal. The wood has a calorific value of 3,5000-4,000 kcal/kg. It serves as a fibrous raw material of the pulp, paper and the board industry (Purkayastha, 1996).

References:

Beck, S.L., Dunlop, R., and Staden, J van. 1998. Micropropagation of *Acacia mearnsii* from ex vitro material. *Plant Growth Regulation*. 26(3): 143-148.

Beck, S.L., Fossey, A., Dunlop, R.W., Roffael, E., Dix, B. and Schneider, T. 2002. Use of tannins as binder in the industry of wood-based panels. *Forstarchiv*. 73(1): 15-22 .

CABI. 1998. The Forestry Compendium - A Silvicultural Reference. Module 1. CABI Publishing, CAB International, Wallingford, Oxon, OX108DE, UK.

Caldeira, M.V.W., Schumacher, M.V., Pereira, J.C., Della Flora, J.B. and Santos, E.M dos. 1999. Concentration and redistribution of nutrients in the leaves and in the litter of *Acacia mearnsii* de Wild. stand at in Rio Grande do Sul State. *Ciencia Florestal*. 9(1): 19-24.

Carlowitz, P.G.V. 1991. Multipurpose Trees and Shrubs: Source of seeds and Inoculants. International Council for Research in Agroforestry, Nairobi, Kenya.

Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 36-37.

CSIR. 1948. The Wealth of India, Vol. I. A Dictionary of Raw materials and industrial products, Publication and Information Directorate, New Delhi.

Duke, J.A. 1981. Handbook of legumes of world economic importance. Plenum Press. NewYork.

Duke, J.A. 1983. Handbook of Energy Crops. unpublished. Available:

http://www.hort.purdue.edu/newcrop/duke_energy/Acacia_mangium.html (Accessed: December 3, 2009).

- Gupta, B.N. and Thapliyal, R.C. 1974. Presowing treatment of Black Wattle (*Acacia mearnsii* de Wild) and Australian Blackwood (*Acacia melanoxylon* R. Br.) seed. *Indian Forester*. 100: 733-735.
- Hepburn, G.A. 1973. The Wattle bagworm. A review of investigations conducted from 1899 to 1970. Report for 1972-1973, Wattle Research Institute. 75-93.
- Khullar, P., Thapliyal, R.C., Beniwal, B.S., Vakshasya, R.K. and Ashok Sharma. 1991. *Forest Seed*. ICFRE, New Forest, Dehra Dun. pp. 374.
- Kindt, R., Mausya, S., Kimotho, J. and Waruhiu. 1997. *Tree seed suppliers Directory: Sources of Seeds and Microsymbionts*. International Centre for Research in Agro Forestry (ICRAF), Nairobi, Kenya.
- Kulkarni, M.G., Sparg, S.G. and Staden, J van. 2007. Germination and post-germination response of *Acacia* seeds to smoke-water and butenolide, a smoke-derived compound. *Journal of Arid Environments*. 69(1): 177-187.
- Martins Corder, M.P. and Borges Junior, N. 1999. Disinfestation and dormancy breaking of seeds of *Acacia mearnsii* de Wild. *Ciencia-Florestal*. 9(2): 1-7.
- Milton, S.J., Dean, W.R.J. and Richardson, D.M. 2003. Economic incentives for restoring natural Capital in Southern African rangelands, *Front Ecol Environ*+c26. 1(5):247 254.
- Mohanani, C. and Anil Chandran. 2001. Microorganisms associated with seeds of tropical forest species and their management for improving the storability and seedling production. *Seed Science and Technology* (in press).
- Muneri, A. 1997. Kraft pulping properties of *Acacia mearnsii* and *Eucalyptus grandis* grown in Zimbabwe. *Southern African Forestry Journal*. (179): 13-19.
- National Academy of Sciences (N.A.S). 1980. *Firewood Crops: Shrub and Tree Species for Energy Production*. NAS, Washington DC. p.72-73.
- Neville, G.A. 1987. Some experiences in the propagation of acacias.
- Purkayastha, S.K. 1996. *A manual of Indian timbers*. Sri Bhumi Publishing Company, Calcutta.
- Rajan, M.R. and Mariappan, V. 2003. Response of multipurpose tree species to different fertilizer treatments on tannery soil at nursery level. *Environment and Ecology*. 21(4): 752-754.
- Ram Parkash and Drake Hocking. 1986. *Some favourite trees for fuel and fodder*. Society for promotion of waste lands development, New Delhi. pp.12-16.
- Roversi, T., Mattei, V.L., Silveira Junior, P., and Falck, G.L. 2002. Dormancy break in seeds of black-wattle (*Acacia mearnsii* Willd.). *Revista Brasileira de Agrociencia*.8(2): 161-163

Srivastava, R.K., Manisha Thapliyal, Ombir Singh and Nawa Bahar. 2006. Forest seeds, Information Booklet. Forest Research Institute, Dehra Dun.

Udaiyan, K., Sugavanam, V., and Manian, S. Growth response of wattle (*Acacia mearnsii*) seedlings to phosphorus fertilisation and inoculations with *Glomus deserticola* and *Rhizobium* sp. in non-sterile soil. *Journal of Tropical Forest Science*.1997.10(2): 212-224.

Zeijlemaker, F.C.J. 1976. Rooting of cuttings of Black Wattle (*Acacia mearnsii* de Wild). Report for 1975-76, Wattle Research Institute, South Africa. 91-92.

Acacia melanoxylon

Nomenclature:

Scientific name: *Acacia melanoxylon* R. Br.

Vernacular name:

Common name: Australian Black wood, Black wood Acacia (Bose *et al.*, 1998; CSIR, 1948).

Synonyms: *Racosperma melanoxylon* (R.Br.) C.Martius

Family: Leguminosae

Subfamily: Mimosoideae

Origin: Native of Tasmania and South Australia (Bose *et al.*, 1998).

Distribution: It was introduced to Nilgiris in 1840, where it has naturalised and has been extensively cultivated; commonly seen as roadside avenue in hills at an elevation of 1800-2400 m.

Description: A large unarmed evergreen tree, 18-36 m in height with straight trunk and pyramidal to cylindrical dense crown (CSIR, 1948; Henderson, 1995).

Flowering season: February to April (Bose *et al.*, 1998).

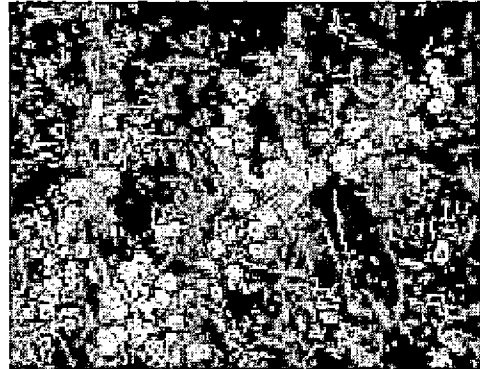
Fruiting season: July to November (Bose *et al.*, 1998).

Flowers: Flowers pale yellow in globose heads, 5 mm in diameter, arranged in short racemes (CSIR, 1948; Henderson, 1995).

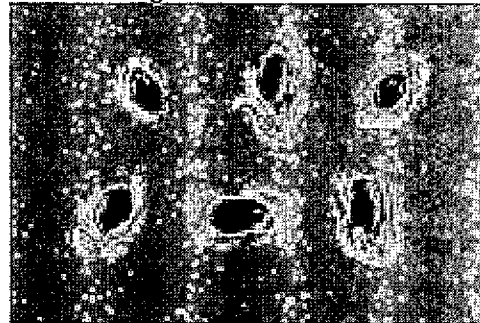
Fruits: Reddish-brown, linear, flat, more or less curved and twisted into shape of letter C or S, narrower than leaves, seeds almost encircled by pinkish-red seed stalks (CSIR, 1948; Henderson, 1995).

Fruit type: Pod.

Seeds: Seeds flat roundish shiny black 2-3 mm long, almost encircled by pinkish-red seed stalks (aril) (Henderson, 1995).



A twig with inflorescence



Seeds

Seed dimension:

Seed length:

Seed width:

Seed thickness:

Seed weight: 65000 to 75000 seeds/kg (Srivastava *et al.*, 2006).

Seed dispersal: Birds (ingest small seeds with pink-red aril), Primates (ingest seeds with pods) (Geldenhuys, 2003).

Seed collection: Seeds are collected during July-November (Srivastava *et al.*, 2006).

Transportation of seeds:

Seed processing: Pods are beaten with a stick, dried in the sun and the seed is extracted by trampling or flailing, and the clean seed is obtained by winnowing (Ram Parkash *et al.*, 1998).

Seed storage: Orthodox seeds, can be stored in room temperature (Srivastava *et al.*, 2006).

Viability period: 1-2 years (Srivastava *et al.*, 2006).

Seed emptiness:

Seedpre treatment: The hard coated seeds are pre-treated with hot water soak for 5 min to get good germination (CSIR, 1948). Acid scarification (Sulphuric acid) for five minutes is also found to increase the germination percent (Srivastava *et al.*, 2006; Gupta and Thapliyal, 1974).

Germination type: Epigeal.

Germination percentage: 60-70% (Srivastava *et al.*, 2006).

Germination period: 30 days (Khullar *et al.*, 1991).

Nursery technique:

Propagation:

Method of propagation: By seeds and root suckers (CSIR, 1948).

Vegetative propagation: Coppice shoots develop from cut and damaged stems, and from damaged roots (Geldenhuys, 2003).

Pests:

Diseases: Leaf infection of nursery seedlings is caused by the *Colletotrichum* state of *Glomerella cingulata*, and shoot dieback of 2 yr old plant caused by *Fusarium semitectum* [*F. pallidoroseum*] (Mohan and Sharma, 1988).

Medicinal properties:

Uses: The timber is useful for cabinet and constructional work. It is also used for bent work, boat building, and for tennis racquet frames. It makes a good roadside tree in USA and the wood is little inferior to black walnut for furniture making (Bose *et al.*, 1998).

Wood properties: The colour of the wood varies from light brown to dark brown. The wood is strong and moderately hard. The heartwood is dark brown and beautifully mottled, shining and even grained. Sapwood and heartwood of *Acacia melanoxylon* possess particleboard properties. Heartwood had higher content of extractives and lower pH-value than sapwood. As the amount of heartwood in the sapwood/heartwood particle mixture increased, the physical-mechanical properties of particleboards improved, except for internal bond (IB). Particle boards with 100% heartwood presented the highest MOR and MOE values, and the lowest

swelling and water absorption values (Pelen *et al.*, 1998).

References:

Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 22.

CSIR. 1948. The Wealth of India, Vol. I. A Dictionary of Raw materials and industrial products, Publication and Information Directorate, New Delhi.

Geldenhuys, C. J., Forestwood cc, P O Box 228, La Montagne, Pretoria 0184, South Africa.

Gupta, B.N. and Thapliyal, R.C. 1974. Presowing treatment of Black Wattle (*Acacia mearnsii* de Wild) and Australian Blackwood (*Acacia melanoxylon* R. Br.) seed. Indian Forester. 100: 733-735.

Henderson, Lesley. 1995. Plant invaders of Southern Africa. Plant Protection Research Institute Handbook No. 5, Agriculture Research Council, ARC/LNR, Pretoria, South Africa. 177 pp.

Khullar, P., Thapliyal, R.C., Beniwal, B.S., Vakshasya, R.K. and Ashok Sharma. 1991. Forest Seed. ICFRE, New Forest, Dehra Dun. pp. 374.

Mohanan, C. and Sharma, J.K. 1988. Diseases of exotic acacias in India. Journal of Tropical Forestry. 4(4): 357-361.

Pelen, P., Poblete, H. and Inzunza, L. Heart and sapwood of *Acacia melanoxylon* as raw material for particleboard. Bosque. 1998. 19(2): 29-36.

Ram Parkash, M.A., Chaudhri, D.C. and Negi, S.S. 1998. Plantation and nursery technique of forest trees. International Book Distributors. Dehra Dun, India.

Srivastava, R.K., Manisha Thapliyal, Ombir Singh and Nawa Bahar. 2006. Forest seeds, Information Booklet. Forest Research Institute, Dehra Dun.

Acacia nilotica

Nomenclature:

Scientific name: *Acacia nilotica* (Linn.) Willd. ex Del.

Vernacular name: Babul, Kikar (Hindi), Karuvelam (Malayalam), Karuvai, Karuvel (Tamil) (Chacko *et al.*, 2002; Bose *et al.*, 1998). Karivelan (Malayalam), Karu velamaram, Karuvelei (CSIR, 1948), Karuvelei (Tamil) (Bose *et al.*, 1998).

Common name: Black babool, Indian gum arabic tree, Babul acacia, Kikar (Chacko *et al.*, 2002; Bose *et al.*, 1998).

Synonyms: *Acacia arabica* auct. non (Lam.) Willd., *Mimosa nilotica* L. (Chacko *et al.*, 2002).

Family: Leguminosae

Subfamily: Mimosoideae

Origin: Indigenous to India.

Distribution: Black babool is indigenous in Sindh and northern Deccan including Berar and Khandeish; occurs in many parts of the plains, Maharashtra, Rajasthan and Gujarat. In Kerala, Palghat near Walayar dam and plains (Brandis, 1921; Bose *et al.*, 1998; Chacko *et al.*, 2002).

Description: A thorny, small to medium sized tree, almost evergreen with a short trunk, a spreading crown and feathery foliage, usually attaining a height of 15 m (Bose *et al.*, 1998).

Flowering season: June to September and also in cold months (Bose *et al.*, 1998).

Fruiting season: February to May (Sen Gupta, 1937; Chacko *et al.*, 2002). Ripens during April to June (Bose *et al.*, 1998).

Flowers: Flowers are minute, yellow, fragrant, crowded in long peduncled globose heads, about 1.3 cm in diameter at the end of slender stalk arising from axil of the leaves (Bose *et al.*, 1998).



Fruits



Seeds

Fruits: Whitish tomentose, solitary, moniliform, much contracted between seeds at both sutures with 1.2-1.8 cm long stalk (Brandis, 1921).

Fruit type: Pod.

Seeds: Compressed, ovoid, dark brown, shining with a hard testa. Seeds 8-12 in each pod (Bose *et al.*, 1998). Seedlings from large seeds have greater survival than those from smaller seeds under intense water stress (Ekta Khurana and Singh, 2004). Small seeds perform poorly in terms of germination as well as in seedling growth and dry weight (Khera *et al.*, 2004). Seeds with a light brown seed coat show good germination and seedling growth (Balkrishan and Singh, 1995).

Seed dimension:

Seed length: 7-9 mm (Chacko *et al.*, 2002).

Seed width: 6-8 mm (Chacko *et al.*, 2002).

Seed thickness: 2 - 5 mm

Seed weight: 5,329 to 11,600 seeds/kg (FRI, 1983; Chacko *et al.*, 2002).

Seed dispersal: Wind and animals.

Seed collection: For collecting seeds, trees of more than eight years should be chosen (Suresh *et al.*, 2001). The ripe pods blown off from the trees by winds may be collected from the ground. The pods may also be beaten off the trees with a stick to the ground previously swept clear (FRI, 1983; Chacko *et al.*, 2002).

Transportation of seeds: Pods are loosely packed in closely woven jute sacks. Adequate air circulation may be ensured within the seed stack during transportation. In dry weather regular rotation of sacks on the roof carrier of the transport vehicle often

promotes the drying process (Doran *et al.*, 1983; Chacko *et al.*, 2002).

Seed processing: Sun-dry the pods and extract seeds by beating them with thick sticks. Seeds can be separated from the husk and other impurities by winnowing (FRI, 1983; Chacko *et al.*, 2002).

Seed storage: Orthodox (Kindt *et al.*, 1997; Chacko *et al.*, 2002). Seeds can be stored in gunny bags, tins or baskets in a cool, dry place with good air circulation (FRI, 1983; Chacko *et al.*, 2002). For long-term storage, seeds should be kept in airtight containers, glass or plastic bottles with screw caps and tin containers with tight fitting lids. The containers should be as full as possible to reduce the amount of included air. The seeds may also be placed in sealed plastic bags within the containers. A desiccant, such as silica gel, placed in the container may reduce the moisture content in storage containers (Doran *et al.*, 1983; Chacko *et al.*, 2002).

Viability period: Seeds retain viability for 3 years without any fall in germination percentage, under proper storage (FRI, 1983). Seeds with an initial germination capacity of 75% when stored in gunny bags give a 50% germination after 2 years, 30% after 5 year and 20% after 10 years (Dent, 1948), suggesting retention of 67%, 40% and 27% of initial germination capacity at the end of 2, 5 and 10 years respectively (Chacko *et al.*, 2002). Seed viability is tested annually by using 0.1% triphenyl tetrazolium chloride. Viability decrease with an increase in the storage period. *Acacia nilotica* var. *cupressiformis* shows 100% viability up to two years of storage. The use

of storage media can help to increase the percentage of seed viability (Khomane and Bhosale, 2003).

Seed emptiness: Sometimes high, due to damage by bruchid beetles (NAS, 1980; Chacko *et al.*, 2002).

Seed pre treatment: Soaking in hot water (80°C) for about 30 mts followed by cold water soaking for 24 hrs, sulphuric acid sacification for 10 to 30 min (FRI, 1983; Chacko *et al.*, 2002), file-off fragment of testa and soak in cold water for 4 to 6 hrs (Edwards and Naithani, 1999) improve germination. Seeds are treated with hot water for 48 h and alternate wetting and drying for 5 cycles also improve the germination. These treatments also increase seedling growth and dry weight considerably. However, maximum increase in seedling growth and dry weight is observed when the seeds are treated with 500 ppm solution of CuSO₄ for 48 h. Soaking seeds in salt solutions and growth regulators (other than ethanol 100%) result in a lower germination but increased seedling growth and dry weight compared to the control (Neeraj Khera and Saxena, 2003). Acid scarification for 60 min followed by 12 hrs water soaking overcomes dormancy. This treatment produces vigorous seedlings (Venkatesh *et al.*, 2002b). Boiling water treatment causes 72.3% germination in *Acacia nilotica* (Avtar Singh *et al.*, 2007). Water treatment of seeds is an alternative for the sulfuric acid treatment (Warrag and Eltigani, 2005). Temperature shock treatments in which seeds are allowed to imbibe water at 37°C for 24-168 h and then left at 16-20°C for 14 h (room temperature

overnight) also improve germination (Nasim *et al.*, 1996).

Germination type: Epigeous (FRI, 1983; Chacko *et al.*, 2002).

Germination percentage: Up to 89 (FRI, 1983; Chacko *et al.*, 2002).

Germination period: 6 to 199 days (FRI, 1983; Chacko *et al.*, 2002). 30 days (Khullar *et al.*, 1991).

Nursery technique: Pre treated seeds are sown in plastic trays filled with vermiculite and watered regularly, the germinated seeds are potted into polythene bags of size 22.5 x 17.5 cm filled with potting mixture (gives a germination of 84% and also give maximum shoot and root length) (Singh *et al.*, 2000). Seedlings are also raised directly in containers. Size of the container has profound influence on the seedlings' morphometric parameters, viz., seedling length, shoot collar diameter and total dry weight throughout the growth period of the seedlings. 15 x 20 cm size polythene containers are proved to be good for the above growth characteristics of the seedlings (Venkatesh *et al.*, 2002a). Excess watering has to be avoided (Kumar and Bhanja, 1992; Chacko *et al.*, 2002). *A. nilotica* seedlings are not shade tolerant. However, light shade may be given at the early stage of seedling development to enhance survival percentage. During the germination stage *A. nilotica* seeds require full sunlight (Chaudhry *et al.*, 2004). Using suitable rhizobial strains it is possible to reduce the nursery age of the seedlings from six to four months without compromising seedling vigour or survival rate (Swaminathan and

Surendran, 2001). VAM fungi inoculation is effective in chlorophyll pigments accumulation and biofertilizer inoculation could improve plant growth, biomass and biochemical constituents of the seedlings and thereby help to produce elite seedlings and improve the survival rate of planted seedlings (Kaushik *et al.*, 2000). Soaking of acid scarified seeds in water for 90 h followed by 3 h of shade drying is the optimum treatment for seed hardening. Hardened seeds perform better than non-hardened seeds in all treatments, recording a higher germination and vigour under a low soil water holding capacity (WHC) of 30% (Umarani *et al.*, 1999).

Propagation:

Method of propagation:

Vegetative propagation: Epicormic branch cuttings treated with 1500 ppm IBA for 15 min are planted in the month of November (Gurumurti *et al.*, 1994; Devaranavadi *et al.*, 2002). Vegetative propagation of *A. nilotica* was attempted with some success by rooting of stem cuttings treated with IAA and IBA

Pests: Moderate. *Argyroploce illepidia* Butl. (Lepidoptera: Eucosmidae) and *Cryptophlebia* sp. (Lepidoptera: Tortricidae), which feed on developing pods as well as *Caryedon gonagra* Fb. (Coleoptera: Bruchidae) which attack the seeds are the potential seed pests in India (Chacko *et al.*, 2002).

Diseases: High (40 to 96%). Seeds harbour a rich microflora comprising 18 fungal genera, bacteria and actinomycetes. Most of them

are storage microbes. *Fusarium* sp., *Coniella* sp., *Beltrania* sp., *Phoma* sp. are the field fungi (Mohan and Geetha varma, 2001; Chacko *et al.*, 2002). The causal organisms identified are *Fusarium lateritium* f. sp. *acaciae* f. sp. nov. and perithecial stage belongs to *Gibberella*. The disease can be controlled by three sprays of mixture of carbendazim and copper oxychloride and mixture of carbendazim and dithane M-45 [mancozeb (Kamla Uniyal *et al.*, 2004).

Medicinal properties: Heartwood, gum and pod are medicinally important and contain several polyphenols like catechin, quercetin and tannin. Leaf and bark are used as tonic for curing eye troubles. Gum is used as tonic for treating cough, lung and throat ailment. The flowers are believed to cure insanity (Bose *et al.*, 1998). The plant parts most commonly used for treatment of various diseases are roots, leaves, bark, fruits and even whole plant (Singh, 2007).

Uses: Tannin extracted is used for dyeing and cloth printing. Bark is collected for tannin. Unripe pods yield an ink (Bose *et al.*, 1998). An acetone extract of *A. nilotica* against pupae of *Trogoderma granarium* cause dose-dependent mortality of pupae. At low doses, pupal development is retarded (Dwivedi and Mamta Bajaj, 2000). Fodder. The pods and leaves contain 8% digestible protein [12.4% crude protein], 7.2 MJ/kg energy, and are rich in minerals (Le Houerou, 1980). In part of its range smallstock mainly consume it, but elsewhere it is also very popular with cattle. Pods are used as a supplement to poultry rations in India. Dried pods are particularly sought out by animals on rangelands. In India branches

are commonly lopped for fodder. Pods are best fed dry as a supplement, not as a green fodder.

Agroforestry. Babul (ssp. *indica*) is a popular farm tree of the central plains of India. More recently interest has centred on the fastigate form (ssp. *cupressiformis*). These subspecies makes an ideal windbreak surrounding fields; its narrow crown shades less than other windbreak species.

Land Rehabilitation. In India this species is used extensively on degraded saline/alkaline soils, growing on soils up to pH 9, with a soluble salt content below 3%. It also grows well when irrigated with tannery effluent, and colonises waste heaps from coal mines. Over 50,000 hectares of the Indian Chambal ravines have been rehabilitated with *A. nilotica* by aerial seeding (it is one of the 3 most frequently used trees for this purpose).

Tannins. The bark of ssp. *indica* has high levels of tannin (12-20%) which are used for tanning leathers. Ten year old trees yield 35-40 kg of bark. The pods of ssp. *nilotica* have been used for tanning in Egypt for 6,000 years. Subspecies *astringens* is used for both

tanning and dye making. Deseeded pods from ssp. *indica* have 18-27% tannin levels, whereas ssp. *tomentosa* and *nilotica* reach up to 50%.

Other Uses: The tannin also contributes to its medicinal use as a powerful astringent. It is also a powerful molluscicide and algicide. Fruits added to ponds in Sudan kill snail species which carry schistosomiasis without affecting the fish.

There are many other reported uses (Fagg and Greaves, 1990). The tree makes effective live fencing, a good host plant for growing sandalwood, and an important source shellac in the Sind. The gum is used in paints and medicines and has been collected for a millennia. It has similar properties to gum arabic (from *A. senegal*) and is frequently used in calico printing in India.

Wood properties: The sapwood is generally wide, white or pale yellow. Heartwood is sharply demarcated from the sapwood, is pinkish brown turning reddish brown with age, sometimes with darker streaks. Weight is about 833 kg/m³ (CSIR, 1948).

References:

- Avtar Singh and Dhillon, G.P.S. 2007. Enhancing germination potential of three leguminous tree species through pre-sowing seed treatments Indian Journal of Forestry. 30(2): 145-146.
- BalKrishan and Singh, V. 1995. Effects of seed size and colour on germination and seedling growth in five tree species. Advances in Horticulture and Forestry. 4: 199-204.
- Brandis, D. 1921. Indian Trees. An account of Trees, shrubs, woody climbers, bamboos and palms indigenous or commonly cultivated in the British Indian Empire. Constable and Company Limited, London.

Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 22-27.

Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 38-39.

Chaudhry, A.K., Zahid Ali, Rashid, C.A., and Chughtai, N.M. 2004. Shade requirement of Acacia nilotica at nursery stage. Pakistan Journal of Agricultural Sciences. 41(3/4): 134-136.

CSIR. 1948. The Wealth of India, Vol. I. A Dictionary of Raw materials and industrial products, Publication and Information Directorate, New Delhi.

Dent, T.V. 1948. Seed storage with particular reference to the storage of seed of Indian forest plants. Indian Forest Records (New Series) Silviculture, 7: 134 pp. Manager of Publications, Delhi.

Devaranavadgi, S.B., Sajjan, A.S., Gaddanakeri, S.A., Wali, S.Y., Ravikumar and Jambagi, M.B. 2002. Studies on vegetative propagation techniques in Acacia nilotica. Myforest. 38: 339-341.

Doran, J.C., Turnbull, J.W., Boland, D.J. and Gunn, B.V. 1983. Hand Book on seeds of Dry-zone Acacias. FAO, Rome.

Dwivedi, S.C. and Mamta Bajaj. 2000. Efficacy of Acacia nilotica leaf extract as pupicidal against Trogoderma granarium (Everts). Journal of Experimental Zoology, India. 3(2): 153-155.

Edwards, D.G. and Naithani, S.C. 1999. Seed and Nursery Technology of forest trees. New Age, New Delhi.

Ekta Khurana and Singh, J.S. 2004. Germination and seedling growth of five tree species from tropical dry forest in relation to water stress: impact of seed size. Journal of Tropical Ecology. 20(4): 385-396.

Fagg, C.W. and A. Greaves. 1990. Acacia nilotica 1869-1988. CABI/OFI Annotated bibliography No. F42. CAB International, Wallingford, Oxon, UK 77 p.

FRI. 1983. Troup's The Silviculture of Indian Trees. Vol. IV. The Controller of publications, Delhi.

Gurumurti, K., Jayachandran, C.K. and Thirunavoukkrasu, M. 1994. Rooting trials in branch cuttings of Acacia nilotica (L.) Del. Indian Journal of Forestry. 17(2): 112-118.

Kamla Uniyal, Harsh, N.S.K., Uniyal, D.P. and Sanjay Verma. 2004. Canker and dieback of Acacia nilotica seedlings in nursery. Indian Forester. 130(1): 95-100.

- Karivaradaraju, T. V., Bharathi, A., Umarani, R. 1999. Effect of seed moisture and drying methods on seed quality of neem (*Azadirachta indica*, A. Juss.). In: *Azadirachta indica* A. Juss, Singly R.P. and R.C. Saxena, eds. Science Publishers p. 277-283.
- Kaushik, J.C., Parmod Dabas, and Rakesh Kumar. 2000. Impact of *Glomus mosseae* inoculation on root pathogens in *Acacia nilotica* and *Dalbergia sissoo* seedlings. *Indian Journal of Forestry*. 23(3): 238-240.
- Khera, N., Saxena, A.K. and Singh, R.P. 2004. Seed size variability and its influence on germination and seedling growth of five multipurpose tree species. *Seed Science and Technology*. 32(2): 319-330.
- Khomane, B.V. and Bhosale, L.J. 2003. Effect of storage medium on viability of seed in some fuelwood species. *International Journal of Forest Usufructs Management*. 4(1): 55-58.
- Khullar, P., Thapliyal, R.C., Beniwal, B.S., Vakshasya, R.K. and Ashok Sharma. 1991. *Forest Seed*. ICFRE, New Forest, Dehra Dun. pp. 374.
- Kindt, R., Mausya, S., Kimotho, J. and Waruhiu. 1997. *Tree seed suppliers Directory: Sources of Seeds and Microsymbionts*. International Centre for Research in Agro Forestry (ICRAF), Nairobi, Kenya.
- Kumar, S.V. and Bhanja, M. 1992. *Forestry Seed Manual of Andhra Pradesh*. Andhra Pradesh Forest Department, Hyderabad, India.
- Le Houerou, H.N. 1980. Chemical composition and nutritional value of browse in tropical West Africa. In H.N. Le Houerou (ed), *Browse in Africa, the Current State of Knowledge*. ILCA, Ethiopia. p. 261-289.
- Mohanani, C. and Geetha Varma. 2001. Microorganisms associated with seeds of *Dalbergia*, *Acacia* and *Albizia* species and their management for optimum seed germination and seedling health. *Journal of Tropical Forestry* (in press).
- National Academy of Sciences (NAS). 1980. *Firewood Crops: Shrub and Tree Species for Energy Production*. NAS, Washington DC. p.72-73.
- Nasim, F.H., Shahzadi, T.F. and Ashraf, M.1996. A cold shock during imbibition improves germination of *Acacia nilotica* seeds. *Pakistan Journal of Botany*.28(2): 183-189.
- Neeraj Khera and Singh, R.P. 2005. Germination of some multipurpose tree species in five provenances in response to variation in light, temperature, substrate and water stress. *Tropical Ecology*. 46(2): 203-217.
- Neeraj Khera and Saxena, A.K. 2003. Effect of pre-sowing treatments on seed germination and seedling growth of *Acacia nilotica* Willd. *Range Management and Agroforestry*. 24(2): 104-113.

Sen Gupta, J.N. 1937. Seed weights, plant percents, etc. for forest plants in India. Indian Forest Records (New Series) Silviculture, 2:221 pp. Manager of Publications, Delhi.

Singh, N.K. 2007. Ethno botanical studies on indigenous medicinal flora of Terai Belt of U.P. International Journal of Forest Usufructs Management. 8(1): 29-34.

Singh, R.R., Kaushik, J.C., and Jagir Singh. 2000. Effect of soil media on germination, shoot and root length and number of nodules of three nitrogen fixing tree species seedlings. Indian Journal of Forestry. 23(2): 157-159.

Suresh, K.K., Jambulingam, R., and Sekar, I. 2001. Effect of tree age on seed and seedling quality in Acacia nilotica. Indian Forester. 127(6): 685-689.

Swaminathan, C. and Surendran, C. 2001. Reducing nursery period in four tropical hardwoods by Rhizobium inoculation. Journal of Tropical Fores Science.13(1): 109-115.

Umarani, R., Bharathi, A., Vanangamudi, K., Karivaratharaju, T.V., and Rai, R.S.V. 1999. Seed hardening studies in Acacia nilotica (Linn.) Willd. ex Del. Indian Journal of Forestry. 22(4): 387-390.

Venkatesh, A., Vanangamudi, K., and Umarani, R. 2002a. Effect of container size on seedling growth of Acacia nilotica ssp. indica. Indian Forester. 128(7): 795-799.

Venkatesh, A., Vanangamudi, K. and Umarani, R. 2002b. Standardization of suitable pre-treatments to break dormancy of Acacia nilotica ssp. indica seeds. Seed Research. 30(2): 284-288.

Warrag, E.I. and Eltigani, M.A. 2005. Breaking seed coat dormancy of Acacia nilotica seeds under simulated natural habitat conditions in Sudan. Tropical Ecology. 46(1): 127-132.

Acacia planifrons

Nomenclature:

Scientific name: *Acacia planifrons* Wt. & Arn.

Vernacular name: Kudavelam (Malayalam) (Sasidharan, 2004), Kodaivelam, Odai (Tamil) (Bose *et al.*, 1998).

Common name: Umbrella thorn (Bose *et al.*, 1998).

Synonyms: *Acacia latronum*

Family: Leguminosae

Subfamily: Mimosoideae

Origin:

Distribution: Common and often gregarious in the S. Indian Peninsula; found in the South Deccan, Tamil Nadu, Kerala, etc.

Description: A small to moderate sized tree up to 8 m high, with a flat, spreading, dense umbrella like crown (CSIR, 1948; Bose *et al.*, 1998).

Flowering season: January to March (Bose *et al.*, 1998).

Fruiting season: July-August (Khullar *et al.*, 1991).

Flowers: Flower heads 6-8 mm across, yellow in bud stage, white when open, in clusters, in the axils of mature branchlets; flowers 2 mm across, calyx tube 5 lobed, 1 mm long; petals 5, cream coloured, 2 mm long, stamens numerous (Bose *et al.*, 1998).

Fruits: Narrow, ligulate (CSIR, 1948), glabrous, nearly cylindric, pointed at the ends and 5-6 cm long (Bose *et al.*, 1998).

Fruit type: Pods.

Seeds:

Seed dimension:

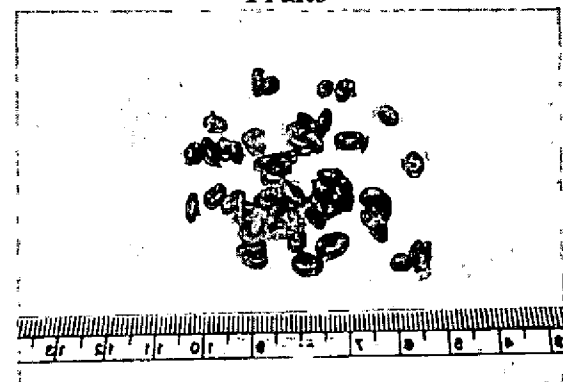
Seed length:

Seed width:

Seed thickness:



Fruits



Seeds

Seed weight: 25,000/Kg (Khullar *et al.*, 1991; Srivastava *et al.*, 2006).

Seed dispersal:

Seed collection: Seeds are collected in June-August (Srivastava *et al.*, 2006).

Transportation of seeds:**Seed processing:**

Seed storage: Seeds are orthodox and low temperature storage is recommended (Srivastava *et al.*, 2006).

Viability period: 1 year (Srivastava *et al.*, 2006).

Seed emptiness:

Seed pre treatment: Seeds are scarified by stirring with 160 ml of concentrated sulfuric acid per kg of seed for 25 min (Natarajan and Rai, 1986; Srivastava *et al.*, 2006).

Germination type: Epigeal.

Germination percentage: 40-50% (Srivastava *et al.*, 2006).

Germination period: 6-10 days (Khullar *et al.*, 1991).

Nursery technique: Combination of 6.75 kg N/100 000 seedlings along with *Rhizobium* and VAM inoculation has a pronounced effect on seedling growth, nodulation and enzyme activities (Backiyavathy *et al.*, 2005). Co-inoculation of AM fungi and *Rhizobium* sp. increase the growth, biomass and nutrient uptake of *A. planifrons* more than the single inoculations of AM fungi or *Rhizobium* sp. Seedlings inoculated with

AM fungi and *Rhizobium* sp. show higher accumulation of nitrogen (N), phosphorus (P) and potassium (K) than un-inoculated controls. The seedlings inoculated with triple root symbionts, *G. fasciculatum*+*G. geosporum*+ *Rhizobium* sp. show good growth and nodular biomass production. Lower root to shoot ratios and increased seedling quality index are also obtained in these combinations (Karthikeyan and Muthukumar, 2006). Polybag seedlings treated with different NPK fertilizer and micronutrient (B, Mo, Cu, Mn, Fe and Zn) doses reduce the planting stock production period (seedlings normally need to be kept for 4-6 months to attain a plantable height) (Chinnathurai *et al.*, 1997).

Propagation:

Method of propagation:

Vegetative propagation:

Pests:**Diseases:****Medicinal properties:**

Uses: The wood is hard and heavy. It is used for agricultural implements and other purposes. The pods contain tannin. They serve as fodder for cattle and goats. The tree has been recorded as a host for lac insect (CSIR, 1948).

Wood properties: Wood is hard, sapwood white and heartwood is red. Pores are small and larged (Gamble, 1922).

References:

- Backiyavathy, M.R., Arulmozhiselvan, K. and Rani Perumal. 2005. Effect of nitrogenous fertilizers, rhizobium and arbuscular mycorrhizal fungi on nodulation and biomass yield in Acacia nilotica (L.) Del and Acacia planifrons (L.) under degraded wasteland. *Advances in Plant Sciences*. 18(1): 91-97.
- Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 27.
- Chinnathurai, A.K., Vivekanandan, R. and Kumaravelu, G. 1997. Response to fertilizer and micro-nutrients in the nursery of some forest species.
- CSIR. 1948. The Wealth of India, Vol. I. A Dictionary of Raw materials and industrial products, Publication and Information Directorate, New Delhi.
- Gamble, J.S. 1922. A manual of Indian timbers. London Sampson Low, Marton and Company Ltd, Calcutta, India.
- Karthikeyan, A. and Muthukumar, T. 2006. Growth response of Acacia planifrons W. et A. to arbuscular mycorrhizal fungi and nitrogen fixing bacteria under nursery conditions. *Forests, Trees and Livelihoods*.16(3): 269-275.
- Khullar, P., Thapliyal, R.C., Beniwal, B.S., Vakshasya, R.K. and Ashok Sharma. 1991. Forest Seed. ICFRE, New Forest, Dehra Dun. pp. 374.
- Natarajan, N. and Rai, R.S.V. 1986. Studies on seed scarification in Acacia planifrons. *Van Vigyan*. 24(3-4): 80-82.
- Sasidharan, N. 2004. Forest Trees of Kerala. Kerala Forest Research Institute, Peechi, Kerala, India.
- Srivastava, R.K., Manisha Thapliyal, Ombir Singh and Nawa Bahar. 2006. Forest seeds, Information Booklet. Forest Research Institute, Dehra Dun.

Acrocarpus fraxinifolius

Nomenclature:

Scientific name: *Acrocarpus fraxinifolius*
Wt. & Arn.

Vernacular name: Kurungadi, Narivenga, Kurungan, Malakonna, Malaveppu (Malayalam) (CSIR, 1948; Chacko *et al.*, 2002); Malankomnao, Nelrai (Tamil) (Chacko *et al.*, 2002); Kurungadi, Malaikonnei (Tamil) (CSIR, 1948); Mandania (Hindi and Bengali) (Bose *et al.*, 1998).

Common name: Pink Cedar, Red cedar (Bose *et al.*, 1998), Mundani, Shingle tree, Indian ash (Chacko *et al.*, 2002).

Synonyms:

Family: Leguminosae

Subfamily: Faboideae

Origin:

Distribution: Distributed in Sikkim, W. Bengal, Assam, Western Ghats from South Kanara southward, Nilgiri, Palni. Anamalai hills in India; Bangladesh; Myanmar; Java (Bose *et al.*, 1998).

Description: A lofty deciduous tree, reaching a height of up to 30 m with a clear bole 18 to 45 m. Usually buttressed at the base (CSIR, 1948).

Flowering season: November to January in South India (CSIR, 1948; Bose *et al.*, 1998).

Fruiting season: April to June (CSIR, 1948; Khullar *et al.*, 1991; Bose *et al.*, 1998).

Flowers: Flowers dull red or orange on short pedicels in simple axillary dense racemes; calyx campanulate, teeth 5, equal; petals equal, slightly imbricate in bud; stamens 5 long exserted (Bose *et al.*, 1998).

Fruits: Fruit is a pod, long stalked, flat, thin, oblong in shape. 12 cm x 2 cm, contains 10 seeds (Chacko *et al.*, 2002).

Fruit type: Pod.

Seeds: Seeds brown, obovate, oblique and compressed (CSIR, 1948).

Seed dimension:

Seed length: 8 mm (Chacko *et al.*, 2002).

Seed width:

Seed thickness:

Seed weight: 1,100 fruits /kg. 28,000 to 46,000 seeds /kg (FRI, 1983; Chacko *et al.*, 2002). 32,000 seeds/kg (Khullar *et al.*, 1991).

Seed dispersal: Animals.

Seed collection: Seeds mature during April-June (FRI, 1983), January-May (Chacko, *et al.*, 2002). Collect mature brown pods before they open (Napier and Robbins, 1989; Chacko *et al.*, 2002).

Transportation of seeds: The pods are collected in gunny bags or cotton bags and transported by ensuring air-circulation within the seed stack (Chacko *et al.*, 2002).

Seed processing: Dry the pods in the sun for 2-3 days and beat with sticks, to enable

opening and dislodging of seeds (FRI, 1983; Chacko *et al.*, 2002).

Seed storage: Orthodox (Napier and Robbins, 1989); Intermediate (Kindt *et al.*, 1997; Chacko *et al.*, 2002). Seeds store well in gunny bags and air tight tins for 19 months. However, seeds stored for long are said to be liable to insect attack (FRI, 1983; Chacko *et al.*, 2002).

Viability period: Seeds, stored in gunny bags or sealed tin, retain 50% viability at the end of 2 years and 17% viability at the end of 3 years (Dent, 1948; Chacko *et al.*, 2002).

Seed emptiness: Low (Chacko *et al.*, 2002).

Seed pre treatment: Concentrated sulphuric acid scarification for 10 minutes followed by cold water soaking for 18 hrs (Rai, 1976; Chacko *et al.*, 2002).

Germination type: Epigeous (Chacko *et al.*, 2002).

Germination percentage: 75% (Khullar *et al.*, 1991). Up to 90 (FRI, 1983; Chacko *et al.*, 2002).

Germination period: 4-21 days (Khullar *et al.*, 1991). 3 to 14 days, for scarified seeds (Napier and Robbins, 1989; Chacko *et al.*, 2002).

Nursery technique: Sow pre treated seeds in plastic trays filled with moist vermiculite. Seedlings are planted in polythene bags of size 22.5 cm x 17.5 cm when they have 3-4 leaves and maintained under shade (FRI, 1983; Chacko *et al.*, 2002).

Propagation:

Method of propagation: By seeds.

Vegetative propagation:

Pests: Caterpillars of *Eurenia blandia* defoliate young plants (Ram Parkash *et al.*, 1998). *Xylosandrus compactus* is causing death of seedlings and young saplings. Spraying with 0.05% monocrotophos in October-November give effective control (Meshram *et al.*, 1993).

Diseases: Storage moulds like *Aspergillus* sp., *Penicillium* sp., and field fungi *Botryodiplodia theobromae* and *Phoma* sp. cause infestation (Mohan and Sharma, 1991; Mohan and Anil Chandran, 2001; Chacko *et al.*, 2002).

Medicinal properties:

Uses: One of the largest trees of India. Wood is used for making furniture, rafters and also used for different structural works for small and medium spans. Uses include wood for packing cases, beehives, fuelwood, and (probably) foliage for fodder (Ghildyal, 1989).

Wood properties: The sapwood is yellowish or greyish white and the heartwood is light pinkish or reddish brown. The wood is moderately hard and moderately heavy with usually straight grain and coarse texture. The wood is lustrous, without characteristic odour, fairly durable (CSIR, 1948). Medullary rays are fine, and moderately broad, rather scanty, wavy (Gamble, 1922). The wood gives satisfactory bends of radius 100-175 mm in 13 and 25 mm thick strips when plasticized with ammonia at 5 kg/cm² pressure (Pandey and Rao, 1995).

References:

- Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 31.
- Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 40-41.
- CSIR. 1948. The Wealth of India, Vol. I. A Dictionary of Raw materials and industrial products, Publication and Information Directorate, New Delhi.
- Dent, T.V. 1948. Seed storage with particular reference to the storage of seed of Indian forest plants. Indian Forest Records (New Series) Silviculture, 7: 134 pp. Manager of Publications, Delhi.
- FRI. 1983. Troup's The Silviculture of Indian Trees. Vol. IV. The Controller of Publications, Delhi.
- Ghildyal, B.N. 1989. Introduction of Acrocarpus fraxinifolius - a fast growing species for social forestry in Himachal Pradesh. Indian Forester. 115(7): 455-458.
- Gamble, J.S. 1922. A manual of Indian timbers. London Sampson Low, Marton and Company Ltd, Calcutta, India.
- Khullar, P., Thapliyal, R.C., Beniwal, B.S., Vakshasya, R.K. and Ashok Sharma. 1991. Forest Seed. ICFRE, New Forest, Dehra Dun.
- Kindt, R., Muasya, S., Kimotho, J. and Waruhiu. 1997. Tree Seed Suppliers Directory: Sources of Seeds and Microsymbionts. International Centre for Research in Agroforestry (ICRAF), Nairobi, Kenya.
- Meshram, P.B., Husen, M. and Joshi, K.C. 1993. A new report of ambrosia beetle, Xylosandrus compactus Eichhoff. (Coleoptera: Scolytidae) as a pest of African mahogany, Khaya sp. Indian Forester. 119(1): 75-77.
- Mohanan, C. and Anil Chandran. 2001. Microorganisms associated with seeds of tropical forest species and their management for improving the storability and seedling production. Seed Science and Technology (in press).
- Mohanan, C. and Sharma, J.K. 1991. Seed pathology of forest tree species in India- Present status, practical problems and future prospects. Commonwealth Forestry Review, 70: 113-151.
- Napier, I. and Robbins, M. 1989. Forest Seed and Nursery Practice in Nepal. Sahayogi Press, Kathmandu.

Pandey, C.N. and Rao, P.V.K. 1995. Wood softening and bending with ammonia. Wood-News. 5(1): 29-31.

Rai, S.N. 1976. Pre-treatment of Acrocarpus fraxinifolius seeds. Indian Forester. 102: 488-491.

Ram Parkash, M.A., Chaudhri, D.C. and Negi, S.S. 1998. Plantation and nursery technique of forest trees. International Book Distributors. Dehra Dun, India.

Acronychia pedunculata

Nomenclature:

Scientific name: *Acronychia pedunculata* (Linn.) Miq.

Vernacular name: Mutta-nari, Vidukanali, Verukutheeni (Malayalam) (Sasidharan, 2004); Mutta-nari (Tamil) (Bose *et al.*, 1998).

Common name: Laka Wood, Claw-flowered laurel (Bose *et al.*, 1998).

Synonyms: *Jambolifera pedunculata* L., *Acronychia laurifolia* Bl., *Acronychia barberi* Gamble (Sasidharan, 2004).

Family: Rutaceae

Subfamily:

Origin:

Distribution: In the Himalayas from the Indus eastward to Sikkim, Meghalaya, Assam, also in Western Ghats, Bangladesh, Sri Lanka (Bose *et al.*, 1998).

Description: A small to medium sized, evergreen tree, 8 to 12 m high, very variable (Bose *et al.*, 1998). Young shoots and inflorescence somewhat silky or puberulous (CSIR, 1948).

Flowering season: June to December (Bose *et al.*, 1998).

Fruiting season: Throughout the year.

Flowers: Flowers are fragrant, greenish yellow, 8 to 16 mm in diameter, in axillary, long peduncled, corymbose cymes, sepals very small; petals linear-oblong from a

broad base, villous on inner surface; stamens 5, alternating with petals (Bose *et al.*, 1998).

Fruits: Fruit ellipsoid, 12 to 18 mm long, black or red, fleshy (Bose *et al.*, 1998). Drupes are variable in size, 3-5 celled, glabrate, black (CSIR, 1948).

Fruit type: Drupe.

Seeds: 1 to 3 cartilaginous seeded kernels (CSIR, 1948).

Seed dimension:

Seed length:

Seed width:

Seed thickness:

Seed weight:

Seed dispersal:

Seed Collection:

Transportation of seeds:

Seed processing:

Seed storage:

Viability period:

Seed emptiness:

Seed pre treatment:

Germination type:

Germination percentage:

Germination period:

Nursery technique:

Propagation:

Method of propagation:

Vegetative propagation:

Pests:

Diseases:

Medicinal properties: The bark and root is used in external application for sores and ulcers. Bark is also used as tonic and is prescribed in scabies (CSIR, 1948; Bose *et al.*, 1998). The leaves and bark are used in medicine (Gamble, 1922).

Uses: The fruit is juicy and edible. The tender leaves are used as salad and condiment (Bose *et al.*, 1998).

Wood properties: Wood white or greyish-white, soft to moderately hard, smooth. Pores moderate-sized, sometimes subdivided, scanty, irregularly distributed in more or less concentrically arranged groups. Medullary rays fine, irregularly spaced, not numerous (Gamble, 1922).

References:

Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 32.

CSIR. 1948. The Wealth of India, Vol. I. A Dictionary of Raw materials and industrial products, Publication and Information Directorate, New Delhi.

Gamble, J.S. 1922. A manual of Indian timbers. London Sampson Low, Marton and Company Ltd, Calcutta, India.

<http://www.efloras.org>

Sasidharan, N. 2004. Forest Trees of Kerala. Kerala Forest Research Institute, Peechi, Kerala, India.

Actinodaphne malabarica

Nomenclature:

Scientific name: *Actinodaphne malabarica* Balak.

Vernacular name: Kambilivirinji, Neyaram (Malayalam) (Sasidharan, 2004).

Common name:

Synonyms: *A. hookeri* sensu Bedd., *Actinodaphne hirsuta* Hook. f. (Sasidharan, 2004).

Family: Lauraceae

Subfamily:

Origin:

Distribution: Endemic to Western Ghats. Rare in Kakki hills.

Description: A small to medium sized tree, 15 to 12 m high, branches symmetrical (Anil Kumar *et al.*, 2005).

Flowering season: September to December (Anil Kumar *et al.*, 2005).

Fruiting season: September to December (Anil Kumar *et al.*, 2005).

Flowers: Flowers in umbels, fulvous, silky pubescent; perianth lobes oblong (Bose *et al.*, 1998). Male and female flowers long-pedicelled, densely rusty, tomentose (Anil Kumar *et al.*, 2005).

Fruits: Globose, seated on cup shaped entire perianth tube (Anil Kumar *et al.*, 2005).

Fruit type: Berry (Anil Kumar *et al.*, 2005).

Seeds:

Seed dimension:

Seed length:

Seed width:

Seed thickness:

Seed weight:

Seed dispersal:

Seed Collection:

Transportation of seeds:

Seed processing:

Seed storage:

Viability period:

Seed emptiness:

Seed pre treatment:

Germination type:

Germination percentage:

Germination period:

Nursery technique:

Propagation:

Method of propagation:

Vegetative propagation:

Pests:

Diseases:

Medicinal properties: The cold infusion of the leaves is used in urinary disorders and in diabetes.

Wood properties: Air dry weight of wood is 720 kg/m³.

Uses: The wood is used for making small articles and as fuel.

References:

Anil Kumar, N., Sivadasan, M. and Ravi, N. 2005. Flora of Pathanamthitta (Western Ghats, Kerala, India). Daya publishing house, New Delhi.

Sasidharan, N. 2004. Forest Trees of Kerala. Kerala Forest Research Institute, Peechi, Kerala, India.

Adenanthera pavonina

Nomenclature:

Scientific name: *Adenanthera pavonina*
Linn.

Vernacular name: Rakta chandana (Hindi), Anikundumani (Tamil), Manchadi (Malayalam) (Chacko *et al.*, 2002).

Common name: Red wood, Peacock wood, Red bead tree (Chacko *et al.*, 2002). Bead tree, Coral wood (Bose *et al.*, 1998).

Synonyms: *Adenanthera microsperma*

Family: Leguminosae

Subfamily: Mimosoideae

Origin: Native of Western ghats, Sub-Himalayan tract and Andamans.

Distribution: Native of Western ghats, Sub-Himalayan tract and Andamans. Also Found in China, Malaya Peninsula and Archipelago.

Description: Fast-growing, moderate sized handsome deciduous tree about 20 m in height. It has a clear bole of 6 m (CSIR, 1948; Prasad and Reshmi, 2003).

Flowering season: March to April (major), Early rain and September (Minor).

Fruiting season: March to July (Chacko *et al.*, 2002).

Flowers: Flowers are pale yellow, in short peduncled racemes or panicles and scented at the end of branches (CSIR, 1948).

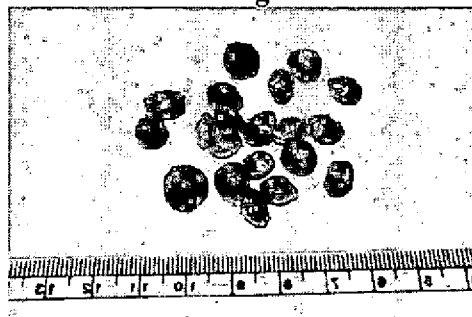
Fruits: Strap shaped pod of 15 to 25 cm length, the valves spirally twisted after dehiscence (CSIR, 1948).



Habit



Dehiscing Fruit



Seeds

Fruit type: Pod.

Seeds: Seeds are hard, bright red, scarlet shining seeds, lenticular-globose.

Seed dimension:

Seed length: 8-9 mm (Chacko *et al.*, 2002).

Seed width:

Seed thickness: 6-7 mm (Chacko *et al.*, 2002).

Seed weight: 1,200 to 3,360 seeds/kg (FRI, 1983; Chacko *et al.*, 2002).

Seed dispersal: Birds, snakes (Engel, 1997).

Seed collection: Pods should be collected from the tree before their dehiscence by lopping off the branches or from the ground soon after fall (Chacko *et al.*, 2002).

Transportation of seeds: Pods / seeds are collected in cotton / plastic / polythene bags and transported (Chacko *et al.*, 2002).

Seed processing: Pods are sun-dried until seeds are released (Chacko *et al.*, 2002).

Seed storage: Orthodox. Seeds can be stored in sealed tin, polythene bags and plastic containers for more than one year (Chacko *et al.*, 2002).

Viability period: Seeds retain viability for more than one year in sealed tins (Chacko *et al.*, 2002).

Seed emptiness: No information (Chacko *et al.*, 2002).

Seed pre treatment: Hot water treatment (FRI, 1983; Chacko *et al.*, 2002) or sulphuric acid scarification for 45 to 60 min

(Kindt *et al.*, 1997) or boiled water treatment for 1 min followed by 24 hrs cold water soaking (Koirala *et al.*, 2000), mechanical scarification treatments with sandpaper + 24 h soaking in water, immersion in water at 90, 80, 70 and 60°C for one min are efficient for breaking seed dormancy (Bruno *et al.*, 2004). GA3 (100-500 ppm) treatments give significantly high, early and less time for 50% germination in *Adenanthera pavonina* seeds (Vasundhara *et al.*, 2006). Seeds also germinate after passing through the gut-passage of a Rock Python (*Python sebae*) (Engel, 1997).

Germination type: Epigeal (Chacko *et al.*, 2002).

Germination percentage: 64 (Koirala *et al.*, 2000), 72 (FRI, 1983; Chacko *et al.*, 2002). Seeds of *Adenanthera pavonina*, a pioneer tree species show better germination in three concentrations of mannitol solution (0, 0.3, 0.5 MPa) and placed in lighted and dark conditions. Seed germination decrease with increase in Mannitol concentration. Increased moisture stress reduces germination. Germination is higher in seeds exposed to light than those kept in the dark (Hashim Md Noor and Wathern, 2003). A significant reduction in the germinability and rate are observed with increased PEG concentrations (Fonseca and Perez, 2003). Germination percentage and rate decrease with increasing salinity (Fonseca and Perez, 2001). The thermal stress reduce the germination rate and percentage. The scarified and imbibed seeds are more sensitive to the thermal stress (Fanti and Perez, 1998).

Germination period: 6 to 45 days (Koirala *et al.*, 2000; Chacko *et al.*, 2002).

Nursery technique: Pre treated seeds are sown in plastic trays filled with vermiculite and watered regularly. The seedlings are pricked out into polythene bags of size 22.5 cm x 17.5 cm filled with potting mixture and kept under shade for about a week for establishment (FRI, 1983; Chacko *et al.*, 2002). 150 days after emerging use of cerrado soil with additions of NPK under high light intensity has good effect on the growth (Fanti and Perez, 2003).

Propagation:

Method of propagation: By seeds, cuttings.

Vegetative propagation:

Pests: Nil (Chacko *et al.*, 2002).

Diseases: Moderate (48 to 52 %). 21 fungi and a bacterium are recorded. *Fusarium solani*, *Candelavrella* sp., *Verticillium* sp., are the important ones (Mohanand Anil Chandran, 2001; Chacko *et al.*, 2002).

Medicinal properties: Seeds are used for the treatment of cholera and general paralysis. A decoction of the seeds and wood is used in pulmonary affection and

externally applied in chronic ophthalmia (CSIR, 1948). A decoction of the leaves or bark is used as a remedy for chronic rheumatism and gout. The raw seeds and leaves have medicinal uses (FRI, 1983; Chacko *et al.*, 2002).

Uses: Good timber for construction of home and furniture. Seeds are used as measure of weight by jewellers and goldsmith and also as beads. Wood gives a red dye. Seeds contain 11-29 mg/g free amino acid (Kadam, 2001), appreciable amounts of proteins (29.44 g/100 g), crude fat (17.99 g/100 g), and minerals, comparable to commonly consumed staples. Total sugar is low (8.2 g/100 g) while starch (41.95 g/100 g) constitutes major carbohydrate. *A. pavonina* seeds represent a potential source of oil and protein that could alleviate shortages (Ezeagu *et al.*, 2004). Seeds also contain three classes of papain (cysteine proteinase) inhibitors (Silva *et al.*, 1995).

Wood properties: The sapwood is yellowish grey. Heartwood is sharply demarcated from the sapwood. It is pinkish brown with darker streaks. The wood is hard and heavy with interlocked grain and medium coarse texture. Pores are small, scanty, in groups or short radial lines. Medullary rays very fine, extremely numerous (Gamble, 1922).

References:

- Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 33.
- Bruno, R.de.L.A., Alves, A.U., Porto, M.L. and Alves, E.U. 2004. Pre-germinative treatments to breaking dormancy of Adenanthera pavonina L. seeds. *Revista Cientifica Rural*. 9(1): 95-104.
- Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 42-43.
- CSIR. 1948. The Wealth of India, Vol. I. A Dictionary of Raw materials and industrial products, Publication and Information Directorate, New Delhi.
- Engel, T.R. 1997. Seed dispersal and plant regeneration by snakes. *Ecotropica*. 3(1): 33-41.
- Ezeagu, I.E., Krishna, G.G., Khatoon, S., Gowda, L.R. 2004. Physico-chemical characterization of seed oil and nutrient assessment of Adenanthera pavonina, L: an underutilized tropical legume. *Ecology of Food and Nutrition*. 43(4): 295-305.
- Fanti, S.C. and Perez, S.C.J.G.de.A. 1998. Effects of water, salt and thermal stress on germination of Adenanthera pavonina L. seeds. *Revista Brasileira de Sementes*.; 20(1): 167-177.
- Fanti, S.C. and Perez, S.C.J.G.de.A. 2003. Effects of artificial shading and chemical fertilization on Adenanthera pavonina L. growth. *Ciencia Florestal*.13(1): 49-56.
- Fonseca, S.C.L., and Perez, S.C.J.G.de.A. 2001. Germination of Adenanthera pavonina L. seeds: polyamines effects on salt stress attenuation: *Revista Brasileira de Sementes*. 23(2): 14-20.
- Fonseca, S.C.L., and Perez, S.C.J.G.de.A. 2003. Germination of Adenanthera pavonina L. seeds: PEG and polyamines effects under different temperatures: *Revista Brasileira de Sementes*. 25(1): 1-6.
- FRI. 1983. Troup's The Silviculture of Indian Trees. Vol. IV. The Controller of Publications, Delhi.
- Gamble, J.S. 1922. A manual of Indian timbers. London Sampson Low, Marton and Company Ltd, Calcutta, India.
- HashimMd Noor and Wathern, P. 2003. Germination characteristics of selected tropical pioneer tree species. Part 1: Effects of light and simulated moisture stress. *Malaysian Forester*. 66(3/4): 228-234.

Kadam, V.B. 2001. Protein and amino acid in seeds of some medicinally important tree species : Plant Archives. 1(1/2): 57-59.

Kindt, R., Mausya, S., Kimotho, J. and Waruhiu. 1997. Tree seed suppliers Directory: Sources of Seeds and Microsymbionts. International Centre for Research in Agro Forestry (ICRAF), Nairobi, Kenya.

Koirala, B., Hossain, M.K. and Hossain, M.S. 2000. Effect of presowing treatments on Adenantha pavonina L. seeds and initial seedling development in the nursery. The Malaysian Forester, 63: 82-91.

Mohanan, C. and Anil Chandran. 2001. Microorganisms associated with seeds of tropical forest species and their management for improving the storability and seedling production. Seed Science and Technology (in press).

Prasad, G., and Reshmi, M.V. 2003. A Manual of Medicinal Trees. Agrobios. pp. 65.

Silva, K.F.F., Lima, C.S., Val, R.R.do., and Xavier Filho, J. 1995. Cysteine proteinase inhibitors from seeds of Adenantha pavonina L. Revista Brasileira de Botanica. 18(2): 137-141.

Vasundhara, M., Gayithri, H.N., Nuthan, D., and Bhoomika, H.R. 2006. Standardizing propagation techniques for commercially important natural dye yielding plants: Biomed. 1(2): 130-134.

Aegle marmelos

Nomenclature:

Scientific name: *Aegle marmelos* (L.)
Correa

Vernacular name: Koovalam, Vilvam (Malayalam); Vilvam, Mavilangai bilva (Tamil) Bela (Hindi) (Chacko *et al.*, 2002).

Common name: Bael tree, Bengal tree, wood apple, Golden apple (Chacko *et al.*, 2002).

Synonyms: *Crataeva marmelos* L. (Chacko *et al.*, 2002). *Crataeva religiosa* Ainslie, *Feronia pellucida* Roth

Family: Rutaceae

Subfamily:

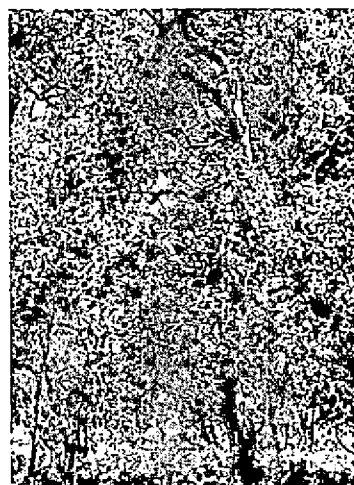
Origin: Indian subcontinent.

Distribution: Bael tree is indigenous to Indian subcontinent and mostly found in the tropical and subtropical regions. The tree is also found in Pakistan, Bangladesh, Sri Lanka, Myanmar, Thailand and Vietnam.

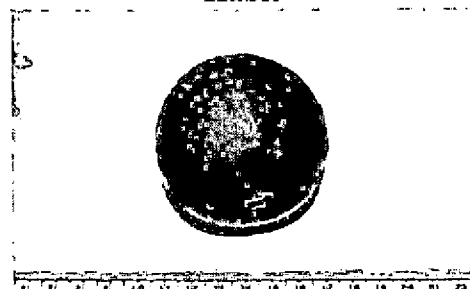
Description: A small to moderate sized slender, aromatic, deciduous tree 6.0-7.5 m in height and 90-120 cm in girth, with somewhat fluted bole of 3.0-4.5 m. Branches armed with straight, sharp, axillary, 2.5 cm long spines (CSIR, 1948).

Flowering season: Summer season from May to July.

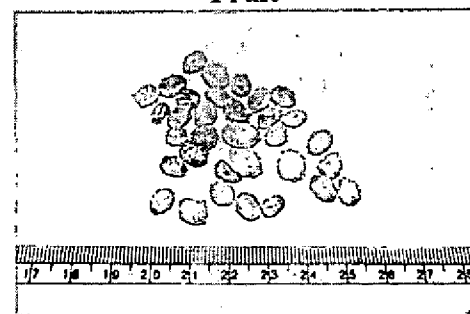
Fruiting season: Fruits attain full size in December; ripens during April to June; March to May and also in October to November (Sen Gupta, 1937; Khullar *et al.*, 1991; Chacko *et al.*, 2002).



Habit



Fruit



Seeds

Flowers: Flowers are fragrant, greenish white, contains honey, sweet scented in short axillary panicles (CSIR, 1948).

Fruits: Fruit 5 to 15 cm in diameter, globose, smooth, green, grey or yellowish; rind hard, woody, pulp is sweet and aromatic.

Fruit type: Berry.

Seeds: Numerous, oblong, compressed with a woody mucus testa embedded in a clean mucilage and mass of yellow or orange coloured sweet aromatic meaty pulp.

Seed dimension:

Seed length: 0.75 cm (Chacko *et al.*, 2002).

Seed width: 0.60 cm (Chacko *et al.*, 2002).

Seed thickness: 0.42 cm (Chacko *et al.*, 2002).

Seed weight: 5,300 seeds/kg; 4,800 to 7,200 seeds/kg (Khullar *et al.*, 1991; Kindt *et al.*, 1997; Chacko *et al.*, 2002).

Seed dispersal: Ants and bees.

Seed collection: The seeds are obtained from the ripe fruits collected from trees (Chacko *et al.*, 2002).

Transportation of seeds: The fruits collected in gunny/ plastic bags are transported. No special care is needed (Chacko *et al.*, 2002).

Seed processing: Break open the fruits and the seeds are washed to remove the

mucilage and dried for a few days in the sun (Chacko *et al.*, 2002).

Seed storage: Recalcitrant (CABI, 1998). The seeds cannot stand storage for long. Therefore, they should be sown as soon after collection, as possible (Chacko *et al.*, 2002).

Viability period: Seed is viable for short period under ambient room temperatures (Chacko *et al.*, 2002).

Seed emptiness: Low (Chacko *et al.*, 2002).

Seed pre treatment: Wash the seed to remove the mucilage and then dry for a few days in the sun; they may be coated with red lead, if necessary, to keep off ants.

Germination type: Hypogeous (Chacko *et al.*, 2002).

Germination percentage: 56 to 90 (Khullar *et al.*, 1991; Chacko *et al.*, 2002).

Germination period: 21 days (Khullar *et al.*, 1991). 10 to 25 days (Chacko *et al.*, 2002).

Nursery technique: Fresh seeds are sown in plastic trays filled with vermiculite. Watering should be done regularly twice a day. The seedlings are pricked out into polythene bags of 20 x 10 cm size filled with potting mixture. The seedlings will be ready for planting in the next season as the growth of seedlings is slow (Chacko *et al.*, 2002).

Propagation:

Method of propagation: Generally by seed, root cutting and air-layering.

Vegetative propagation: It can be propagated vegetatively through ring grafting. This technique is an improvement over bud grafting where instead of a bud patch being removed and inserted, a bud with a ring of bark is freshly cut and removed without damaging the cambium. For this, root stock should be selected from 12 to 18 months old seedlings having 60 to 75 cm height and 0.75 cm thickness. Auxillary bud is selected from the plus tree clone after the leaf fall and when the bud initiation has started usually during the month of February and March. This can also be induced manually by removing the leaves after which bud initiation takes place. The scion branch is removed when the bud initiation has started. A circular cut is made 0.5 cm above and 0.5 cm below the bud and a cross-cut is made behind the bud. A ring of bark along the bud is slowly removed without damaging it. On the root stock a similar ring is made and the ring with the bud of scion is placed there. Polythene strip is tied around the ring leaving the bud exposed. In about 30 to 45 days after grafting the bud develops into a shoot indicating a fusion with the root stock. Care should be taken while watering to prevent water falling on the bud as it may cause rotting. Fifteen days after grafting, the top portion of the stock (leaving 3 cm above the grafted portion) is cut off to facilitate early union (Rai, 1999; Chacko *et al.*, 2002).

Pests: Nil (Chacko *et al.*, 2002).

Diseases: Low (Chacko *et al.*, 2002).

Medicinal properties: Unripe fruits are astringent, digestive in ayurvedic system. The fruits are good remedy for diarrhoea and dysentery. The fruit is nutritive and contains fair amount of Vitamin A, B, C, minerals and high amount of carbohydrates. The root is one of the ingredients of the Dasamool of Ayurveda. The fruit, the root, bark, leaf and seed of bael are valued in the indigenous system of medicine. The fruit is used in chronic diarrhoea and dysentery, and is said to act as a tonic for heart and brain. The root as well as the bark is used in the form of a decoction as a remedy for melancholia, intermittent fevers and palpitation of the heart. In pharmacological trials, as in the case of fruits, the roots have exhibited anti-Amoebic and Hypoglycaemic properties (CSIR, 1948).

Uses: A yellow edible dye is obtained from the unripe fruit. The seed oil possesses antibacterial properties. It is extensively planted near Hindu temples for its leaves and wood which are used for worship. The young leaves and shoots are used as a fodder. The timber is commonly used for making pestles of oil and sugar mills, for posts, shafts, axles and naves of carts, tool handles, helms, and agricultural implements. It is also used for making pulp for manufacture of wrapping paper. It is prized for sacrificial and religious fires (CSIR, 1948). The seed oil content of *A. marmelos* is much higher (40.25) than that of the other species (1.0-7.1%) (Ahmad, 1998).

Wood properties: The wood is light yellow, strongly aromatic when first exposed, later

fading to yellowish grey or greyish white. It is a very hard and very heavy wood with usually straight grain and fine texture and without any distinct heartwood. The wood is lustrous with a smooth feel, without characteristic taste, heavy, hard, straight-grained or occasionally curly-grained in the radial plain, even and fine-textured (CSIR,

1948). Pores are small, ringed, in small groups of 2 or 3 together, sometimes, but not always, more numerous in the autumn wood. Medullary rays wavy, fine, short, white, numerous, uniform and equidistant. Annual rings marked by distinct lines, and often by a continuous belt of pores (Gamble, 1922).

References:

Ahmed et al., 1998.

Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 44-45.

CABI. 1998. The Forestry Compendium – A Silvicultural Reference. Module 1. CABI Publishing, CAB International, Wallingford, Oxon, OX108DE, UK.

CSIR. 1948. The Wealth of India, Vol. I. A Dictionary of Raw materials and industrial products, Publication and Information Directorate, New Delhi.

Gamble, J.S. 1922. A manual of Indian timbers. London Sampson Low, Marton and Company Ltd, Calcutta, India.

Khullar, P., Thapliyal, R.C., Beniwal, B.S., Vakshasya, R.K. and Ashok Sharma. 1991. Forest Seed. ICFRE, New Forest, Dehra Dun.

Kindt, R., Mausya, S., Kimotho, J. and Waruhiu. 1997. Tree seed suppliers Directory: Sources of Seeds and Microsymbionts. International Centre for Research in Agro Forestry (ICRAF), Nairobi, Kenya.

Rai, S.N. 1999. Nursery and Planting Techniques of Forest Trees in Tropical South-Asia. Eastern Press, Bangalore, India.

Sen Gupta, J.N. 1937. Seed weights, plant percents, etc. for forest plants in India. Indian Forest Records (New Series) Silviculture, 2:221 pp. Manager of Publications, Delhi.

Ailanthus excelsa

Nomenclature:

Scientific name: *Ailanthus excelsa* Roxb.

Vernacular name: Peenari, Matti, Pongilyam (Chacko *et al.*, 2002); Peemaram, Peruppi (Malayalam) (Sasidharan, 2004); Pimaram, Pinari, Perumaram (Tamil); Peetheri, Doddamara (Kannada); Maharukh, Arua, Limbado (Hindi) (Chacko *et al.*, 2002).

Common name: Ardusi, Mahanim (India), Tree of Heaven (Chacko *et al.*, 2002).

Synonyms: *Pongelion wightii* Tieghem (Chacko *et al.*, 2002).

Family: Simaroubaceae

Subfamily:

Origin:

Distribution: It occurs widely in some forests of Deccan, Bihar, Jharkhand, Western Ghats from N. Kanara, Karnataka to Travancore in road sides and garden.

Description: A lofty deciduous tree, large, fast growing, attaining a height of 18 to 24 m. Trunk straight, 60-80 cm in diameter.

Flowering season: February to March.

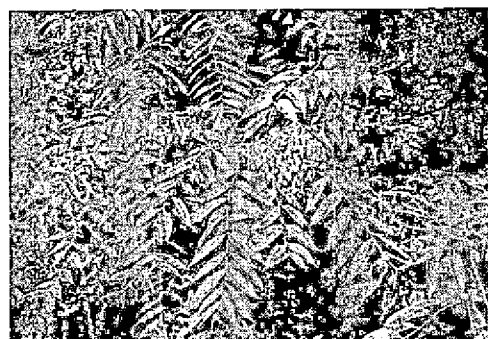
Fruiting season: April to May, May to July (FRI, 1981; Chacko *et al.*, 2002).

Flowers: The panicles of small yellowish or creamy flowers about 10 mm across.

Fruits: Fruit is a samara, copper red winged with prominent veins (Chacko *et al.*, 2002).

Fruit type: Samara.

Seeds: Samara, strongly veined, coppery red, twisted at the base and very short lived.



Branch with fruits



Fruits

Seed dimension:

Seed length: 7.2 cm (Chacko *et al.*, 2002).

Seed width: 0.185 cm (Chacko *et al.*, 2002).

Seed thickness:

Seed weight: 4,200 to 18,000 seeds/kg (Carlowitz, 1991; Kindt *et al.*, 1997; Chacko *et al.*, 2002).

Seed dispersal: Wind dispersal.

Seed collection: Mature pods are usually blown away by wind. Therefore the seeds

should be collected, when they are pale yellow in colour, from the tree, by lopping the fruiting twig (Chacko *et al.*, 2002).

Transportation of seeds: The fruits collected in cotton or plastic bags may be transported as quickly as possible (Chacko *et al.*, 2002).

Seed processing: Since the winged seeds are light in weight, they are easily blown away by wind. The seeds are, therefore, dried on a clean surface with a covering of net/cloth to prevent them, from being blown away. Wings are removed by beating and the seeds cleaned by winnowing (Chacko *et al.*, 2002).

Seed storage: Orthodox (Rawat *et al.*, 2001). The seeds are stored in sealed airtight tins. Seeds stored at 5% moisture content and at 5°C retain about 70% viability after 3 years (Rawat *et al.*, 2001; Chacko *et al.*, 2002).

Viability period: Well dried seeds are viable for about one year in sealed containers under ambient temperatures (Rawat *et al.*, 2001; Chacko *et al.*, 2002).

Seed emptiness: Moderate (Chacko *et al.*, 2002).

Seed pre treatment: Soaking in 2.5% potassium nitrate increase germination parameters and vigour index (Ramakrishnan *et al.*, 1990). Seeds are sown in primary beds and covered with fine soil. Seedlings are liable for damping off. Hence, care should be taken during watering.

Germination type: Epigeal (Chacko *et al.*, 2002).

Germination percentage: 70 (Rawat *et al.*, 2001) to 90 (Chacko *et al.*, 2002).

Germination period: 15 to 25 days (Chacko *et al.*, 2002).

Nursery technique: Fresh seeds are sown in plastic trays filled with vermiculite and watered. The seedlings are pricked out into polybags of 22.5 x 17.5 cm size filled with potting mixture. The seedlings will be ready for planting within three months, as the growth is very fast (Chacko *et al.*, 2002).

Propagation:

Method of propagation: Natural reproduction occurs through seed and coppice.

Vegetative propagation:

Pests: Low (Chacko *et al.*, 2002).

Diseases: Low (18 to 22%). Ten fungi and bacterium are recorded. *Botryodiplodia theobromae* and *Myrothecium* sp. are the important fungi recorded (Mohanan and Anil Chandran, 2001; Chacko *et al.*, 2002).

Medicinal properties: The leaves, bark and gum are of medicinal value. Leaves are specially used in asthma, bronchitis, dyspepsia, in the treatment of weakness after child birth. The methanol extract of stem barks of *Ailanthus excelsa* partitioned with chloroform extract shows fungistatic and fungicidal activity (Joshi *et al.*, 2003). Extracts of the root bark shows antitumour and cytotoxic activities (Ogura *et al.*, 1977). *Ailanthus excelsa* bark is used for constipation.

Uses: The wood is used for manufacturing news print, in the match box industry and in the manufacture of packing cases. It is cultivated as an avenue tree for its deep shade and can be used for anti-erosion purposes. The wood is used in boxes, crates, poles, fishing floats, tool handles, matches and drums. The bark yields a gum of inferior quality.

Wood properties: It is soft, light, perishable, coloured yellowish white which

turns greyish-white with age. The bark is rough and light grey. Air dry weight about 433 kg/m³. Wood white, soft. Pores large, scanty, subdivided, ringed. Medullary rays broad, numerous, close, the distance between them less than the transverse diameter of the pores (Gamble, 1922)

References:

- Carlowitz, P.G.V. 1991. Multipurpose Trees and Shrubs: Source of seeds and Inoculants. International council for research in Agroforestry, Nairobi, Kenya.
- Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 46-47.
- FRI. 1981. Troup's The Silviculture of Indian Trees. Vol. III. The Controller of Publications, Delhi
- Gamble, J.S. 1922. A manual of Indian timbers. London Sampson Low, Marton and Company Ltd, Calcutta, India.
- Joshi, B.C., Anuj Pandey, Leena Chaurasia, Mahesh Pal, Sharma, R.P. and Anakshi Khare. 2003. Antifungal activity of the stem bark of Ailanthus excelsa Fitoterapia. 74(7/8): 689-691.
- Kindt, R., Mausya, S., Kimotho, J. and Waruhiu. 1997. Tree seed suppliers Directory: Sources of Seeds and Microsymbionts. International Centre for Research in Agro Forestry (ICRAF), Nairobi, Kenya.
- Mohanan, C. and Anil Chandran. 2001. Microorganisms associated with seeds of tropical forest species and their management for improving the storability and seedling production. Seed Science and Technology (in press).
- Ogura, M., Cordell, G.A., Kinghorn, A.D. and Farnsworth, N.R. 1977. Potential anticancer agents. VI. Constituents of Ailanthus excelsa (Simaroubaceae). Lloydia. 1977, 40: 579-584.

Ramakrishnan, H.B., Jacqueline, A.S. and Vinaya Rai, R.S. 1990. Studies on ripeness index and presowing seed treatment in Ailanthus excelsa Roxb. Seed Scienc and Technology. 18(3): 491-498.

Rawat, M.M.S., Naithani, K.C. and Thapliyal, R.C. 2001. Germination behaviour and Storability of Ailanthus excelsa seeds. Indian Forester, 127: 973-979.

Sasidharan, N. 2004. Forest Trees of Kerala. Kerala Forest Research Institute, Peechi, Kerala, India.

Ailanthus triphysa

Nomenclature:

Scientific name: *Ailanthus triphysa*
(Dennst.) Alston.

Vernacular name: Perumaram, Matti, Pongilium (Malayalam) (Sasidharan, 2004); Mattipal (Tamil); Dhupa, Hal-maddi (Kannada) (Chacko et al., 2002).

Common name: Maharuk (Chacko et al., 2002).

Synonyms: *Adenanthera triphysa* Dennst., *Ailanthus malabarica* DC. (Chacko et al., 2002; Sasidharan, 2004).

Family: Simaroubaceae

Subfamily:

Origin:

Distribution: Occurs in the Western Ghats, from Konkan, Southwards to Kerala up to 1500 m. It also occurs in Myanmar (FRI, 1981). This indigenous tree is widely cultivated in Kerala (Chacko et al., 2002). In Kerala it occurs in Thrissur, Malappuram, Idukki, Palghat, Calicut and Thiruvananthapuram districts.

Description: Fast growing evergreen tree attaining a height of 30 m and breast height diameter of 95 cm (Chacko et al., 2002).

Flowering season: February to March (Bose et al., 1998); March to April (Chacko et al., 2002).

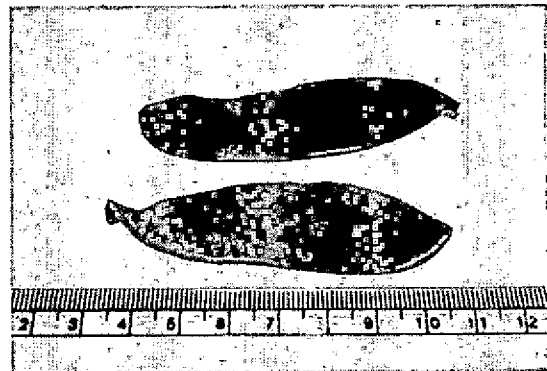
Fruiting season: May to June, March to April (Rai, 1999; Chacko et al., 2002).

Flowers: Flowers large in lax, much branched panicles.

Fruits: Fruits is a samara, winged membranous, reddish-brown, flat and obtuse at the ends (Luna, 1996; Chacko et al., 2002).

Fruit type: Samara.

Seeds: Samara, 1-seeded, oblong, 6.4 x 7.6 cm, flat, reddish brown with rounded ends, very short lived.



Fruits

Seed dimension:

Seed length: 8.5 cm (Chacko et al., 2002).

Seed width: 2 cm (Chacko et al., 2002).

Seed thickness:

Seed weight: 24,000 to 25,000 (Kindt et al., 1997; Chacko et al., 2002); 7,620 to 10,000 fruits/kg (With wings) (Chacko et al., 2002).

Seed dispersal: Wind dispersal.

Seed collection: Mature fruits are collected from the tree by lopping off the fruiting branches, since they are wind dispersed (Luna, 1996; Chacko et al., 2002).

Transportation of seeds: Fruits are collected in cotton / plastic / polythene / gunny bags, packed and transported by ensuring air-circulation within the stack (Chacko et al., 2002).

Seed processing: The fruits are dried under sun and the insect attacked ones are removed by hand picking (Chacko et al., 2002).

Seed storage: Orthodox (Kindt et al., 1997). Fruits can be stored in gunny bags for about 3 months (Luna, 1996; Nair, 2000; Chacko et al., 2002).

Viability period: Seed is viable up to two months under ambient conditions (Chacko et al., 2002).

Seed emptiness: Moderate (Chacko et al., 2002).

Seed pre treatment: Removal of the wings before sowing will help in sowing more seeds in the given space (Chacko et al., 2002).

Germination type: Epigeal (Chacko et al., 2002).

Germination percentage: 70 (Luna, 1996; Chacko et al., 2002).

Germination period: 10 to 20 days (Luna, 1996; Chacko et al., 2002).

Nursery technique: The de-winged seeds are sown flat in plastic trays containing

vermiculite and watered regularly. Heavy watering causes rotting of the seeds. Seedlings are potted in polythene bags of size 22.5 x 17.5 cm. Seedlings in the nursery are susceptible to defoliator attack, which can be controlled by spraying insecticide (Rai, 1999). Seedlings are also affected by damping off, collar rot and seedling blight diseases, which can be controlled by fungicidal application (Sharma et al., 1985; Chacko et al., 2002).

Propagation:

Method of propagation: By seeds.

Vegetative propagation:

Pests: Moderate. Most damage is caused by the leaf and shoot webber, *Atteva fabriciella* Swed. (Lepidoptera: *Attevidae*/Yponomeutidae) which webs the tender shoots and developing fruits and feeds on it (Chacko et al., 2002).

Diseases: Damping off caused by *Pythium* sp.; collar rot caused by *Rhizoctonia solani*; seedling blight caused by *Colletotrichum dematium*; and bacterial leaf spot caused by *Pseudomonas* (Sharma et al., 1987). High (30 to 91%). More than 23 fungi and a bacterium are recorded on seeds. *Aspergillus* sp. and *Penicillium* sp. are the important storage moulds. *Drechslera* sp., *Colletotrichum gloeosporioides*, *Curvularia* sp., *Fusarium moniliforme*, *Helminthosporium* sp., *Phoma* sp. are the important field fungi recorded on seeds (Mohan and Anil Chandran, 2001; Chacko et al., 2002).

Medicinal properties: The bark, the gum that exudes from the trunk, leaves and roots are used in medicine.

Uses: The bark extract is a valuable tonic, febrifuge and carminative. It is also used as an incense and forms an ingredient of agarbattis. The crude resin and ester val contains a volatile oil. Wood is used for match boxes and splints.

Wood properties: The bark is grey, smooth in young tree. The air dry weight of wood about 400 kg/m³. Wood white, very soft and spongy. Pores large, scanty, subdivided. Medullary rays short, moderately broad, the distance between the rays being greater than the transverse diameter of the pores (Gamble, 1922).

References:

- Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 42.
- Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 48-49.
- FRI. 1981. Troup's The Silviculture of Indian Trees. Vol. III. The Controller of Publications, Delhi.
- Gamble, J.S. 1922. A manual of Indian timbers. London Sampson Low, Marton and Company Ltd, Calcutta, India.
- Kindt, R., Mausya, S., Kimotho, J. and Waruhiu. 1997. Tree seed suppliers Directory: Sources of Seeds and Microsymbionts. International Centre for Research in Agro Forestry (ICRAF), Nairobi, Kenya.
- Luna, R.K. 1996. Plantation Trees. International Book Distributors, Ddehra Dun, India.
- Mohanan, C. and Anil Chandran. 2001. Microorganisms associated with seeds of tropical forest species and their management for improving the storability and seedling production. Seed Science and Technology (in press).
- Nair, K.K.N. 2000. Manual of non-wood forest produce plants of Kerala. KFRI, Peechi, Kerala, India.
- Rai, S.N. 1999. Nursery and Planting Techniques of Forest Trees in Tropical South-Asia. Eastern Press, Bangalore, India.

Sasidharan, N. 2004. Forest Trees of Kerala. Kerala Forest Research Institute, Peechi, Kerala, India.

Sharma, J.K., Mohanan, C. and Maria Florence, E.J. 1985. Disease survey in Nurseries and Plantations of Forest Tree Species Grown in Kerala. KFRI. Research Report No. 36. Kerala Forest Research Institute, Peechi.

Sharma, J.K., Florence, E.J.M. and Mohanan, C. 1987. Diseases of forest trees in Kerala 2. Ailanthus triphysa. Evergreen Trichur. (19): 7-11.

Alangium salvifolium

Nomenclature:

Scientific name: *Alangium salvifolium* (Linn.f.) Wang.

Vernacular name: Alangi (Tamil); Akola (Hindi); Ankolam, Azhinni, Arinjil (Malayalam) (Gamble, 1922).

Common name: Sage-leaved alangium.

Synonyms: *Alangium lamarkii* Thw., *Grewia salvifolia* Linn.f., *A. hexapetalum* Roxb., *A. decapetalum* Lamk., *A. sundanum* Miq.

Family: Alangiaceae

Subfamily:

Origin:

Distribution: In tropical regions of India, Myanmar, Sri Lanka, South China, Malaysia, Philippines and East Africa.

Description: A small deciduous tree up to 10 m high, with thorny branches, young parts pubescent.

Flowering season: February to April.

Fruiting season: December to June.

Flowers: Flowers white, few, in axillary fascicles, pedicels 4-6 mm long, densely pubescent, calyx turbinate, densely silky pubescent, tube 2-3 mm long, petals 5-10, stamens 20-30. The flowers are pollinated by *Dicaeum erythrorhynchos*, *Nectarinia zeylonica* and *N. asiatica*, and *Xylocopa* bees and birds such as *Acridotheres tristis*, *Turdoides caudatus* and *Psittacula*

krameri are the seed dispersal agents of *A. salvifolium* (Raju *et al.*, 2005).

Fruits: Drupe, ovoid or ellipsoid, 12-15 mm long, black when ripe, seed enclosed in red pulp.

Fruit type: Drupe.

Seeds: Seeds 2, large, enclosed in red pulp, sweet but rather astringent pulp. The seed oil content of *Alangium lamarkii* is 1.0-7.1% (Ahmad and Kaur, 1998).

Seed dimension:

Seed length:

Seed width:

Seed thickness:

Seed weight:

Seed dispersal: Passerine birds, such as *Acridotheres tristis*, *Turdoides caudatus* and *Psittacula krameri* are the seed dispersal agents of *A. salvifolium* (Raju *et al.*, 2005).

Seed Collection:

Transportation of seeds:

Seed processing:

Seed storage:

Viability period:

Seed emptiness:

Seed pre treatment:

Germination type:

Germination percentage:

Germination period:

Nursery technique:

Propagation:

Method of propagation:

Vegetative propagation:

Pests:

Diseases:

Medicinal properties: The roots are useful for external application in acute case of rheumatism, leprosy and inflammation and for external and internal application in case of bites of rabid dogs. *Alangium salvifolium* is used by the tribal people against asthma (Singh, 1994). Chloroform and methanol extracts of roots show moderate antibacterial activity against *Escherichia coli*, *Staphylococcus aureus*, *Bacillus subtilis* and *B. cereus* (Porchezian and Ansari, 2001; Natarajan *et al.*, 2003; Katyayani *et al.*, 2002; Adeeba Anjum *et al.*, 2002; Mosaddik *et al.*, 2000). It is also used as contraceptives for pig and cattle rearing by the tribes in the Javadhi hills (Tamil Nadu, India) called malayalis (Kumari and Narasimhan, 2003). Ethyl acetate solubles of acidified aqueous mother liquor and buffer solubles of neutral mother liquor of stem bark of *Alangium salvifolium* [*A. lamarckii*] show

antimicrobial activity against fungi (*Aspergillus niger*, *Trichoderma viride* and *Rhizopus oryzae*) and yeast (*Saccharomyces cerevisiae* and *Candida utilis*) (Katyayani *et al.*, 2002). *Alangium salvifolium* used by Sahariya tribe in the Lalitpur area for curing certain ailments like leucorrhoea, rheumatism and stomach-ache (Rajan and Jain, 1994). Butanol extract show growth inhibitory effect at 4 mg/ml against *Bacillus cereus*, *B. pumilus*, *B. subtilis*, *Bordetella bronchiseptica*, *Micrococcus luteus*, *Staphylococcus epidermidis*, *Escherichia coli*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa* and *Enterococcus faecalis* (Pandian *et al.*, 2006). Ethanolic leaf extract of *Alangium salviifolium* has antifungal properties against *Aspergillus niger* and *Fusarium oxysporum* (Xavier *et al.*, 2005). Aqueous root extract shows anthelmintic activity on adult earthworm and is comparable with piperazine citrate (Rajasekaran *et al.*, 2007).

Uses: Wood is used for construction, cabinet work and agricultural implements. It is also valuable as fuel.

Wood properties: The sapwood is pale yellow, wide, and the heartwood is olive-brown, with a pleasant smell when fresh. It is a moderately hard and moderately heavy wood (Gamble, 1922).

References:

Adeeba Anjum, Haque, M.E., Rahman, M.M. and Sarker, S.D. 2002. Antibacterial compounds from the flowers of *Alangium salviifolium*. *Fitoterapia*. 73(6): 526-528.

- Ahmad, I. and Kaur, A. 1998. Studies on minor seed oils. *Journal of the Oil Technologists' Association of India*. 30(3): 114-116.
- Bose, T.K., Das, P. and Maiti, G.G. 1998. *Trees of the world*, Vol. 1. Regional Plant Resource Centre, Orissa. India.
- Gamble, J.S. 1922. *A manual of Indian timbers*. London Sampson Low, Marton and Company Ltd, Calcutta, India.
- Katyayani, B.M., Rao, P.M., Muralichand, G., Rao, D.S. and Satyanarayana, T. 2002. Antimicrobial activity of bark of Alangium salvifolium Linn. F. *Indian Journal of Microbiology*. 42(1): 87-89.
- Kumari, M.R. and Narasimhan, D. 2003. Abortifacient and contraceptive plants used by Malayalis of Javadhi hills. *Journal of Economic and Taxonomic Botany*. 27(4): 788-790.
- Mosaddik, M.A., Kabir, K.E. and Parvez-Hassan. 2000. Antibacterial activity of Alangium salviifolium flowers. *Fitoterapia*. 71(4): 447-449.
- Natarajan, E., Kumar, S.S., Xavier, T.F., and Selvi, V.K. 2003. Antibacterial activities of leaf extracts of Alangium salvifolium. *Journal of Tropical Medicinal Plants*. 4(1): 9-13.
- Pandian, M.R., Banu, G.S., and Kumar, G.A. 2006. Study of the antimicrobial activity of Alangium salviifolium. *Indian Journal of Pharmacology*. 38(3): 203-204.
- Porchezian, E. and Ansari, S.H. 2001. Anti-microbial activity of Alangium salvifolium. *Indian Journal of Natural Products*. 17(1): 20-22.
- Purkayastha, S.K. 1996. *A manual of Indian timbers*. Sri Bhumi Publishing Company, Calcutta.
- Rajan V. and Jain S.K. 1994. Some ethno-medicinal plants of Lalitpur district, Uttar Pradesh, India. *Ethnobiology in human welfare: abstracts of the fourth international congress of ethnobiology*, Lucknow, Uttar Pradesh, India. 286.
- Rajasekaran, A., Rajamanickam, V., Sivagnanam, G., Anandarajagopal, K., and Sivakumar, V. 2007. Anthelmintic activity of the root extract of Alangium salvifolium. *Journal of Tropical Medicinal Plants*. 8(1): 39-42.
- Raju, A.J.S., Rao, S.P., and Rangaiah, K. 2005. Bird-mediated pollination and seed dispersal in a deciduous tree species, Alangium salviifolium (L.f.) Wangerin (Alangiaceae) in the subtropical Eastern Ghats forests of India. *Journal of the National Taiwan Museum*. 58(1): 69-82.

Singh, K.K.1994. Ethnomedicinal plants diversity in Sonbhadra district of southern Uttar Pradesh, India - utilization and conservation. Ethnobiology in human welfare: abstracts of the fourth international congress of ethnobiology, Lucknow, Uttar-Pradesh, India. 83.

Xavier, T.F., Kalaiselvi, V., Kandhasamy, M., Rajakumari, M.P., Srinivasan, K., and Natarajan, D. 2005. Antifungal activity of leaf extracts of Alangium salviifolium. Journal of Tropical Medicinal Plants. 6(2): 179-182.

Albizia amara

Nomenclature:

Scientific name: *Albizia amara* (Roxb.) Boivin

Vernacular name: Oonjal, Nenmenivaka (Chacko et al., 2002 and Sasidharan, 2004); Varacchi (Malayalam); Wonja Shekaram, Suranji, Thuringa, Turina, Usil (Tamil); Tugal, Tugli, Sujalli, Sujjalu (Kannada) (Chacko et al., 2002).

Common name: Oonjal (Chacko et al., 2002).

Synonyms: *Mimosa amara* Roxb. (Chacko et al., 2002; Sasidharan, 2004).

Family: Leguminosae

Subfamily: Mimosoideae

Origin:

Distribution: Occurs in the dry forests of Indian Peninsula from Maharashtra in the west to Andhra Pradesh in the east. It is common in dry mixed deciduous and thorn forests of the Deccan, Carnatic and Southern parts of India. It is also found in Sri Lanka (Chacko et al., 2002).

Description: Slow-growing, deciduous tree reaching a height of 9 m and a breast height diameter of 57 cm (Chacko et al., 2002).

Flowering season: April to August.

Fruiting season: February to April (Sen Gupta, 1937; Chacko et al., 2002).

Flowers: Yellow fragrant in peduncled heads.

Fruits: Fruit is a pod, 10 to 20 x 3 to 4 cm size, linear thin and flat. It contains 6 to 10 ovoid flat seeds (Chacko et al., 2002).

Fruit type: Pod.

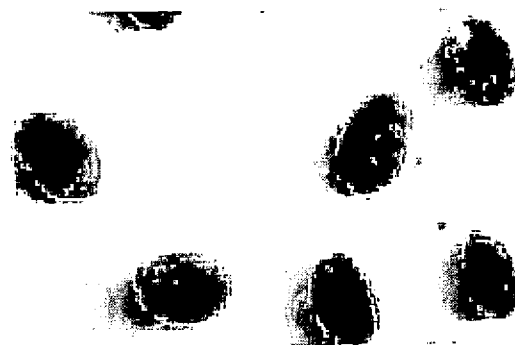
Seeds:

Seed dimension:

Seed length: 0.83 cm (Chacko et al., 2002).

Seed width: 0.49 cm (Chacko et al., 2002).

Seed thickness:



Seeds

Seed weight: 14,000 to 27,000 seeds/kg (FRI, 1983; Chacko et al., 2002).

Seed dispersal: Wind dispersal.

Seed collection: Mature pods are collected from the tree by shaking the branches using a long pole with a hook (Chacko et al., 2002).

Transportation of seeds: Seeds collected in cotton/jute bags are loosely stacked during transportation (Chacko et al., 2002).

Seed processing: The pods are sun dried for 2 to 3 days. The dried pods are beaten with a wooden stick to extract the seeds, and are then cleaned and stored for use (Chacko et al., 2002).

Seed storage: Orthodox (Kindt et al., 1997; CABI, 1998; Chacko et al., 2002). Seeds can be stored in closed plastic or aluminium containers for two years (Kumar and Bhanja, 1992) without significant loss of viability.

Viability period: Seeds are viable for two years under room temperatures in sealed tins (Chacko et al., 2002).

Seed emptiness: Moderate (Chacko et al., 2002).

Seed pre treatment: Soak the seed in boiling water and allow the contents to cool for 24 hrs (Kumar and Bhanja, 1992; Chacko et al., 2002). Immerse in boiling water and cool for 2 to 3 hrs (Edwards and Naithani, 1999).

Germination type: Epigeal (Chacko et al., 2002).

Germination percentage: 83 (FRI, 1983; Chacko et al., 2002).

Germination period: 2 to 7 days (Chacko et al., 2002).

Nursery technique: Pre - treated seeds are sown in plastic trays containing vermiculite and watered regularly. When the seedlings are about 4 to 5 cm high, they are

transplanted into the polythene bags of size 20 x 10 cm filled with potting mixture and kept under shade (Chacko et al., 2002). 1:1:2 ratio of sand, soil and FYM significantly influence the seed germination and biomass of individual seedlings of *Albizia amara* (Handa et al., 2005).

Propagation:

Method of propagation:

Vegetative propagation: Cuttings treated with IBA 200 ppm and 400 ppm concentrations give good rooting and sprouting (Handa et al., 2003).

Pests: Bruchids are the important pests (Chacko et al., 2002).

Diseases: No information (Chacko et al., 2002).

Medicinal properties: The gum is used in eye diseases and ulcers. The leaves are used in ophthalmia and the oil from the seed is said to cure leprosy. It can also be used for the treatment of malaria and gastrointestinal diseases (Muthaura et al., 2007; Muthukumarasamy et al., 2003).

Uses: The tree yields a good gum. Timber is used locally for house building. It is an excellent firewood. High contents of linoleic, oleic and palmitic acids and low contents of capric, lauric and lignoceric acids were found in the seed oil (Porchezian et al., 2001). The smoke toxicity of *A. amara* is effective against *Aedes aegypti* (Murugan et al., 2007). Plant extracts have phenolic compounds as well as significant antioxidant activity (Muchuweti et al., 2006). *A. amara* seed oil has high

contents of linoleic, oleic and palmitic acids and low contents of capric, lauric and lignoceric acids (Munir Ahmed and Shadab Qamar, 1995). The trees reproduce freely from coppice shoots. Coppice sprouts are often produced in large numbers; as a result their size suffers and thinning is necessary. Natural reproduction by seed is usually good.

Wood properties: Wood very hard, sapwood large, white, heartwood purplish brown, beautifully mottled with alternate concentric, light and dark bands. Pores moderate sized, scanty, in patches of soft tissue, which are frequently joined, forming short, concentric bands. Medullary rays very fine, numerous (Gamble, 1922).

References:

- CABI. 1998. The Forestry Compendium – A Silvicultural Reference. Module 1. CABI Publishing, CAB International, Wallingford, Oxon, OX108DE, UK.
- Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 50-51.
- Edwards, D.G. and Naithani, S.C. 1999. Seed and Nursery Technology of forest trees. New Age, New Delhi.
- FRI. 1983. Troup's The Silviculture of Indian Trees. Vol. IV. The Controller of Publications, Delhi.
- Gamble, J.S. 1922. A manual of Indian timbers. London Sampson Low, Marton and Company Ltd, Calcutta, India.
- Handa, A.K., Dar, S.A., and Uma. 2005. Response of different growing media on germination and seedling growth of Albizia amara. Indian Journal of Agroforestry. 7(2): 58-61.
- Handa, A.K., Khare, N., Chauhan, S.P.S. 2003. Vegetative propagation of Albizia amara through stem cuttings and biochemical status during rooting. Indian Journal of Agroforestry. 5(1/2): 103-105.
- Kindt, R., Mausya, S., Kimotho, J. and Waruhiu. 1997. Tree seed suppliers Directory: Sources of Seeds and Microsymbionts. International Centre for Research in Agro Forestry (ICRAF), Nairobi, Kenya.
- Kumar, S.V. and Bhanja, M. 1992. Forestry Seed Manual of Andhra Pradesh. Andhra Pradesh Forest Department, Hyderabad, India.

- Muchuweti, M., Nyamukonda, L., Chagonda, L.S., Ndhlala, A.R., Mupure, C., and Benhura, M. 2006. Total phenolic content and antioxidant activity in selected medicinal plants of Zimbabwe. *International Journal of Food Science and Technology*. 41(Suppl. 1): 33-38.
- Munir Ahmed and Shadab Qamar. 1995. Studies on the fixed oil of the seed of Albizia amara. *Pakistan Journal of Scientific and Industrial Research*. 38(7): 277-278.
- Murugan, K., Murugan, P., and Noortheen, A. 2007. Larvicidal and repellent potential of Albizzia amara Boivin and Ocimum basilicum Linn against dengue vector, Aedes aegypti (Insecta:Diptera:Culicidae). *Bioresource Technology*. 98(1): 198-201.
- Muthaura, C.N., Rukunga, G.M., Chhabra, S.C., Mungai, G.M., and Njagi, E.N.M. 2007. Traditional phytotherapy of some remedies used in treatment of malaria in Meru district of Kenya. *South African Journal of Botany*. 73(3): 402-411.
- Muthukumarasamy, S., Mohan, V.R., Kumaresan, S. and Chelladurai, V. 2003. Herbal medicinal plants used by Palliyars to obtain relief from gastro-intestinal complaints. *Journal of Economic and Taxonomic Botany*. 27(3): 711-714.
- Porchezian, E., Asif Ali and Ansari, S.H. 2001. Studies on some medicinally important species of Albizia. *Hamdard Medicus*. 44(2): 74-81.
- Sasidharan, N. 2004. *Forest Trees of Kerala*. Kerala Forest Research Institute, Peechi, Kerala, India.
- Sen Gupta, J.N. 1937. Seed weights, plant percents, etc. for forest plants in India. *Indian Forest Records (New Series) Silviculture*, 2:221 pp. Manager of Publications, Delhi.

Albizia chinensis

Nomenclature:

Scientific name: *Albizia chinensis* (Osbeck) Merr.

Vernacular name: Pottavaka, Ponthanvaka (Malayalam) (Sasidharan, 2004); Pilivagei (Tamil) (Bose et al., 1998).

Common name: Siran, The Sau tree.

Synonyms: *Mimosa chinensis* Osb., *A.stipulata* (Roxb.) Boiv., *A.marginata* (Lamk.) Merr., (Sasidharan, 2004). *Acacia latronum* Willd., *Mimosa horrida* L.f., *Acacia latronum* (L.f.) Willd., *Mimosa stipulacea* Roxb. (Gamble, 1922).

Family: Leguminosae

Subfamily: Mimosoideae

Origin:

Distribution: Distributed throughout the sub Himalayan valleys, Assam, West Bengal, Bihar, South India and Andamans.

Description: A large deciduous tree, with a broad, spreading and flat-topped crown.

Flowering season: March to May.

Fruiting season: January to February.

Flowers: Flowers white with pinkish filaments, in terminal and axillary panicles.

Fruits: Fruit is a pod, thin brown, flat, 7 to 12 cm long, thickened at sutures.

Fruit type: Pod.

Seeds: 8 to 12 seeded.

Seed dimension:

Seed length:

Seed width:

Seed thickness:



Habit



twig with flowers

Seed weight: 32000 seeds/kg.

Seed dispersal: By Wind.

Seed collection: December to February . Optimum time for pod collection is last week of January when their colour is grey-orange (Bhardwaj et al., 2002). The ripe

Pods are collected directly from the tree during the month of January and February.

Transportation of seeds:

Seed processing:

Seed storage: Seeds are treated with Aluminium phosphide and stored in poly bag at 5 +or- 10C temperature (Nayital and Richa Mehta, 2003).

Viability period:

Seed emptiness:

Seed pre treatment: Soaking the seed in water for 48 hrs. Irrespective of temperature conditions, scarification with acid treatment give good germination in seeds of *A. chinensis* (Punam et al., 2002).

Germination type: Epigeous.

Germination percentage: 50

Germination period:

Nursery technique: Germination, root length, collar diameter, shoot weight, root weight and stock quality are positively influenced by treatment with 10 t FYM/ha + 50 kg P/ha (Vipan Guleria et al., 2006).

Propagation:

Method of propagation: By seed and stump planting.

Vegetative propagation:

Pests:

Diseases:

Medicinal properties: The bark yield tannin, its infusion is used as a lotion for cuts, scabies and other skin diseases.

Uses: The wood is used as a timber and it yields an insoluble gum which is used in Nepal for sizing paper. It is used for box making especially tea boxes and packing cases. The leaves and twigs are used as a fodder.

Wood properties: Wood is soft, sapwood large, white; heartwood brown, generally not durable, shining. Annual rings are distinctly marked. Pores large, often oval and subdivided, very prominent on a longitudinal section. Medullary rays fine, short, reddish, not very distinct (Gamble, 1922). Most of the properties are observed to be significantly higher than that of *T. grandis*. The suitability indices indicate that the timber is superior to teak in many aspects. Based on the strength properties it is suitable for use in construction, door frames and shutters, tool handles, packing cases and crates, dunnage pallet, furniture, cabinet making, and flooring (Jain et al., 2002).

References:

Bhardwaj, S.D., Sandeep Sharma, and Pankaj Panwar. 2002. Standardisation of date of collection and mother tree diameter class for harvesting *Albizia chinensis* seeds. Seed Research. 30(1): 30-35.

- Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 44.
- Gamble, J.S. 1922. A manual of Indian timbers. London Sampson Low, Marton and Company Ltd, Calcutta, India.
- Jain, V.K., Mohan Lal, and Daleep Ram. 2002. Journal of the Timber Development Association of India. 48(3/4): 36-40.
- Nayital, R.K. and Richa Mehta. 2003. Effect of storage conditions on the germinability of *Albizia chinensis* seed. Indian Journal of Forestry. 26(1): 35-40.
- Punam, Shivesh Sharma, and Atul. 2002. Effect of scarification, temperature and storage conditions on the germination of two ecologically important Albizia species of Himalayas. Annals of Forestry. 10(2): 262-267.
- Sasidharan, N. 2004. Forest Trees of Kerala. Kerala Forest Research Institute, Peechi, Kerala, India.
- Vipan Guleria, Nayital, R.K., and Bhardwaj, S.D. 2006. Nutrition of Albizia chinensis Merr. as affected by farm yard manure and phosphorus interaction under nursery. Indian Forester. 132(9): 1216-1220.

Albizia lebbbeck

Nomenclature:

Scientific name: *Albizia lebbbeck* (L.) Benth.

Vernacular name: Bhandir, Garso (Hindi); Vellavaga, Vaka, Karimthakara (Malayalam); Karuvagei (Tamil); Kalshish, Siris (Hindi) (Chacko et al., 2002).

Common name: East Indian Walnut, Frywood tree, Indian siris, Woman's tongue tree (Chacko et al., 2002).

Synonyms: *Mimosa lebbbeck* L., *Acacia lebbbeck* (L.) Willd., (Chacko et al., 2002); *A. latifolia* Boivin, *A. speciosa* Willd., *A. sirissa* Ham.

Family: Leguminosae

Subfamily: Mimosoideae

Origin:

Distribution: One of the most commonly found trees in India both in forests and cultivated in the avenues (Troup, 1921).

Description: A moderate sized to a large deciduous tree, usually with a straight bole and broad crown (Gamble, 1922).

Flowering season: March to June (Troup, 1921).

Fruiting season: Ripens during December to January; January to February (Sen Gupta, 1937; Chacko et al., 2002).

Flowers: Whitish, very fragrant, in globose umbellate heads.

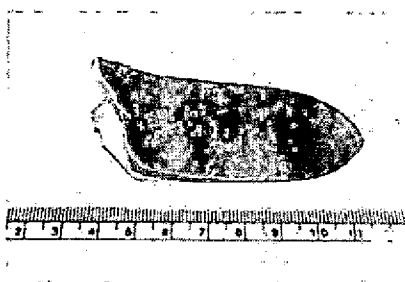
Fruits: Pods are thin, flat shaped, dehiscent, rounded at both ends, pale straw colour, smooth, shiny, reticulately veined (Troup, 1921).



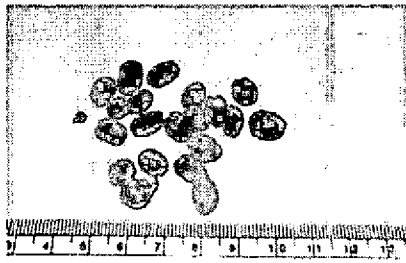
Habit



Branch with fruits



Fruit



Seeds

Fruittype: Pods.

Seeds: Seed 4-12, ellipsoid, ovate or oblong, compressed, pale brown, and smooth, with a hard testa (Troup, 1921).

Seed dimension:

Seed length: 7-13 cm (Chacko et al., 2002).

Seed width: 6-9 cm (Chacko et al., 2002).

Seed thickness: 1-3 mm (Chacko et al., 2002).

Seed weight: 8,000 seeds/kg 3,700 to 6,000 to 16,000 seeds/kg (FRI, 1981; Carlowitz, 1991; Kindt et al., 1997; Chacko et al., 2002).

Seed dispersal: Wind.

Seed collection: Maturity indices for harvesting pods is a change in colour from yellow green to greyed-orange and that of seeds, from yellow-green to brown which is associated with the decline in moisture content of the seeds and an increase in its dry weight. Last week of December is the ideal time for the seed collection of *A. lebeck* (Bhardwaj et al., 2004; Bhardwaj et

al., 2002). Mature fruits (Pods) are yellow in colour, collected from the tree by knocking off the pods using long stick (FRI, 1983). Mature pods remain on trees for about four months (Chacko et al., 2002). The seed collection methods are: hand plucking of ready to mature seeds in December and collection from the ground of seeds that had fallen naturally in February (Archana Sharma and Sunil Agarwal, 2002).

Transportation of seeds: Pods are packed in cotton jute bags and transported (Chacko et al., 2002).

Seed processing: The pods are dried in the sun till they dehisce and release seeds. Seeds are also extracted by beating them with a stick if necessary (FRI, 1983; Chacko et al., 2002).

Seed storage: Orthodox (Napier and Robbins, 1989; Kindt et al., 1997). Seeds after drying under sun, can be stored in sealed plastic or aluminium containers for one year (FRI, 1983) and even up to five years if properly stored (Dent, 1948; Chacko et al., 2002). The seeds are separated from the pods and stored in full sunlight for 5 months (Navarro Boulandier and Gonzalez, 2000). Viability decreases with increase in the storage period. Use of storage media help to increase the percentage of seed viability (Khomane and Bhosale, 2003). The seeds stored in sealed plastic container with silica gel after 12 months give germination value of 55%, plant percent 49.3, growth of seedling 49.3 and a root shoot ratio of 1.37 (Archana Sharma and Sunil Agarwal, 2002). Seeds stored in plastic jars at 4 +or-1oC temperature after 16 months of storage give 54% germination (Bhardwaj et al., 2007).

Viability period: Seeds with initial germination of 20% have been stored in sealed tins for six years without substantial loss of viability (Dent, 1948; Chacko et al., 2002). Viability decreased with an increase in the storage period. In general, the use of storage media help to increase the percentage of seed viability (Khomane and Bhosale, 2003).

Seed emptiness: Negligible (up to 3%) (Chacko et al., 2002).

Seed pre treatment: Soak the seeds for 24 hrs in boiled water and allow to cool (Kumar and Bhanja, 1992; Chacko et al., 2002; Bhardwaj et al., 2007; Gopal Shukla et al., 2007) or scarify the seeds using conc. Sulphuric acid for 25 min, wash thoroughly with running water and soak for 24 hrs in water before sowing (Chacko et al., 2002; Bhardwaj et al., 2007; Agboola et al., 2005). File-off fragment of testa and soak in water for 2 to 3 hrs (Edwards and Naithani, 1999). In addition, different pretreatments include sulfuric acid treatment, puncturing with hot needle; scaling with knife; and rubbing with sand paper (Neeta Mutha et al., 2004). Mechanical scarification by puncturing with hot needle or scaling with knife is done to achieve high values of germination percentage and germination value (Neeta Mutha et al., 2004). 0.01-0.04 ppm IAA, and 0.01-0.05 ppm-GA3 also enhance germination in *A. lebbeck*. IAA (01-0.05 ppm), IBA (0.03-0.04 ppm), and GA3 enhance plant height, dry weight and leaf number respectively in *A. lebbeck* (Ebofin et al., 2003). Irrespective of temperature conditions, scarification with acid treatment provides significantly maximum

germination (Punam et al., 2002). Gibberellic acid (300 ppm), has positive influence over shoot length, total chlorophyll and soluble protein content of the seedlings. Cycocel (3%) affects leaf area and total dry weight. Whereas Alar (300 ppm) has influence on root length (Ilango et al., 1999). Dry dressing of *A. lebbeck* seeds with calcium oxychloride (bleaching powder) at 2 g/kg of seeds reduce the physiological deterioration of seeds inflicted due to storage. Besides germination percentage, seed vigour as measured by shoot and root length and dry matter of seedlings is also influenced by this treatment (Vanangamudi et al., 2002). It is also recommended to treat *A. lebbeck* seeds with water at 80°C for 5-30 min before sowing (Gonzalez and Navarro, 2001).

Germination type: Epigeal (FRI, 1983; Chacko et al., 2002).

Germination percentage: Up to 94 (Sen Gupta, 1937; Chacko et al., 2002). The percentage germination in pretreated seeds ranged between 60-100% (Agboola et al., 2005). Heavy seeds recorded higher germination percentage, germination value and Dickson's quality index compared to the light seeds. 100% germination at 400 ppm of GA3 (Ghyare, 2005). The germination capacity and energy of *A. lebbeck* is 72 and 56%, respectively in water (Lokendra Singh and Khan, 2004). Sulfuric acid treatment for 30-60 min give 100% germination (Padma et al., 1994). Treatments with 3% KCl gives 83.5% germination and vigour index of 2771 (Ilango et al., 1999).

Germination period: 7 to 30 days (Kumar and Bhanja, 1992; Chacko et al., 2002).

Nursery technique: Seeds are sown in seed beds or germination trays in March and seedlings are pricked out to containers. Seeds can also be sown directly in 20 x 10 cm bags filled with potting mixture. 1:1 mixture of soil and sheep manure is also good for germination. The seedlings are sometimes attacked by jassids, systemic insecticide (Nuvacron) (monocrotophos) can be used at 0.2 to 0.5% by volume (Rai, 1999; Chacko et al., 2002). Seeds stored for 5 months in full sunlight, followed by seeds stored for 3 and 2 months in full sunlight (Navarro Boulandier et al., 2000). Treatment with 46 mg N+17 mg P₂O₅ +30 mg K₂O and 23 mg N+8.5 mg P₂O₅ +30 mg K₂O are effective in increasing biomass production (Jai Kumar and Siddiqui, 2005). The application of 100 kg P₂O₅ ha⁻¹ is found to be suitable for better growth and production (Roy et al., 2004). Rhizobium + Trichoderma inoculation with a potting mixture of sand, soil and farmyard manure in the ratio of 1:1:1/2 (v/v) results in better performance of the seedlings (Mohit Gera and Neelu Gera, 2002).

Propagation:

Method of propagation: By seeds.

Vegetative propagation:

Pests: Low to moderate (8 to 53%). Beetles are the major pests. The bruchids, Bruchus pisorum L., B. saundersi Jekel., Bruchidius uberatus Fb., B. sparsimaculatus Pisc. and Caryedon gonagra Fb., cause most damage (Browne, 1968; Chacko et al., 2002).

Diseases: High (53-73%). Species of Aspergillus, Chaetomium, Rhizopus,

Pencillium are the important storage moulds. Colletotrichum gloeosporioides, Fusarium sp. and Phoma sp. are the important field fungi affecting the seeds (Mohan and Sharma, 1991, Chacko et al., 2001, Chacko and Mohan, 2002; Chacko et al., 2002).

Medicinal properties: Bark, leaves, flowers are medicinal. The plant is reported to have antiseptic and anti tubercular properties. The bark is recommended for bronchitis, leprosy and useful in inflammations. The bark and seeds are astringent, useful in piles and diarrhoea and act as a tonic and restorative. Albizzia lebeck is used to treat chronic diarrhoea, dysentery and snake bite. The methanol extracts of A. lebeck is effective against Klebsiella pneumoniae (Goswami and Singh, 2006). Alcoholic extract from leaves of Albizzia lebeck with an antibiotic (oxytetracycline) is active against Salmonella typhi using disc diffusion method (Gaurav Srivastava and Bohra, 2005). Albizzia lebeck is used to treat chronic diarrhoea, dysentery and snake bite (Ch et al., 2006). A. lebeck possess anti-asthmatic, anti-inflammatory, anti-fertility and anti-diarrhoeal properties. A. lebeck is an important source of chemicals of melacacidin, D-catechin, beta -sitosterol, albizzia hexoside, betulinic acid which are effective as antiseptic, anti-dysenteric, anti-tubercular and used in bronchitis, leprosy, paralysis, and helminth infection (Arvind Kumar et al., 2007).

Uses: The tree is planted to check soil erosion, as shade tree in coffee and cardamom plantations and as a green manure. The wood is short fibred, suitable for writing and printing paper. Bark

contains tannin and is used for tanning fishing nets. A. lebeck has salt tolerance (Yadav et al., 2003, 2005). Aqueous leaf extracts derived from Albizia lebeck has inhibitory effect in root and lateral root development, germination and shoot growth. Inhibitory effect is proportional to the concentrations of the extracts and higher concentration (50%-100%) had the stronger inhibitory effect whereas the lower concentration (10%-25%) showed stimulatory effect (Uddin et al., 2007). A. lebeck seeds are rich in crude protein and carbohydrate but low in lipid content. Phytochemical screening of the seeds reveal the presence of saponins and oxalate, while tannins, cyanogenic glycoside and phytic

References:

- Agboola, D.A., Ebofin, A.O., Aduradola, A.M., and Ajiboye, A.A. 2005. The effect of presowing treatments on the germination of seeds of two Savannah tree legumes: *Indian Forester*. 131(5): 701-710.
- Anwa, E.P., Auta, J., and Abdullahi, S.A. 2007. Bolorunduro, P-I Effects of processing on seeds of Albizia lebeck: proximate analysis and phytochemical screening. *Research Journal of Biological Sciences*. 2(1): 41-44.
- Archana Sharma and Sunil Agarwal. 2002. Effect of different methods of seed collection and storage on seed quality of Albizia lebeck (L) Benth Vaniki Sandesh. 26(3/4): 1-7.
- Arvind Kumar, Saluja, A.K., Shah, U.D., and Mayavanshi, A.V. 2007. Pharmacological potential of Albizia lebeck: a review. *Pharmacognosy Reviews*. 1(1): 171-174.
- Auta, J., and Anwa, E.P. 2007. Preliminary studies on Albizia lebeck seeds: proximate analysis and phytochemical screening. *Research Journal of Biological Sciences*. 2(1): 33-35
- Bhardwaj, S.D., Pankaj Panwar, and Manisha Kumar. 2002. Physical and biochemical changes in seeds - as a maturity indices for harvesting Albizia lebeck seeds. *Journal of Hill Research*.15(1): 52-55.
- Bhardwaj, S.D., Pankaj Panwar; and Manisha Kumar. 2004. Estimating maturity of Albizia lebeck seed using leachate conductivity. *Indian Forester*. 130(3): 346-348.

acid levels are low. The seeds of this plant may serve as a cheap source of protein and carbohydrate in food supplements for animals (Auta and Anwa, 2007; Anwa et al., 2007).

Wood properties: The sapwood is white or yellowish white and the heartwood, which is sharply demarcated from the sapwood, is brown or darker streaks. The wood is moderately hard and moderately heavy with interlocked grain and coarse texture. Pores are scanty, large, in rings of soft tissue, in oblique somewhat radial strings, very prominent as dark streaks on a vertical section. Medullary rays fine, distant, not conspicuous in silver grain (Gamble, 1922).

- Bhardwaj, S.D., Pankaj Panwar, and Manisha Kumar. 2007. Effect of temperature and containers on seed storability of Albizia lebbeck. *Indian Journal of Forestry*. 30(2): 151-154.
- Browne, F.G. 1968. *Pests and Diseases of Forest Plantation Trees*. An annotated list of the principal species occurring in the British Commonwealth. Clarendon Press, Oxford.
- Carlowitz, P.G.V. 1991. *Multipurpose Trees and Shrubs: Source of seeds and Inoculants*. International council for research in Agroforestry, Nairobi, Kenya.
- Ch, M.I., Khan, M.A. and Wajahat Hanif. 2006. Ethno veterinary medicinal uses of plants from Samahni valley dist. Bhimber, (Azad Kashmir) Pakistan. *Asian Journal of Plant Sciences*. 5(2): 390-396.
- Chacko, K.C., Mohanan, C., Seethalakshmi, K.K. and George Mathew. 2001. Seed handling and nursery practices for selected forest trees of Kerala. Final Technical Report of ICFRE – World Bank Forestry Research Education and Extension Project. Kerala Forest Research Institute, Peechi.
- Chacko, K.C. and Mohanan, C. 2002. Development of technology for collection, processing and testing seeds of five important tree species of Kerala. Final report of project KFRI 279/97. Kerala Forest Research Institute, Peechi.
- Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. *Manual of Seeds of Forest Trees, Bamboos and Rattans*. Kerala Forest Research Institute, Peechi, Kerala. pp. 52-53.
- Dent, T.V. 1948. Seed storage with particular reference to the storage of seed of Indian forest plants. *Indian Forest Records (New Series) Silviculture*7: 134 pp. Manager of Publications, Delhi.
- Ebofin, A.O., Agboola, D.A., Aduradola, A.M., and Ayodele, M.S. 2003. Effect of some growth hormones on seed germination and seedling growth of some savanna tree legumes. *ASSET Series B: Natural Sciences, Engineering and Technology*. 2(1): 141-150.
- Ebofin, A.O., Agboola, D.A., Ayodele, M.S. and Aduradola, A.M. 2003. Effect of seed sizes on seedling growth of some savanna tree legumes. *ASSET Series A: Agriculture and Environment*. 3(2): 109-113.
- Edwards, D.G. and Naithani, S.C. 1999. *Seed and Nursery Technology of forest trees*. New Age, New Delhi.
- FRI. 1981. Troup's *The Silviculture of Indian Trees*. Vol. III. The Controller of Publications, Delhi.

- FRI. 1983. Troup's The Silviculture of Indian Trees. Vol. IV. The Controller of Publications, Delhi.
- Gamble, J.S. 1922. A manual of Indian timbers. London Sampson Low, Marton and Company Ltd, Calcutta, India.
- Gaurav Srivastava and Bohra, A. 2005. Antibacterial activity of extract of leaves of some tree plants against Salmonella typhi: a study in vitro. *Advances in Plant Sciences*.18(2): 601-603.
- Ghyare, B.P. 2005. Effect of gibberellic acid on germination of five timber tree species. *Indian Forester*. 131(6): 844-846.
- Gopal Shukla, Koul, D.N., Sumit Chakravarty, and Pankaj Panwar. 2007. Effect of pre-sowing treatments on germination and initial seedling growth of Albizia lebbeck in terai zone of West Bengal. *Environment and Ecology*. 25S(Special 3A): 964-966.
- Goswami, S. and Singh, L.S. 2006. Antibacterial potential of some indigenous plants against human pathogenic bacteria. *Environment and Ecology*. 24S(Special 2): 403-405.
- Ilango, K., Mallika Vanangamudi, Vanangamudi, K., Venkatesh, A., Rai, R.S.V., and Balaji, S. 1999. Effect of growth stimulants on seed germination and seedling vigour in Albizia lebbeck (L.) Benth. *Seed Research*. 27(2): 188-190.
- Jai Kumar and Siddiqui, M.H. 2002. Influence of fertilizers on seedling growth of Albizia lebbeck (L.) Benth. *Journal of Research, Birsa Agricultural University*. 14(2): 285-288.
- Jai Kumar and Siddiqui, M.H. 2005. Increased biomass production of Albizia lebbeck (L.) Benth. in nursery by the use of inorganic fertilizers. *Indian Journal of Forestry*. 27(4): 360-366.
- Khomane, B.V. and Bhosale, L.J. 2003. Effect of storage medium on viability of seed in some fuelwood species. *International Journal of Forest Usufructs Management*. 4(1): 55-58.
- Kindt, R., Mausya, S., Kimotho, J. and Waruhiu. 1997. Tree seed suppliers Directory: Sources of Seeds and Microsymbionts. International Centre for Research in Agro Forestry (ICRAF), Nairobi, Kenya.
- Kumar, S.V. and Bhanja, M. 1992. Forestry Seed Manual of Andhra Pradesh. Andhra Pradesh Forest Department, Hyderabad, India.
- Lokendra Singh and Khan, M.H. 2004. Effects of various treatments on seed germination of Albizzia sp. *Plant Archives*. 4(1): 159-161.
- Mohanan, C. and Sharma, J.K. 1991. Seed pathology of forest tree species in India - Present status, practical problems and future prospects. *Commonwealth Forestry Review*, 70: 113-151.

Mohit Gera and Neelu Gera. 2002. Boosting growth of root trainer seedlings by application of Rhizobium. *Indian Journal of Tropical Biodiversity*.10(1/4): 39-43.

Napier, I. and Robbins, M. 1989. *Forest Seed and Nursery Practice in Nepal*. Sahayogi Press, Kathmandu.

Navarro Boulandier, M. and Gonzalez, Y. 2000. Optimal conditions for the effective germination of Albizia lebbeck. *Boletin Mejoramiento Genetico y Semillas Forestales*. (24): 6-8.

Navarro, M. and Gonzalez, Y. 2001. Germinability of seeds of Albizia lebbeck (L.) Benth. I. Dynamics and variability. *Pastos y Forrajes*. 24(3): 217-224 Besra, S.E.,

Neeta Mutha, Bohra, M.D., Uday Burman, and Harsh, L.N. 2004. Effect of seed size and pretreatments on germination of Albizia lebbeck (L.) Benth. *Indian Journal of Forestry*. 27(1): 11-14.

Padma, V., Satyanarayana, G., and Reddy, B.M. 1996. Effect of scarification treatments on the germination of *Leucaena leucocephala*, Albizia lebbeck and Samanea saman [*Albizia saman*]. *Seed Research*. 22(1): 54-57.

Punam, Shivesh Sharma, and Atul. 2002. Effect of scarification, temperature and storage conditions on the germination of two ecologically important Albizia species of Himalayas. *Annals of Forestry*. 10(2): 262-267.

Rai, S.N. 1999. *Nursery and Planting Techniques of Forest Trees in Tropical South Asia*. Eastern Press, Bangalore, India.

Roy, K.C., Zaman, M.S., Salam, M.A., Bari, M.S., and Miah, M.M.U. 2004. Effect of phosphorus on different multipurpose tree species at seedling growth stage. *Journal of Subtropical Agricultural Research and Development*. 2(2): 66-69.

Sen Gupta, J.N. 1937. Seed weights, plant percents, etc. for forest plants in India. *Indian Forest Records (New Series) Silviculture*, 2:221 pp. Manager of Publications, Delhi.

Troup, R. S. 1921. *The Silviculture of Indian Trees*. (Vol II) International Book Distributors, Dehra Dun.

Uddin, M.B., Mukul, S.A., Khan, M.A.S.A. and Hossain, M.K. 2007. Effects of phosphorous fertilizer on seedlings growth and nodulation capabilities of some popular agroforestry tree species of Bangladesh. *Journal of Forestry Research*. 18(4): 283-286.

Uddin, M.B., Romel Ahmed, Mukul, S.A., and Hossain, M.K. 2007. Inhibitory effects of Albizia lebbek leaf extracts on germination and growth behavior of some popular agricultural crops. *Journal of Forestry Research*.18(2): 128-132.

Vanangamudi, K., Vijayaragavan, A., Parthiban, K.T., and Umarani, R. 2002. Effect of halogenation on seed germination and seedling vigour of stored Albizia lebbek seeds. *Seed Research*. 30(1): 36-38.

Yadav, B.S., Ravi Kumar, Neeraj Kumar, and Yadav, S.K. 2003. Effect of salinity on germination and mineral composition of Albizia lebbek and Melia azadirach in arid conditions. *National Journal of Plant Improvement*. 5(1): 58-60.

Yadav, B.S., Ravi Kumar, and Neeraj Kumar. 2005. Effect of soil salinity on germination and seedling growth of Albizia lebbek (L.) Benth. and Melia azedarach L. *Indian Journal of Forestry*. 28(2): 132-135.

Albizia odoratissima

Nomenclature:

Scientific name: *Albizia odoratissima* (L.f.) Benth.

Vernacular name: Kunnivaka, Pulivaka (Malayalam) (Sasidharan, 2004); Karuvaka, Nellivaga (Malayalam) (Chacko et al., 2002); Bas, Kalasiris, (Hindi), Karu vagai, Chittalei vagai (Tamil) (Chacko et al., 2002).

Common name: Ceylon Rose wood (Chacko et al., 2002); Kala Siris, Black Siris.

Synonyms: *Mimosa odoratissima* L.f.(Sasidharan, 2004); *Acacia odoratissima* (L. f.) Willd., *Albizia micrantha* Boiv. (Chacko et al., 2002).

Family: Leguminosae

Subfamily: Mimosoideae

Origin:

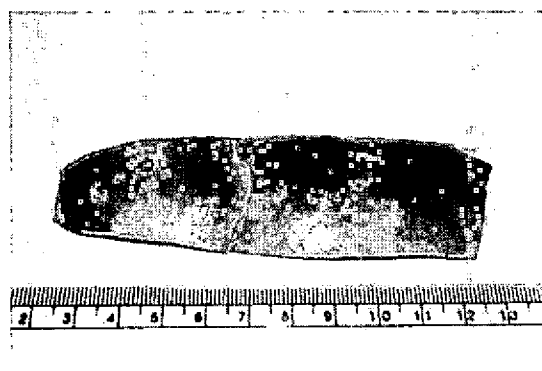
Distribution: Widely distributed throughout India, ascending to 1500 m in the sub - Himalayan tract. It is common, especially along hill slopes in the dry deciduous forests of the Siwaliks, Ajmer - mervara, Khandesh, etc. It also occurs in Bangladesh, Myanmar and Sri Lanka (FRI, 1983). In Kerala it is found in the deciduous and semi- evergreen forests (Chacko et al., 2002).

Description: Fast growing, moderate sized to a large tree with a straight bole and dark green foliage. Sometimes reach a height of 24 m, commonly 15-18 m in height and 1.2

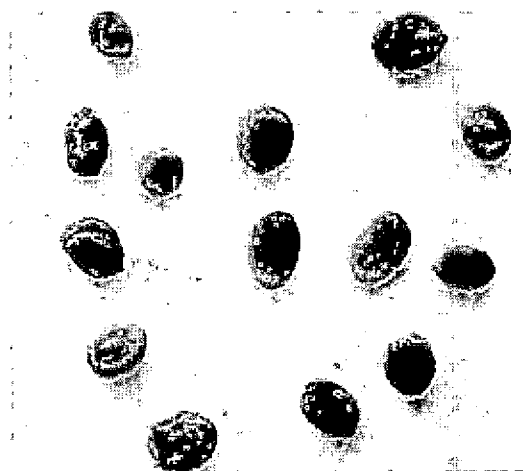
to 1.8 m girth with a clear bole of 7.5-9 m (Troup, 1921).

Flowering season: April to June (Troup, 1921).

Fruiting season: January to March (Sen Gupta, 1937; Chacko et al., 2002).



Fruit



Seeds

Flowers: Pale yellow, fragrant, in peduncled heads, sessile, numerous, in small globose 5-10 or more flowered heads (Troup, 1921). Flower heads white or yellowish white, up to 2 cm across, in umbellate or corymbose

panicles of up to 15 cm long; calyx and corolla densely strigose with short hairs, the later about 5 mm long; anthers yellow (Bose et al., 1998).

Fruits: Shortly stalked pods, thin, flexible, tomentose when young, glabrous when old, reddish brown or dusky green (Troup, 1921).

Fruit type: Pods.

Seeds: Flat, compressed brownish-black seeds, 8 to 12 (Chacko et al., 2002).

Seed dimension:

Seed length: 7-9 mm (Chacko et al., 2002).

Seed width: 5-6 mm (Chacko et al., 2002).

Seed thickness:

Seed weight: 7,400 to 22,900 seeds/kg (Sen Gupta, 1937; Chacko et al., 2002).

Seed dispersal:

Seed collection: Pods are collected from the trees by lopping off the branches. Freshly fallen pods can also be collected from the ground (FRI, 1983; Chacko et al., 2002).

Transportation of seeds: The pods collected in cotton or gunny bags are packed and transported (Chacko et al., 2002).

Seed processing: The pods are spread out in the sun until dry, when they open and release the seeds. If the pods do not split open; beat with a stick to release the seeds. Seeds are separated by winnowing (FRI, 1983; Chacko et al., 2002).

Seed storage: Orthodox (CABI, 1998). The seeds can be stored in gunny bags in a dry place for longer periods (Chacko et al., 2002) in metal tins or polythene containers (Aswathanarayana et al., 1997).

Viability period: Seeds retain viability for long period. Seeds stored in stoppered bottle have given 1% germination even after 27 years (FRI, 1983; Chacko et al., 2002).

Seed emptiness: Moderate (Chacko et al., 2002).

Seed pre treatment: Dormancy is due to a water soluble inhibitor present in the seed coat, in addition to the presence of an impermeable seed coat and micropylar plug (Kannan et al., 1996). Soaking 24 hrs in cold water (Kindt et.al., 1997; Chacko et al., 2002). IAA, IBA and GA3 has only a marginal increase in germination and plant percentages at lower concentrations (1-20 ppm) and has an inhibitory effect at higher concentrations (Tiwari et al., 1999). Seed germination is increased by the 3-min hot water seed treatment (Aswathanarayana et al., 1997).

Germination type: Epigeous (Chacko et al., 2002).

Germination percentage: 47 (FRI, 1983; Chacko et al., 2002).

Germination period: 10 to 17 days (Chacko et al., 2002).

Nursery technique: Pre treated seeds are sown in germination trays containing vermiculite. Seedlings are potted in polythene bags of size 20 x 10 cm filled

with potting mixture when they have a pair of leaves (Chacko et al., 2002).

Propagation:

Method of propagation: Seedlings, stump planting.

Vegetative propagation:

Pests: Moderate. Seeds prone to infestation in storage mainly by the bruchids *Bruchus chinensis* Lin., *Bruchids andrewesi* Pic., *B. bilineatopygus* Pic. and *Caryedon serratus* Oliv. (Chacko et al., 2002). Grubs of *Bruchidius bilineatopygus* cause heavy damage to the developing pods and seeds (Abraham et al., 1995). They cause damage by feeding on the endosperm and single grub feeds on 3-4 seeds in succession. Pupation takes place in seeds and adults escape through circular holes drilled on the pods. Field infestation of the pods was 90%. On storage the seeds extracted from infested pods showed a progressive increase in insect infestation.

Diseases: Nineteen fungi, actinomycetes and a bacterium are recorded on seeds. *Penicillium* sp. and *Cladosporium* sp. are the important storage moulds. *Drechslera* sp., *Fusarium* sp., *Myrothecium* sp., *Phoma* sp., *Colletotrichum gloeosporioides* are the important field fungi (Mohanan and Sharma, 1991; Chacko et al., 2001).

References:

Abraham, C.C, Sudhakara, K. and Ushakumari, R. 1995. Occurrence of *Bruchidius bilineatopygus* Pic. (Bruchidae: Coleoptera) as pest of pods and seeds of the multipurpose tree species *Albizia odoratissima*(L.F.) A. procera (Roxb.) and *Paraserianthus falcataria* (L.). Insect environment. 1(1):8.

Medicinal properties: The bark is astringent, acrid, cooling, depurative and expectorant, and is useful in ulcers, leprosy, skin diseases, cough, bronchitis, diabetes and burning sensation. The leaves are emetic and are used for abdominal pain. The fruits and seeds are sweet, acrid and astringent, and are given in biliousness and uterine complaints (CSIR, 1948).

Uses: Wood is used for construction and for making cabinet, good avenue species. It gives a dark brown gum. The leaves are used as fodder. Root bark contains 2,5-deoxyflavones, 7,8-dimethoxy-3',4'-methylenedioxyflavone (1) and 7,2',4'-trimethoxyflavone (2) together with a known flavone, 7,4'-dimethoxy-3'-hydroxyflavone (Rao et al., 2002). *A. odoratissima* can tolerate water stress (Sundaravalli et al., 2005).

Wood properties: Sapwood is whitish or yellowish white and distinct from the heartwood, which is light to dark brown with darker streaks and fairly lustrous. Moderately hard to very hard, heavy. Annual rings sometimes marked by a belt with few or no pores. Pores moderate sized to large, often subdivided, in rings of soft tissue, oblique strings less prominent. Medullary rays fine, rather distant, short, silver grained of long shallow plates (Gamble, 1922).

- Aswathanarayana, S.C., Mahadevappa, M., Ranganathaiah, K.G., Kalappa, V.P., and Reddy, Y.A.N. 1997. Seed viability and microflora of forest tree species. *Indian Journal of Forestry*. 19(4): 326-329.
- Bose, T.K., Das, P. and Maiti, G.G. 1998. *Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa, India.* pp. 45.
- CABI. 1998. *The Forestry Compendium – A Silvicultural Reference. Module 1.* CABI Publishing, CAB International, Wallingford, Oxon, OX108DE, UK.
- Chacko, K.C., Mohanan, C., Seethalakshmi, K.K. and George Mathew. 2001. Seed handling and nursery practices for selected forest trees of Kerala. Final Technical Report of ICFRE – World Bank Forestry Research Education and Extension Project. Kerala Forest Research Institute, Peechi.
- Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. *Manual of Seeds of Forest Trees, Bamboos and Rattans.* Kerala Forest Research Institute, Peechi, Kerala. pp. 54-55.
- CSIR. 1948. *The Wealth of India, Vol. I. A Dictionary of Raw materials and industrial products,* Publication and information directorate, New Delhi.
- FRI. 1983. *Troup's The Silviculture of Indian Trees. Vol. IV.* The Controller of Publications, Delhi.
- Gamble, J.S. 1922. *A manual of Indian timbers.* London Sampson Low, Marton and Company Ltd, Calcutta, India.
- Kannan, C.S., Sudhakara, K., Augustine, A. and Ashokan, P.K. 1996. Seed dormancy and pre-treatments to enhance germination in selected *Albizia* species. *Journal of Tropical Forest Science*. 8(3): 369-380.
- Kindt, R., Mausya, S., Kimotho, J. and Waruhiu. 1997. *Tree seed suppliers Directory: Sources of Seeds and Microsymbionts.* International Centre for Research in Agro Forestry (ICRAF), Nairobi, Kenya.
- Mohanan, C. and Sharma, J.K. 1991. Seed pathology of forest tree species in India - Present status, practical problems and future prospects. *Commonwealth Forestry Review*, 70: 113-151.
- Rao, Y.K., Reddy, M.V.B., Rao, C.V., Duvvuru Gunasekar, Blond, A., Caux, C., and Bodo, B. 2002. Two new 5-deoxyflavones from *Albizia odoratissima*. *Chemical and Pharmaceutical Bulletin*. 50(9): 1271-1272.
- Sasidharan, N. 2004. *Forest Trees of Kerala.* Kerala Forest Research Institute, Peechi, Kerala, India.

Sen Gupta, J.N. 1937. Seed weights, plant percents, etc. for forest plants in India. Indian Forest Records (New Series) Silviculture, 2:221 pp. Manager of Publications, Delhi.

Sundaravalli, V.M., Kailash Paliwal, and Ruckmani, A. 2005. Effect of water stress on photosynthesis, protein content and nitrate reductase activity of Albizzia seedlings. Journal of Plant Biology. 32(1): 13-17.

Tiwari, P.K., Ravi Agrawal, and Savita Kiran. 1999. Studies on the effect of growth regulators on germination percent and plant percent of some leguminous forest tree species. Journal of Tropical Forestry. 15(3): 196-201.

Troup, R. S. 1921. The Silviculture of Indian Trees. (Vol II) International Book Distributors, Dehra Dun.

Albizia procera

Nomenclature:

Scientific name: *Albizia procera* (Roxb.) Benth.

Vernacular name: Jalavaka, Vellavaka (Malayalam) (Sasidharan, 2004); Kondavagei (Tamil) (Bose et al., 1998).

Common name: White siris.

Synonyms: *Mimosa elata*, *Mimosa procera* Roxb. (Sasidharan, 2004).

Family: Leguminosae

Subfamily: Mimosoideae

Origin:

Distribution: Found in sub Himalayan tracts from Yamuna Eastwards to West Bengal, Satpura range, South India and Gujarat (CSIR, 1948).

Description: A large deciduous tree, 18 to 24 m in height (CSIR, 1948).

Flowering season: May to August (CSIR, 1948).

Fruiting season: February to May (CSIR, 1948).

Flowers: Flowers small heads, forming ample deltoid terminal panicles crowded in peduncled corymbs (CSIR, 1948). Heads 1-5 together, in large terminal and axillary panicles; flowers white, 10-12 mm long; corolla about 5 mm long, petals oblong-lanceolate (Bose et al., 1998).

Fruits: Pod 8-20 cm long, reddish brown, 8 to 12 seeded (CSIR, 1948).

Fruit type: Pod.

Seeds: Flat, elliptical to nearly orbicular, hard, smooth, pale brown, with a hard leathery testa (CSIR, 1948).



Fruits

Seed dimension:

Seed length:

Seed width:

Seed thickness:

Seed weight: 21000-24000 seeds/kg (CSIR, 1948).

Seed dispersal:

Seed collection: The pods fall to the ground during the month of May. The ripe pods are collected from the trees before they dehisce during the month of April (CSIR, 1948).

Transportation of seeds:

Seed processing: The pods are dried in the sun, beaten and winnowed to obtain the seeds (CSIR, 1948).

Seed storage: Seed stores well for at least a year in dry sacks in a well-ventilated atmosphere.

Viability period:

Seed emptiness:

Seed pre treatment: Dormancy is due to a water soluble inhibitor present in the seed coat, in addition to the presence of an impermeable seed coat and micropylar plug (Kannan et al., 1996). The seeds should be soaked in cold water for 48 hrs (Edwards and Naithani, 1999). Four-minute boiling in water, followed by 24 hrs cold water dipping. Soaking in 100 ppm gibberellin solution for 24 hrs influence initial seedling growth (Gopal Shukla et al., 2007b). *A. procera* seeds treated in hot water give 66% germination (Lokendra Singh and Khan, 2004). Mechanical scarification or 30 minutes concentrated sulfuric acid treatment give 100% germination. These treatments affect the ultrastructures of the hilar region and the testa surface; effects include removal of the hilar plug, and formation of cracks in the testa surface. The affected regions facilitate water uptake which results in 100% germination (Das and Saha, 1999). Scarification with concentrated H₂SO₄ for 10 or 20 min gave the largest germination

percentage and vigour in *A. procera* (Kannan et al., 1996).

Germination type: Epigeal.

Germination percentage: 50 to 80.66% germination by hot water treatment (Lokendra Singh and Khan, 2004).

Germination period:

Nursery technique: Seedling growth is enhanced significantly with the application of P fertilizer. The nodulation in terms of nodule number and size is also increased significantly with the application of P fertilizer (Uddin et al., 2007). Sand medium gives good vigour index for seedlings (Vanangamudi et al., 1998). Seeds sown in equal proportion of soil, sand and FYM give good germination and initial seedling growth (Gopal Shukla et al., 2007a).

Propagation:

Method of propagation: By seeds.

Vegetative propagation:

Pests: *Albizia procera* seeds in storage recorded 28.0-30.5% damage by *Bruchus bilineatopygus*. To prevent this during long-term storage, sun-dried seeds should be treated with 0.1% malathion (Jayalaxmi Ganguli et al., 2000). Grubs of *Bruchidius bilineatopygus* cause heavy damage to the developing pods and seeds (Abraham et al., 1995). They cause damage by feeding on the endosperm and single grub feeds on 3-4 seeds in succession. Pupation takes place in seeds and adults escape through circular holes drilled on the pods. Field infestation of the pods was 55%. On storage the seeds

extracted from infested pods showed a progressive increase in insect infestation.

Diseases: *Alternaria alternata* causes 34.30% inhibition in the germination of *Albizia procera* seeds (Kavita Tandon et al., 2001). 16 fungi belonging to 8 genera are recorded of which moulds are predominant eg. *Trichothecium roseum*, *Fusarium avenaceum* [*Gibberella avenacea*] etc. are present on seeds of *Albizia procera*. Application of Emisan control the infection (Punam Singh and Mehrotra, 1999).

Medicinal properties: The plant is used for stomach and intestinal diseases and during pregnancy. All parts of the plant are reported to show anti cancer activity (CSIR, 1948).

References:

Abraham, C.C., Sudhakara, K. and Ushakumari, R. 1995. Occurrence of *Bruchidius bilineatopygus* Pic. (Bruchidae: Coleoptera) as pest of pods and seeds of the multipurpose tree species *Albizia odoratissima*(L.F.) A. *procera* (Roxb.) and *Paraserianthus falcataria* (L.). Insect environment. 1(1):8.

Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 45.

CSIR. 1948. The Wealth of India, Vol. I. A Dictionary of Raw materials and industrial products, Publication and Information Directorate, New Delhi.

Das, B. and Saha, P.K. 1999. Effect of dormancy breaking treatments on testa ultrastructures and water uptake patterns of *Albizia procera* seed. Seed Science and Technology.27(2): 615-625.

Edwards, D.G. and Naithani, S.C. 1999. Seed and Nursery Technology of forest trees. New Age, New Delhi.

Gamble, J.S. 1922. A manual of Indian timbers. London Sampson Low, Marton and Company Ltd, Calcutta, India.

Uses: The leaves are said to be a source of condensed type of tannins. Wood is suited for structural purposes, flooring, and panelling (CSIR, 1948).

Wood properties: The sapwood is yellowish white and the heartwood is brown to dark brown. The wood is moderately hard to moderately heavy with shallowly interlocked grain and coarse texture. Annual rings not usually visible. Pores moderate sized and large, in narrow rings of soft tissue, uniformly distributed in small groups of a few, very prominent on a longitudinal section. Medullary rays fine, short, distant (Gamble, 1922).

- Gopal Shukla, Sumit Chakravarty, and Dey, A.N. 2007a. Effect of growing media on germination and initial seedling growth of Albizia procera (Roxb.) Benth. in Terai zone of West Bengal. *Environment and Ecology*. 25S(Special 2): 406-407.
- Gopal Shukla, Sumit Chakravarty, and Pankaj Panwar. 2007b. Effect of date of collection and pre-sowing treatments on germination and initial seedling growth of Albizia procera (Roxb.) Benth. in Terai Zone of West Bengal. *Environment and Ecology*. 25(3): 617-621.
- Jayalaxmi Ganguli, Yadav, S.B., Swamy, S.L., and Sunil Puri. 2000. Bruchus bilineatopygus Pic.: a pest of Albizia procera and A. lebbek seeds in storage. *Insect Environment*. 6(1): 6-7.
- Kannan, C.S., Sudhakara, K., Augustine, A. and Ashokan, P.K. 1996. Seed dormancy and pre-treatments to enhance germination in selected Albizia species. *Journal of Tropical Forest Science*. 8(3): 369-380.
- Kavita Tandon, Khan, S.N. and Singh, P.K. 2001. Effect of toxic metabolites of seed-borne fungi on germination of Albizia procera. *Indian Journal of Forestry*. 24(1): 88-89.
- Lokendra Singh and Khan, M.H. 2004. Effects of various treatments on seed germination of Albizzia sp. *Plant Archives*. 4(1): 159-161
- Punam Singh and Mehrotra, M.D. 1999. Seed-borne fungi of some forest trees and their control. *Indian Journal of Forestry*. 22(4): 320-324.
- Sasidharan, N. 2004. *Forest Trees of Kerala*. Kerala Forest Research Institute, Peechi, Kerala, India.
- Uddin, M.B., Mukul, S.A., Khan, M.A.S.A., and Hossain, M.K. 2007. Effects of phosphorous fertilizer on seedlings growth and nodulation capabilities of some popular agroforestry tree species of Bangladesh. *Journal of Forestry Research*. 18(4): 283-286, 2.
- Vanangamudi, K., Umarani, R., and Venkatesh, A. 1998. Media for testing germination of Albizia procera. *Seed Research*. 26(2): 195-196.

Aleurites moluccana

Nomenclature:

Scientific name: *Aleurites moluccana* (L.) Willd.

Vernacular name: Akkrottu, Akshotam (Malayalam); Nattakarottu (Tamil), Candle nut tree (English).

Common name: Jungle akhrot, Candle nut tree, Indian walnut.

Synonyms: *A. javanica* Forst.

Family: Euphorbiaceae

Subfamily:

Origin: Indo-Malaysian region.

Distribution: Native to the Indo - Malaysian region, but now widely distributed throughout the tropics. It is naturalized in India and is found in a wild state in South India and Assam.

Description: 25 m high with soft wood. An evergreen tree of medium height, up to 15 m; shoots, young leaves, petioles and inflorescence clothed with grey, stellate tomentum (Bose et al., 1998).

Flowering season: March to May.

Fruiting season: During rainy season.

Flowers: Flowers white, shortly pedicelled in tomentose cymes. Unisexual, monoecious, white, in large, terminal cymose panicles; calyx 2-3-lobed, velvety; petals 5, 6-10 mm long; male flowers: stamens 15-20, on hairy receptacle; ovary 2-celled (Bose et al., 1998).

Fruits: Moderate sized globose, green dry drupe up to 5 cm long with rough mesocarp and containing a single seed.

Fruittype: Drupe.

Seeds: Seeds are contained within a hard, black, rough shell elliptical in shape.

Seed dimension:

Seed length:

Seed width:

Seed thickness:



Seed

Seed weight: 100 to 120 seeds/kg.

Seed dispersal:

Seed collection:

Transportation of seeds:

Seed processing:

Seed storage:

Viability period:

Seed emptiness:

Seed pre treatment:

Germination type:

Germination percentage: 80

Germination period:

Nursery technique:

Propagation:

Method of propagation: By seeds and vegetative method.

Vegetative propagation: Propagated vegetatively

Pests:

Diseases:

Medicinal properties: The plant is used to treat pain in the bones and weakness after child birth. The leaves are used to treat constipation and food poison. Bark is used

References:

Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 46.

Pedrosa, R.C., Meyre Silva, C., Cechinel Filho, V., Benassi, J.C., Oliveira, L.F.S., Zancanaro, V., Magro, J dal, and Yunes, R.A . 2002. Hypolipidaemic activity of methanol extract of Aleurites moluccana. Phytotherapy Research. 16(8): 765-768.

Satyanarayana, P., Kumar, K.A., Singh, S.K. and Rao, G.N. 2001. A new phorbol diester from Aleurites moluccana. Fitoterapia. 72(3): 304-306.

Sotheeswaran, S., Sharif, M.R., Moreau, R.A., and Piazza, G.J. 1994. Lipids from the seeds of seven Fijian plant species. Food Chemistry. 49(1): 11-13.

to treat wounds. A decoction of the leaves is used in treating cough, diarrhoea, pains in the chest and hernia. Benzene extract of the heartwood contains phorbol diester, (13-O-myristyl-20-O-acetyl-12-deoxyphorbol (1)), hentriacontane, 6,7-dimethoxycoumarin, 5,6,7-trimethoxycoumarin and beta - sitostenone (Satyanarayana et al., 2001). Methanol leaf extract of Aleurites moluccana has lipid-lowering action through inhibition of hepatic cholesterol biosynthesis and reduction of lipid absorption in the intestine (Pedrosa et al., 2002). The seed oil of A. moluccana contains high concentrations of the fatty acids 18:2 (43.8 mol%) and 18:3 (25.8 mol%) and gamma-tocopherol (Sotheeswaran et al., 1994).

Uses: Fruit contains alkaloids and seeds contain lipids, proteins and other chemicals.

Wood properties: Wood is soft and is used for making packing cases. It is reported to be suitable for match sticks and as a raw material for pulp.

Alnus nepalensis



Nomenclature:

Scientific name: *Alnus nepalensis* D. Don

Vernacular name: Alnus (Malayalam); Alnus (Tamil); Alnus (Kannada) (Chacko et al., 2002).

Common name: Nepalese alder (Chacko et al., 2002; Troup, 1921). Indian alder, Udis.

Synonyms: *Alnus mairei* A. Leveille, *Clethropsis nepalensis* Spach. (Chacko et al., 2002).

Family: Betulaceae

Subfamily:

Origin: Burmese hills.

Distribution: Native of Burmese hills and the Himalayas from 1000 m to 3000 m above sea level. Planted extensively in the hills of Northern and Southern India (Chacko et al., 2002).

Description: Fast growing, shade tolerant, large deciduous tree with 30 m height, and breast height diameter of 80 cm with straight cylindrical bole (Chacko et al., 2002).

Flowering season: April to June (Bose et al., 1998). September to November (Troup, 1921).

Fruiting season: February to March (Troup, 1921). December to January (Sen Gupta, 1937; Chacko et al., 2002).

Flowers: Flowers in group of 5-12, subtended by both bracts and bracteoles,

perianth 4-lobed, stamens-4. Male catkins slender to 12 cm in terminal drooping clusters. Female clusters cone-like, becoming woody (Sahni, 2000). Inflorescence axillary or terminal; male spikes: paniced, pendulous, 10-20 cm long; flowers in groups of 5-12, subtended by both bracts and bracteoles; perianth 4-lobed; stamens 4, with ciliate scales; female spikes: 6-10 mm long, in groups, pendulous; bracteoles 2-4; perianth absent; ovary 2-celled, 1 ovule in each cell (Bose et al., 1998).



Habit



Twig with seeds



Seeds

Fruits: Ovoid, woody cone, 1-2.5 cm long. Cones 1.2-2.5 x 0.7 cm in erect clusters. Nutlet with a narrow papery wing (Sahni, 2000). Fruit, spikes, 12 x 7 mm, ovoid or cylindrical, short peduncled in lateral panicles (Chacko et al., 2002).

Fruit type: Cones.

Seeds: Nuts with a narrow membranous wing (Chacko et al., 2002; Troup, 1921).

Seed dimension:

Seed length: 1 mm (Chacko et al., 2002).

Seed width:

Seed thickness:

Seed weight: 5,29,110 seeds/kg (Sen Gupta, 1937; Chacko et al., 2002); 28,57,142 seeds/kg; 2,18,000 to 30,00,000 seeds /kg (Carlowitz, 1991; Chacko et al., 2002).

Seed dispersal: Wind dispersal.

Seed collection: Fruits are collected from the trees by lopping off the branches before they dehisce (Chacko et al., 2002).

Transportation of seeds: Fruits collected in plastic / cotton / polythene bags are packed and transported. Tight packing may be avoided if the fruits are moist (Chacko et al., 2002).

Seed processing: Cones are sun-dried and beaten with a stick to release the seeds. Care should be taken during extraction of seeds as they are easily blown by wind (Chacko et al., 2002).

Seed storage: Orthodox (Napier and Robbins, 1989; CABI, 1998). Seeds can be stored in sealed polythene bags, plastic container and kept in a cool place for more than one year (Napier and Robbins, 1989).

Viability period: Seed kept in unsealed containers absorbs moisture very quickly and loose viability in a few months (Napier and Robbins, 1989; Chacko et al., 2002).

Seed emptiness: Low (Chacko et al., 2002).

Seed pre treatment: Not necessary (Chacko et al., 2002).

Germination type: Epigeal (Chacko et al., 2002).

Germination percentage: 70 (Carlowitz, 1991; Chacko et al., 2002).

Germination period: 7 to 30 days (Napier and Robbins, 1989; Chacko et al., 2002).

Nursery technique: Seeds are sown in plastic trays containing vermiculite and watered. The seedlings are potted in polythene bags of size 10 x 20 cm when they have 2 to 4 primary leaves and should be maintained under shade. The growth of seedlings is slow (Chacko et al., 2002).

Propagation:

Method of propagation: By seed.

Vegetative propagation:

Pests: No information (Chacko et al., 2002).

Diseases: Eleven fungi, bacteria and actinomycetes were recorded. *Alternaria* sp., *Chlamydomyces palmarum* are the

important fungi recorded (Mohanan and Anil Chandran, 2001; Chacko et al., 2002).

Medicinal properties: The astringent alder is employed most often as a mouthwash and argle for tooth, and throat problems. Leaves are used to help reduce breast engorgement in nursing mothers. A decoction of bark is used for the treatment of external bleeding and to heal wounds (Sahni, 2000).

Uses: Wood yields 39% pulp suitable for news print production and for ordinary wrapping and writing paper. Leaves are sometimes used as fodder. The bark contains 7% tannin, used in dyeing (Bose et al., 1998).

Wood properties: Wood light pinkish brown, soft, light and even-grained (Troup, 1921).

References:

- Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 46-51.
- CABI. 1998. The Forestry Compendium- A Silvicultural Reference. Module 1. CABI publishing, CAB International, Wallingford, Oxon, OX108DE, UK.
- Carlowitz, P.G.V. 1991. Multipurpose Trees and Shrubs: Source of seeds and Inoculants. International Council for Research in Agroforestry, Nairobi, Kenya.
- Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 56-57.
- Mohanan and Anil Chandran. 2001. Microorganisms associated with seeds of tropical forest species and their management for improving the storability and seedling production. Seed Science and Technology (in press).
- Napier, I. and Robbins, M. 1989. Forest Seed and Nursery Practices in Nepal. Sahayogi Press, Kathmandu.
- Sahni, K.C. 2000. The Book of Indian Trees. BNHS, Mumbai.
- Sen Gupta, J.N. 1937. Seed weights, plant percents, etc. for forest plants in India. Indian Forest Records (New Series) Silviculture, 2:221pp. Manager of Publications, Delhi.
- Troup, R.S. 1921. The Silviculture of Indian Trees. (Vol III) International Book Distributors, Dehra Dun.

Aphanamixis polystachya

Nomenclature:

Scientific name: *Aphanamixis polystachya* (Wall.) Parker

Vernacular name: Chemmaram (Malayalam) (Sasidharan, 2004); Malampuluvan (Tamil) (Bose *et al.*, 1998).

Common name: Rohituka tree

Synonyms: *Aglaia polystachya* Wall., *Amoora rohituka* Wt. & Arn., (Sasidharan, 2004). *Amoora macrophylla* Nimmo., *Sphaerosaema polystachya* Wall., *Sphaerosaema spicata* Wall., *Andersonia rohituka* Roxb. (Gamble, 1922).

Family: Meliaceae

Subfamily:

Origin:

Distribution: Throughout India, in evergreen forests. Also distributed in Myanmar, Sri Lanka, and Philippines. In Kerala it occurs in Calicut, Palghat, Trichur, Ernakulam, Idukki and almost throughout the state in the mid and highlands.

Description: A medium to large sized tree, 18-25 m height.

Flowering season: April to May, September to November (Bose *et al.*, 1998).

Fruiting season: February to March; February to April (Bose *et al.*, 1998).

Flowers: Flowers small, unisexual, dioecious, males sessile, in terminal

panicles, female solitary, in spike, up to 35 cm long. Flowers yellow or dull white, 3 to 5 mm across, petals 3, anthers 6, attached to the staminal tube (Bose *et al.*, 1998).

Fruits: Fruit globose or obovoid capsule, 3 valved, 3 to 4 cm long, pinkish white or yellow when ripe (Bose *et al.*, 1998).

Fruit type:

Seeds: Seeds two or three, purplish brown, broadly ovoid, smooth, shining, marked with raised fibrous raphe along the ventral side.

Seed dimension:

Seed length:

Seed width:

Seed thickness:

Seed weight:

Seed dispersal:

Seed Collection:

Transportation of seeds:

Seed processing:

Seed storage: Seeds show a recalcitrant storage behaviour (Ellis *et al.*, 2007).

Viability period:

Seed emptiness:

Seed pre treatment:

Germination type:

Germination percentage:

Germination period:

Nursery technique:

Propagation:

Method of propagation:By seeds.

Vegetative propagation:

Pests:

Diseases: The oil and alkaloid solution show antifungal activities against fungi like *Alternaria alternata*, *Cochliobolus lunatus*, *Colletotrichum corchori*, *Fusarium equiseti*, *Macrophomina phaseolina* and *Botryodiplodia theobromae* (Bhuyan *et al.*, 2000).

Medicinal properties: Seeds and bark of the tree is extracted for medicinal use. The bark is astringent, bitter, vulnerary, digestive. The seeds are useful in ulcers, otopathy, skin diseases, intestinal worms. A new compound isolated from the bark of the *Aphanamixis polystachya* (a plant widely used in folk medicine in India) has been characterized as dihydroamoorinin by physicochemical studies (Agarwal *et al.*, 2001). It is also used in traditional medicine to treat diseases of the spleen, liver and abdomen, and rheumatism and tumours (Rabi, 1996). Extracts have anticancer potential. It was tested using the brine shrimp lethality assay, sea urchin eggs assay, hemolysis assay and MTT assay using tumour cell lines (Costa *et al.*, 2005). *A. polystachya* seeds have antimicrobial activities against human bacterial strains (*Staphylococcus aureus* ATCC 6538, *Escherichia coli* ATCC 8739, *Shigella dysenteriae*-1 AE 14396, *Salmonella*

*typhi*AE 14612 and INABA-ET AE 14748, *Bacillus cereus* and *B. subtilis*) and plant pathogenic fungi (*Alternaria alternata*, *Cochliobolus lunatus*, *Colletotrichum corchori*, *Fusarium equiseti*, *Macrophomina phaseolina*, *Drechslera oryzae* [*Cochliobolus miyabeanus*] and *Botryodiplodia theobromae*) (Bhuyan *et al.*, 2000). Stem bark has Amooranin (25-hydroxy-3-oxoolean-12-en-28-oic acid), a triterpene acid. Amooranin and its methyl ester has greater cytotoxicity against MCF-7 and HeLa cells derived from tumour tissues with a 50% inhibitory concentration (IC₅₀) of 1.8-3.4 micro g/mL (Rabi *et al.*, 2002). It is used in traditional medicine to treat diseases of the spleen, liver and abdomen, and rheumatism and tumours (Rabi, 1996). A resuspended residue of the alcohol extract of bark has antihepatotoxic activity in rats with hepatic injury induced by CCl₄ (Gole *et al.*, 1997).

Uses: The fruit is associated with the folk religious songs of Manipur. The wood is used for all types of construction work. Water and acetone leaf extract has toxicant, repellent and feeding deterrent activity on grain weevil (*Sitophilus granarius* L.) (Islam *et al.*, 2004). Bark has a limonoid, dihydroamoorinin (Agarwal *et al.*, 2001). Sub-fractions of an acetone extract of seeds have feeding deterrent effects on adult *T. castaneum* (Talukder and Howse, 2000). Petroleum ether extract of stem bark has phenolics, eugenol and myristicin along with stigmaterol (Rasheduzzaman-Chowdhury *et al.*, 2003) gal effect. The petrol ether, dichloromethane and methanol extracts have antibacterial activity and antifungal activity (Chowdhury *et al.*, 2003). Hexane extracts

of the seed yields kihalactone A and three novel limonoids (Mulholland and Naidoo, 1999). Seed oil has 7-keto-octadec-cis-11-enoic acid (Daulatabad and Jamkhandi, 1997) and seed extracts possess repellent

and antifeedant activity (Talukder and Howse, 1995).

Wood properties: Close and even grained, hard. Wood is moderately heavy. Pores small and moderate sized.

References:

- Agarwal, S.K., Sushma Verma, Singh, S.S., and Sushil Kumar. 2001. A new from *Aphanamixis polystachya*. Indian Journal of Chemistry Section B, Organic including Medicinal. 40(6): 536-538.
- Bhuyan, M.A.K., Begum, J., Chowdhury, J.U., Ahmed, K., and Anwar, M.N. 2000. Antimicrobial activity of oil and crude alkaloids from seeds of *Aphanamixis polystachya* (Wall.) R.N. Parker. Bangladesh Journal of Botany. 29(1): 1-5.
- Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 57.
- Chowdhury, R., Hasan, C.M., and Rashid, M.A. 2003. Antimicrobial activity of *Toona ciliata* and *Amoora rohituka*. Fitoterapia. 74(1/2): 155-158.
- Costa Lotufo, L.V., Khan, M.T.H., Arjumand Ather; Wilke, D.V., Jimenez, P.C., Pessoa, C., Moraes, M.E.A de., Moraes, M.O de. 2005. Studies of the anticancer potential of plants used in Bangladeshi folk medicine. Journal of Ethnopharmacology. 99(1): 21-30.
- Daulatabad, C.D. and Jamkhandi, S.A.M. 1997. A keto fatty acid from *Amoora rohituka* seed oil. Phytochemistry. 46(1): 155-156.
- Ellis, R.H., Mai Hong, T., Hong, T.D., Tan, T.T., Xuan Chuong, N.D., Hung, L.Q., Ngoc Tam, B., and Le Tam, V.T. 2007. Comparative analysis by protocol and key of seed storage behaviour of sixty Vietnamese tree species. Seed Science and Technology. 35(2): 460-476.
- Gamble, J.S. 1922. A manual of Indian timbers. London Sampson Low, Marton and Company Ltd, Calcutta, India.
- Gole, M.K., Dasgupta, S., Sur, R.K., and Ghosal, J. 1997. Hepatoprotective effect of *Amoora rohituka*. International Journal of Pharmacognosy. 35(5): 318-322.
- Islam, M.N., Talukder, M.A.H., Nasreen, A., Islam, M.R., and Alam, M.M. 2004. Pesticidal potentials of some indigenous plants against grain weevil, *Sitophilus granarius* L. (coleoptera: curculionidae). Journal of Subtropical Agricultural Research and Development. 2(2): 47-52.

Alstonia scholaris

Nomenclature:

Scientific name: *Alstonia scholaris* (L.) R. Br.

Vernacular name: Pala, Elaipalai, Mukampalei (Tamil); Ezhilampala, Kodapal, Mangalapala, Pala (Malayalam); Chatian, Chatium (Hindi) (Chacko et al., 2002).

Common name: Devils tree, Black board tree (Chacko et al., 2002); Chatian.

Synonyms: *Echites scholaris* L. (Chacko et al., 2002; Sasidharan, 2004).

Family: Apocynaceae

Subfamily:

Origin:

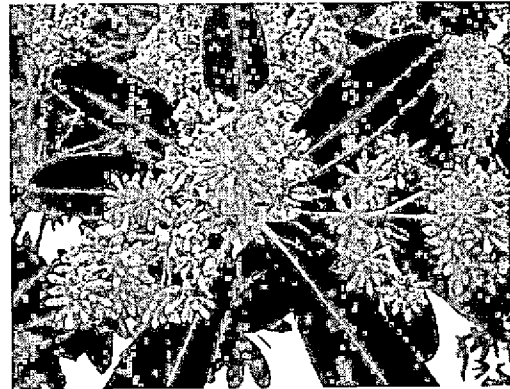
Distribution: Occurs throughout the moist regions of India in Northern tropical semi-evergreen forest and in the West coast forests (Sahni, 2000). In Kerala, it occurs in moist deciduous forests (Chacko et al., 2002).

Description: Fast growing, large buttressed and fluted evergreen tree reaching 30 m height, and a breast height diameter of 143 cm (FRI, 1985; Chacko et al., 2002). Branches whorled, exuding milk latex when cut (Sahni, 2000).

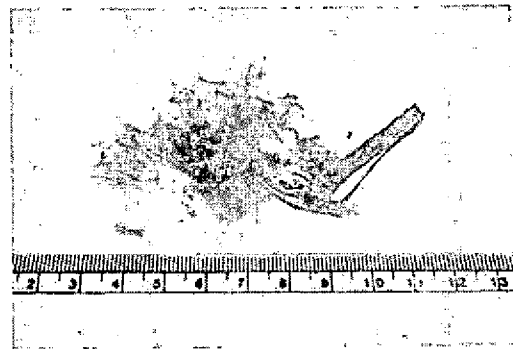
Flowering season: December to March (Sahni, 2000); November to December (Bourdillon, 1908); October to December (Bose et al., 1998).

Fruiting season: May to July (Gopikumar et al., 2003); December to January and April to May (FRI, 1985; Luna, 1996; Chacko et al., 2002; Bhat et al., 2003).

Flowers: Greenish-white, flowers small, numerous in umbellate panicles, corolla tube short, very strongly scented, born in capitate cymes. Flowers in many-flowered corymbose cymes on long terminal stalks; calyx 5-lobed; corolla tube about 6 mm long (Bose et al., 1998).



Twig with flowers



Seeds

Fruits: Fruit is a pair of follicles, slender, 30-60 cm long and pendulous with numerous seeds, which are linear-oblong

shaped with a tuft of hairs at both ends (Chacko et al., 2002).

Fruit type: Follicle.

Seeds: Seeds about 3 lines long, the hairs at each end longer than the seed itself.

Seed dimension:

Seed length: 0.8 cm (Chacko et al., 2002).

Seed width:

Seed thickness:

Seed weight: 2,70,000 to 6,60,000 seeds/kg (FRI, 1985; Chacko et al., 2002).

Seed dispersal: By wind.

Seed collection: Fruits are collected from the trees by lopping branches just before they dehisce. Care should be taken while collecting the seeds as the pods may burst open and release the seeds (FRI, 1985; Chacko et al., 2002).

Transportation of seeds: Follicles (Fruits) are loosely packed in cotton bags / plastic bags and transported. Adequate air circulation within the stack should be ensured (Chacko et al., 2002).

Seed processing: Care should be taken during extraction of the seeds. Do not keep the follicles exposed, as the seeds are blown away by wind easily. Keep follicles in cotton bags for a few days, till they dehisce and release the seeds (Chacko et al., 2002).

Seed storage: Orthodox (CABI, 1998). Seeds can be stored for two months in sacks

(Kumar and Bhanja, 1992; Chacko et al., 2002).

Viability period: Seeds are viable for about two months under natural conditions (Chacko et al., 2002).

Seed emptiness: No information (Chacko et al., 2002).

Seed pre treatment: No treatment is required (Chacko et al., 2002). However, soaking in IAA (200 ppm), water soaking for 24 h and continuous hot water (50°C) soaking for 30 min. improve germination (Kundu et al., 1998).

Germination type: Epigeal (Chacko et al., 2002).

Germination percentage: 50 to 60 (Kumar and Bhanja, 1992; Chacko et al., 2002).

Germination period: 14 to 20 days (Chacko et al., 2002).

Nursery technique: Seeds are sown in germination trays filled with vermiculite and watered regularly. Seedlings are potted in polythene bags of size 22.5 x 17.5 cm filled with soil and maintained under shade and irrigation (Chacko et al., 2002).

Propagation:

Method of propagation: By seeds, Vegetative propagation.

Vegetative propagation:

Pests: No information (Chacko et al., 2002).

Diseases: No information (Chacko et al., 2002).

- Mulholland, D.A. and Naidoo, N. 1999. Limonoids from Aphanamixis polystachya. *Phytochemistry*. 51(7): 927-930.
- Nair, K.K.N. 2001. Manual of non-wood forest produce plants of Kerala. KFRI, Peechi.
- Rabi, T. 1996. Antitumour activity of amooranin from Amoora rohituka stem bark. *Current Science*. 70(1): 80-81.
- Rabi, T., Karunakaran, D., Nair, M.K., and Bhattathiri, V.N. 2002. Cytotoxic activity of amooranin and its derivatives. *Phytotherapy Research*. 16(S1): S84-S8.
- Rasheduzzaman Chowdhury, Rashid, R.B., and Hasan, C.M. 2003. Phenolics from the stem bark of Amoora rohituka. *Journal of Tropical Medicinal Plants*. 4(1): 1-3.
- Sasidharan, N. 2004. Forest Trees of Kerala. Kerala Forest Research Institute, Peechi, Kerala, India.
- Talukder, F.A. and Howse, P.E. 1995. Evaluation of Aphanamixis polystachya as a source of repellents, antifeedants, toxicants and protectants in storage against *Tribolium castaneum* (Herbst). *Journal of Stored Products Research*. 31(1): 55-61.
- Talukder, F.A., and Howse, P.E. 2000. Isolation of secondary plant compounds from Aphanamixis polystachya as feeding deterrents against adult *Tribolium castaneum* (Coleoptera:Tenebrionidae). *Zeitschrift für Pflanzenkrankheiten und Pflanzenschutz*. 107(5): 498-504.

Medicinal properties: The fresh bark juice with milk is administered in leprosy. Also as a bitter tonic. The bark is used to dispel fever and in the treatment of dysentery, skin diseases, asthma, malarial fever and ulcers. Bark drugs from *Alstonia* is used for the treatment of different human ailments (Khan et al., 2003b). Extracts from leaves, bark and flowers of *A. scholaris* possess antimalarial, antidiarrhoeal, antifilarial, antimutagenic and antileishmanial properties (Ansari et al., 2004). Crude methanolic extracts of *Alstonia scholaris* show antibacterial activity against 25 bacteria (including *Escherichia coli*, *Bacillus subtilis*, *Proteus vulgaris* and *Pseudomonas aeruginosa*), a protozoan (*Trichomonas vaginalis*) and 11 fungi (including *Aspergillus niger*, *Cladosporium cladosporioides*, *Penicillium notatum* [*P. chrysogenum*] and *Trichophyton mentagrophytes*) (Khan et al., 2003a). Flower extracts at 1:10 (w/v) concentration shows nematicidal activity against root-knot nematode (*M. incognita*) (Rakesh Pandey et al., 2001; Saleem et al., 1997). Ethanolic extract of fruits of *Alstonia scholaris* possess anthelmintic activity against adult earthworms (*Pheretima posthuma*). In addition, *A. scholaris* contain various alkaloids, flavonoids and phenolic acids having antimicrobial, antiamoebic, antidiarrhoeal, antiplasmodial,

References:

- Ajay Singh and Singh, S.K. 2005. Molluscicidal evaluation of three common plants from India. *Fitoterapia*. 76(7/8): 747-751.
- Ansari, M.M., Javed Ahmad, Ansari, S.H. and Khan, S.A. 2004. *Alstonia scholaris* (L.) R. Br. - a review on its chemistry and biological activities. *Hamdard Medicus*. 47(1): 45-49.
- Arambewela, L.S.R. and Ratnayake, C. 1991. Constituents of *Alstonia scholaris*. *Fitoterapia*. 62: 357.

hepatoprotective, immunomodulatory, anti-cancer, antiasthmatic, free radical scavenging, antioxidant, analgesic, antiinflammatory, antiulcer, antifertility and wound healing activities. Traditionally it is also used for its cardiotonic, anti-diabetic and anti-arthritic properties (Arulmozhi et al., 2007). It is used as a bitter tonic, febrifuge and anthelmintic. It also serves as a remedy for malaria, diarrhoea and dysentery (Arambewela and Ratnayake, 1991).

Uses: Aqueous extract of latex is of great value for the control of harmful aquatic snails *Lymnaea acuminata* and *Indoplanorbis exustus* and other molluscan pests (Ajay Singh and Singh, 2005). Leaves, bark and roots possess echitamine, picric acid and tubotaiwine and picraline deacetyl (Arambewela and Ratnayake, 1991). The tree is used for the construction of flood trap. It is easily raised through seeds. The wood is used for packing cases, match splints, tea boxes and furniture. Also used in paper industry.

Wood properties: Wood white, soft, even grained, lustrous. The bark is grey and rough and exude a milky latex when cut. Wood of *Alstonia scholaris* is suitable for pencil manufacture (Khan, 1963).

- Arulmozhi, S., Mazumder, P.M., Purnima Ashok and Narayanan, L.S. 2007. Pharmacological activities of Alstonia scholaris Linn. (Apocynaceae) - A review.
- Bhat, D.M., Vidya, S.S. and Ravindranath, N.H. 2003. Nursery manual for forest tree species. Universities Press, Hyderabad, India.
- Bora, P.J. and Yogendra Kumar. 2003. Floristic diversity of Assam: study of Pabitora Wild life Sanctuary. Daya publishing House, New Delhi. pp. 452.
- Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 51.
- Bourdillon, T.F. 1908. Forest trees of Travancore. International Book Distributors, Dehradun. pp. 265-266.
- CABI. 1998. The Forestry Compendium – A Silvicultural Reference. Module 1. CABI Publishing, CAB International, Wallingford, Oxon, OX108DE, UK.
- Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 58-59.
- FRI. 1985. Troup's Silviculture of Indian Trees. Vol. VI. The Controller of Publications, Delhi.
- Gopikumar, K., Gopakumar, S. and Anoop, E.V. 2003. Nursery manual for forest tree species. International Book Distributors.
- Khan, S.A. 1963. Pencil wood studies. Pakistan J. For. 13 (4), (367-9).
- Khan, M.R., Omoloso, A.D. and Kihara, M. 2003a. Antibacterial activity of Alstonia scholaris and Leea tetramera. Fitoterapia.74(7/8): 736-740.
- Khan, S.A. 1963. Pencil wood studies. Pakistan J. For. 13 (4), (367-9).
- Khan, S.A., Ahmad, J. and Ansari, S.H. 2003b. Ethnobotanical aspects of some medicinal barks of forestry origin. Forest conservation and management.470-479.
- Kumar, S.V. and Bhanja, M. 1992. Forestry Seed Manual of Andhra Pradesh. Andhra Pradesh Forest Department, Hyderabad, India.
- Kundu, M., Sharma, P., Kachari, J. and Sett, R. 1998. Effect of pretreatment on germination and seedling vigour in Alstonia scholaris. Seed Research. 25(1): 16-18.
- Luna, R.K. 1996. Plantation Trees. International Book Distributors, Dehra Dun, India.

Rakesh Pandey, Alok Kalra, Neetu Katiyar and Sunil Kumar. 2001. Nematicidal activity in flowers of some medicinal and aromatic plants: *Indian Journal of Nematology*. 31(1): 96-98.

Sahni, K.C. 2000. *The Book of Indian Trees*. BNHS, Mumbai.

Saleem, K., Sultana, V., Ara, J. and Ehteshamul Haque, S. 1997. Nematicidal activity of some medicinal plants. *Pakistan Journal of Nematology*. 15(1/2): 101-105.

Sasidharan, N. 2004. *Forest Trees of Kerala*. Kerala Forest Research Institute, Peechi, Kerala, India.

Alstonia venenata

Nomenclature:

Scientific name: *Alstonia venenata* R. Br.

Vernacular name: Analivegam, Thippili, Theeppala (Malayalam) (Sasidharan, 2004); Sinnappalai, Pazha munnipala (Tamil).

Common name:

Synonyms:

Family: Apocynaceae

Subfamily:

Origin:

Distribution: Distributed in the Western Ghats, Nilgiri and Palni hills, also in Orissa (Bose et al., 1998).

Description: A small tree, up to 6 m high, branches many, erect, with greyish brown bark, delicately rugose, bright yellow hard and woody root.

Flowering season: April to July.

Fruiting season:

Flowers: Flowers white, calyx glabrous, lobes ciliate, small, in terminal, subumbellate cymes or in racemes. Corolla with slender tube, about 2 cm long; petal lobes about 12 mm long; anthers at the mouth of tube (Bose et al., 1998).

Fruits: Fruit fusiform, stalked and beaked follicles, tapering at both ends. Follicles slender, terete, 8 to 10 cm long, wide at the middle region, tapering at both ends and with long beak (Bose et al., 1998).

Fruit type: Follicles.

Seeds: Seeds many, flattened with a tuft of hair at each end (Prajapati et al., 2003); wing-like margin all around or at both ends (Bose et al., 1998).

Seed dimension:

Seed length:

Seed width:

Seed thickness:



Branches



Twig with flowers

Seed weight:

Seed dispersal: By wind.

Seed collection:

Transportation of seeds:

Seed processing:

Seed storage:

Viability period:

Seed emptiness:

Seed pre treatment:

Germination type: Epigeal.

Germination percentage:

Germination period:

Nursery technique:

Propagation:

Method of propagation: By seeds.

References:

Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 53.

Prajapati, N.D., Purohit, S.S., Arun K. Sharma and Tarun Kumar. 2003. A Hand Book of medicinal plants. A complete source book. Agrobios. Jodhpur, India.

Sasidharan, N. 2004. Forest Trees of Kerala. Kerala Forest Research Institute, Peechi, Kerala, India.

Singh, S.K., Sarma, B.K., Srivastava, J.S., Singh, U.P. and Ray, A.B. Antifungal activity of Delta superscript 3-*alstovenine*, a plant alkaloid isolated from *Alstonia venenata*. *Folia Microbiologica*. 1999. 44(5): 510-512.

Singh, U.P., Sarma, B.K., Mishra, P.K. and Ray, A.B. 2000. Antifungal activity of *venenatine*, an indole alkaloid isolated from *Alstonia venenata*. *Folia Microbiologica*. 45(2): 173-176

Vegetative propagation:

Pests:

Diseases:

Medicinal properties: The roots are used for the treatment of skin diseases, leprosy, cobra bite and other venomous bites. The fruits are useful in syphilis, insanity and epilepsy and a remedy for impure blood. The indole alkaloid *venenatine* exhibit antifungal activity against *Fusarium udum*, *Alternaria brassicicola*, *Ustilago cynodontis* and *Aspergillus flavus* (Singh et al., 2000; Singh et al., 1999).

Uses: Tree yields guttapercha-like concrete latex called *Bresk* or *Dead Borneo*; *lupeol* is its chief constituent (Bose et al., 1998).

Wood properties: Wood white, soft and even grained. Pores moderate sized, oval, ringed, scanty.

Anacardium occidentale

Nomenclature:

Scientific name: *Anacardium occidentale* L.

Vernacular name: Kasumavu, Parankimavu (Malayalam); Muntiri paruppu, Kola mavu, Mundiri (Tamil); Kaju (Hindi) (Gamble, 1922).

Common name: The Cashew nut tree (Gamble, 1922).

Synonyms:

Family: Anacardiaceae

Subfamily:

Origin: South America (Sasidharan, 2004).

Distribution: Cultivated widely along the sea coasts. Introduced by the Portuguese from Brazil centuries ago in Goa and now common in India. It is cultivated in Maharashtra, Andhra Pradesh, Kerala, Tamil Nadu, Orissa and West Bengal (Bhat et al., 2003).

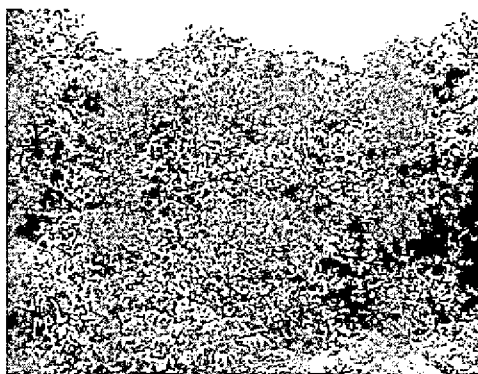
Description: A small tree with short, thick, crooked trunk, 18 to 12 m high.

Flowering season: December to April / March to May (Sahni, 2000).

Fruiting season: March to June.

Flowers: Small, yellow, with pink stripes borne in 15-25 cm long, terminal panicles, with both staminate and hermaphrodite flowers. The perianth is typically pentamerous. There are from 8 to 11 stamens, of unequal size, 1 or 2 being about

7.9 and 6.1 mm in length in staminate and hermaphrodite flowers, respectively, compared to 3-5 mm for the others. Gynoecium, style and stigma are present in both hermaphrodite and male flowers, although rudimentary in the latter. The carpel size varies from 0.1-6.0 mm for staminate and 6.0-12.0 mm for hermaphrodite flowers, respectively (Ascenso and Mota, 1972).



Habit



Twig with flowers



Seeds

Fruits: Drupe is a kidney-shaped nut, hard smooth, oleaginous, 2.5 cm long, seated on a fleshy thick hypocarp which is 5 to 8 cm long, formed of the enlarged torus and calyx base (Troup, 1921).

Fruit type: Drupe.

Seeds: One seeded, greyish white nut.

Seed dimension:

Seed length:

Seed width:

Seed thickness:

Seed weight: 150 - 300 seeds/kg.

Seed dispersal: Birds and Bats.

Seed collection: Ripe pods are collected from the trees, dried and seeds are extracted, cleaned and stored (Vanangamudi and Natarajan, 2006). Nuts are collected from the ground under the mother tree during the month of April to May.

Transportation of seeds:

Seed processing:

Seed storage: Cashew shows orthodox seed storage behaviour (Mwasha et al., 1998). After sun-curing, cashew seeds are stored in polyethylene bags at 10°C for one month (Hore and Sen, 1999).

Viability period:

Seed emptiness:

Seed pre treatment: Pre-soaking cashew seeds in chloroform or acetone for 2 h hastens and partially synchronize germination and advanced field emergence. The organic solvents remove the waxy layer of the pericarp and thereby facilitate water imbibition and phenol exudation (Subbaiah and Chenchu Subbaiah, 1982).

Germination type: Epigeal.

Germination percentage: Increasing medium salinity reduce germination percentage and rate, as well as seedling growth (Soares et al., 2000).

Germination period:

Nursery technique: One seed is sown in each polybag with the stalk end facing upwards and in a slanting position with a depth of 5-8 cm. Shade may be given. Watering is frequently done to keep the soil moist until 3-4 leaf stage. Germination is noticed in 10 days time. Later after germination the seedlings are transplanted (Vanangamudi and Natarajan, 2006). The media has significant effect on number of days to first and 50% seedling emergence, and percentage of total emergence in cashew (Baiyeri, 2003). A light seedbed medium of rotted coir waste encourage rapid germination and permits lifting of seedlings

with a minimum of lateral root damage (Adams, 1975). As a sowing medium sawdust or its mixture with sand could be used (Ibikunle and Komolafe, 1973).

Propagation:

Method of propagation: By seed, side grafting (Nagabhushanam et al., 1979) and layering. Patch-budding in cashews results in 71% success (Palaniswamy and Hammeed, 1976; Ferraz et al., 1974). Air-layering and inarch grafting (Damodaran, 1985) are also successful.

Vegetative propagation:

Pests:

Diseases: Powdery mildew infection (caused by *Oidium anacardii*) occurs on the panicles of cashews (Masawe et al., 1997). Root rot disease of cashew seedlings caused primarily by *Pythium ultimum*. Complete control is achieved with dexton at 113.6 kg/ha, especially when incorporated in the soil (Olunloyo, 1976).

Medicinal properties: Roots are considered as purgative. The gum from the bark is recommended in leprosy, ringworm and also used for preventing hair loss.

Uses: The bark of *T. ciliata* is used in traditional medicine as an astringent and

antiperiodic, and in the treatment of chronic infantile dysentery and ulcers (Singh and Plant, 1995). *Anacardium occidentale* used as mouth freshener in Gujarat (Patel, 2004). Fleshy peduncles of the fruit is known as 'cashew apple', while the fruit is the kidney-shaped nut attached to it. The white kernels in the nuts possess pleasant taste and flavour. They are eaten either raw or fried and salted or sugared, also used in large quantities in the preparation of sweetmeat and in confectioneries. They constitute a highly nutritious and concentrated food. The commercial shell oil is used in paints, varnishes and many other industrial purposes. Cashew apple is edible and yield a delicious beverage. The juice is fermented and made into a wine which retains the flavour of the fresh fruit. The tree yields a pale yellow to reddish gum (Bose et al., 1998).

Wood properties: It is fairly hard and reddish brown in colour. It is a diffuse porous wood with indistinct growth rings. Wood is reddish-brown, moderately hard. Pores large, filled with pithy substance, prominent on a vertical section. Medullary rays fine, dark, interrupted, indistinct (Gamble, 1922).

References:

- Adams, B.R. 1975. Container production of cashew seedling rootstocks - seed germination in beds as an alternative to direct sowing. Acta Horticulturae. 49: 99-108.
- Ascenso, J.C. and Mota, M.I. 1972. Studies on the flower morphology of cashew (*Anacardium occidentale* L.). Agronomia Mocambicana. 6: 107-117.

- Baiyeri, K.P. 2003. Evaluation of nursery media for seedling emergence and early seedling growth of two tropical tree species. *Moor Journal of Agricultural Research.*; 4(1): 60-65.
- Bhat, D.M., Vidya, S.S. and Ravindranath, N.H. 2003. Nursery manual for forest tree species. Universities Press, Hyderabad, India.
- Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 53.
- Damodaran, V.K. 1985. Vegetative propagation of cashew - review of work done in Kerala. *Acta Horticulturae.* 108: 51-56.
- Ferraz, L., Souza, M.M de., Dantas, A.P., Wanderley, M de B. and Pedrosa, A.C. 1974. Methods of grafting cashews. *Boletim Tecnico do Instituto de Pesquisas Agronomicas, Recife, Brazil.* 67: 17.
- Gamble, J.S. 1922. A manual of Indian timbers. London Sampson Low, Marton and Company Ltd, Calcutta, India.
- Hore, J.K. and Sen, S.K. 1999. Extension of storage life of cashewnut (Anacardium occidentale L.) seeds. *Advances in Horticulture and Forestry.* 6: 45-48.
- Ibikunle, B.O. and Komolafe, D.A. 1973. Some experiments on the germination of cashew nuts (Anacardium occidentale Linn.). *Nigerian Journal of Science.* 7: 19-29.
- Masawe, P.A.L., Cundall, E.P. and Caligari, P.D.S. 1997. Powdery mildew (anacardii) onset and development on flowering panicles of cashew clones (Anacardium occidentale L.) as a measure of clone resistance. *Tropical Agriculture.* 74(3): 229-233.
- Mwasha, A.J., Ellis, R.H. and Hong, T.D. 1998. The effect of desiccation on the subsequent survival of seeds of cashew (Anacardium occidentale L.). Proceedings of the international cashew and coconut conference: trees for life the key to development, Dar-es-Salaam, Tanzania. 309-312.
- Nagabhushanam, S., Murthy, K.N. and Mohan, E. 1979. More on vegetative methods *Intensive Agriculture.* 17: 15-19.
- Olunloyo, O.A. 1976. Incidence and control of root rot disease of cashew seedlings, Anacardium occidentale in the nursery: *Turrialba.*, 26: 1, 33-38.
- Palaniswamy, V. and Hammeed, A.S. 1976. Study of propagation of cashew (Anacardium occidentale Linn.) by patch budding. *South Indian Horticulture.* 23: 24-25.
- Patel, P.K. 2004. Plant species being used in 'mukhwas' (mouth freshener) in North Gujarat. *Advances in Plant Sciences.* 17(1): 47-48.

Sahni, K.C. 2000. The Book of Indian Trees. BNHS, Mumbai.

Sasidharan, N. 2004. Forest Trees of Kerala. Kerala Forest Research Institute, Peechi, Kerala, India.

Singh, D.P. and Plant, A.K. 1995. Constituents of Toona ciliata. Fitoterapia. 66: 192.

Soares, A.C.D., Costa, J.T.A., Crisostomo, L.A. and Melo, F.I.O. 2000. Germination and development of cashew seedlings under saline stress : Revista Brasileira de Fruticultura. 22(3): 458-462.

Subbaiah, C.C. and Chenchu Subbaiah, C. 1982. Effect of pre-soaking in organic solvents on seed germination and seedling growth of cashew. Scientia Horticulturae. 18: 137-142.

Troup, R. S. 1921. The Silviculture of Indian Trees. (Vol I) International Book Distributors, Dehra Dun.

Vanangamudi, K. and Natarajan. 2006. Advances in Seed science and technology (Vol I): recent trends in seed technology and management.

Annona reticulata

Nomenclature:

Scientific name: *Annona reticulata* L.

Vernacular name: Manilanilam, Parankich - chakka (Malayalam); Luvani (Hindi).

Common name: Bullocks heart, Ramphal

Synonyms:

Family: Annonaceae

Subfamily:

Origin: Tropical America (Sasidharan, 2004).

Distribution: A native of West Indies, naturalized in eastern and south India (Prajapati et al., 2003).

Description: A small deciduous tree, larger than squamosa, up to 10 m high (Prajapati et al., 2003).

Flowering season: Summer season (Prajapati et al., 2003).

Fruiting season: End of the rainy season (Prajapati et al., 2003).

Flowers: Flowers cordate or subglobose, brownish or yellowish (Prajapati et al., 2003). Greenish white, 2 or 3 in short lateral peduncles, usually scattered in the branches; sepals 3, small; outer petals 3, fleshy, rigid, 2.5 cm long; inner ones very small; stamens many; carpels many (Bose et al., 1998).

Fruits: Fruits subglobose, yellowish brown, when ripe (Prajapati et al., 2003).

Fruit type:

Seeds: Black smooth seeds (Prajapati et al., 2003).

Seed dimension:

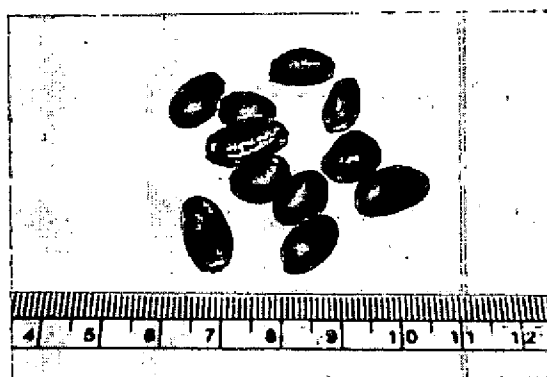
Seed length:

Seed width:

Seed thickness:



Twig with flowers



Seeds

Seed weight:

Seed dispersal:

Seed collection:**Transportation of seeds:****Seed processing:****Seed storage:****Viability period:****Seed emptiness:**

Seed pre treatment: GA3 promotes germination (Cartagena Valenzuela et al., 1998).

Germination type:**Germination percentage:****Germination period:****Nursery technique:****References:**

Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 54.

Cartagena Valenzuela, J.R. and Barreto Osorio, J.D. 1998. Effect of gibberellic acid and sowing method on seed germination and seedling growth of bullock's heart (*Annona reticulata* L.). Revista Facultad Nacional de Agronomia Medellin. 51(2): 235-244.

Prajapati, N.D., Purohit, S.S., Arun K. Sharma and Tarun Kumar. 2003. A Hand Book of medicinal plants. A complete source book. Agrobios. Jodhpur, India.

Sasidharan, N. 2004. Forest Trees of Kerala. Kerala Forest Research Institute, Peechi, Kerala, India.

Propagation:

Method of propagation: By seeds (Prajapati et al., 2003).

Vegetative propagation:

Pests:**Diseases:**

Medicinal properties: Unripe and dried fruits are used in diarrhoea and blood dysentery. Fruits, leaves, seeds and bark are used as medicinal (Prajapati et al., 2003).

Uses: Ripe fruits are sweet and edible (Prajapati et al., 2003).

Wood properties: Wood soft, close grained, greyish white. Pores moderate sized scanty (Prajapati et al., 2003).

Annona squamosa

Nomenclature:

Scientific name: *Annona squamosa* L.

Vernacular name: Sitappalam, Attaccakka, Atta (Malayalam); Sitappalam, Atta seethappazham (Tamil); Seetaphal, Sharifa (Hindi) (Bose et al., 1998).

Common name: Custard apple, Sugar apple (Bose et al., 1998).

Synonyms:

Family: Annonaceae

Subfamily:

Origin: Tropical America (Sasidharan, 2004).

Distribution: The tree is cultivated almost all over India, but mainly in Maharashtra, Andhra Pradesh, Karnataka, Madhya Pradesh, Bihar, Assam and Orissa.

Description: A small tree above 6 m height.

Floweringseason: March to July, April to July (Bose et al., 1998).

Fruitingseason: September to October; August to November (Bose et al., 1998).

Flowers: Flowers yellowish green, solitary, borne in short extra axillary branches, leaf-opposed or 2-4 on short extra axillary branchlets. Flowers greenish, on short drooping stalk opposite a leaf, single or in pairs; petals thick and fleshy, 2.5 cm long; stamens many, crowded, surrounding the numerous stigmas (Bose et al., 1998).

Fruits: Fruits 5 to 10 cm in diameter, yellowish green, globose with well marked areoles easily breaking into large pieces, irregularly tubercled, containing sweet, white custard-like pulp of delicate flavour and many, large black seeds (Bose et al., 1998).



Habit



Fruit



Seeds

Fruittype:

Seeds: Seeds hard, brownish black, smooth.

Seeddimension:

Seed length:

Seed width:

Seed thickness:

Seed weight: 400 to 500 seeds/kg.

Seed dispersal:

Seed collection:

Transportation of seeds:

Seed processing:

Seed storage:

Viability period:

Seed emptiness:

Seed pre treatment: Freshly collected seeds are immersed in boiling water which is allowed to cool overnight. Seeds are soaked in 1% sodium nitrate for 24 h before sowing in raised beds (Ratan and Reddy, 2003). 50 ppm GA3 and 100 ppm GA3 treatments

give 75% and 44% germination respectively (Stenzel et al., 2003).

Germination type:

Germination percentage: 70 to 80

Germination period:

Nursery technique:

Propagation:

Method of propagation: By seeds.

Vegetative propagation:

Pests:

Diseases:

Medicinal properties:The roots are powerful purgative and are useful in mental depression and spinal disorders. They are useful in anaemia, burning sensation, vomiting, cough, malignant tumours, and for strengthening muscles.

Uses: The seed powder mixed with mung seed in a ratio of 0.5:2 is used as an insecticide. Powdered seeds and leaves are used as vermicides and to kill lice on cattle and worms in sores. Custard apple is a delicious table fruit with pleasant aroma. It is also used in ice cream and other milk products (Bose et al., 1998).

Wood properties: Wood is soft, close grained, greyish white with numerous firm, clear, wavy cross-bars and weighs about 600 kg/m³. Pores moderate sized, scanty, subdivided or in short radial lines. Medullary rays moderate sized (Gamble, 1922).

References:

- Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp.54.
- Gamble, J.S. 1922. A manual of Indian timbers. London Sampson Low, Marton and Company Ltd, Calcutta, India.
- Ratan, P.B. and Reddy, Y.N. 2003. Influence of potassium nitrate on germination and subsequent seedling growth of custard apple (Annona squamosa L.). Journal of Research ANGRAU; 31(4): 70-73.
- Sasidharan, N. 2004. Forest Trees of Kerala. Kerala Forest Research Institute, Peechi, Kerala, India.
- Stenzel, N.M.C., Murata, I.M. and Neves, C.S.V.J. 2003. Overcoming seed dormancy in atemoya and custard apple. Revista Brasileira de Fruticultura. 25(2): 305-308.

Anogeissus latifolia

Nomenclature:

Scientific name: *Anogeissus latifolia* (Roxb.ex DC.) Wall.ex Guill. & Perr.

Vernacular name: Mazhukanjiram, Malakanjiram, Korattykanjiram, Vellanava (Malayalam); Namai, Nanme, Vekkali, Vellagagai (Tamil); Bakla, Dhauta (Hindi) (Chacko et al., 2002).

Common name: Dhavada, (Chacko et al., 2002); Bakla.

Synonyms: *Conocarpus latifolia* Roxb.ex DC. (Chacko et al., 2002; Sasidharan, 2004). *Andersonia altissima* Herb. Madr.

Family: Combretaceae

Subfamily:

Origin: India.

Distribution: It occurs throughout India except in West Bengal, Assam, West Rajasthan and Andamans. It is also found in drier region of Sri Lanka and Nepal (FRI, 1984). In Kerala, it occurs in the dry and moist deciduous forests (Chacko et al., 2002).

Description: Slow growing, moderate to large sized deciduous tree attaining a height of 25 m and a breast height diameter of 55 cm. In favourable localities it attains a height of 30 m and a breast height diameter of 95 cm. It has feathery rounded crown and drooping branches (FRI, 1984; Ram Parkash and Drake Hocking, 1986; Chacko et al., 2002).

Flowering season: March to May; May-August (Bose et al., 1998).

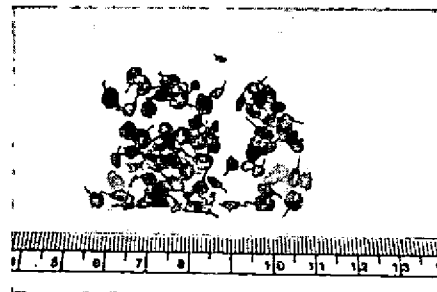
Fruiting season: January to February, December to May (Sen Gupta, 1937; Chacko et al., 2002).



Habit



Twig



Seeds

Flowers: Minute, Greenish yellow in globose heads on short axillary peduncles. Flower heads 6-8 mm in diameter, on short peduncles often in axillary racemes; flowers yellow; calyx tube 2-winged, 1-1.6 mm; filaments about 3 mm; ovary globose; style about 3 mm (Bose et al., 1998).

Fruits: Fruit is a drupe, yellowish brown compressed, narrowly 2 winged (Chacko et al., 2002).

Fruit type: Drupe.

Seeds: Hard, mostly infertile, single seeded and wedge shaped.

Seed dimension:

Seed length: 7-8 mm (Chacko et al., 2002).

Seed width: 4-5 mm (Chacko et al., 2002).

Seed thickness:

Seed weight: 1,06,000 to 1,36,000 seeds/kg (FRI, 1984; Chacko et al., 2002).

Seed dispersal: By insects.

Seed collection: Ripe fruits are beaten off the tree with a stick on to the ground, previously swept clean (FRI, 1984; Chacko et al., 2002).

Transportation of seeds: The seeds are loosely packed in polythene / cotton bags and transported ensuring air-circulation with in the stack (Chacko et al., 2002).

Seed processing: Sun-dry the seeds for a few days (Chacko et al., 2002).

Seed storage: Orthodox. Store the sun-dried seeds in gunny bags (FRI, 1984; Kumar and Bhanja, 1992; Chacko et al., 2002). Storage in metal tins or polythene containers is good to maintain viability (Aswathanarayana et al., 1997).

Viability period: No information (Chacko et al., 2002).

Seed emptiness: Very high (99%) (Chacko et al., 2002).

Seed pre treatment: Soaking in cold water for 48 hrs (FRI, 1984; Kumar and Bhanja, 1992; Chacko et al., 2002). Seed germination is increased by the 3-min hot water treatment (Aswathanarayana et al., 1997).

Germination type: Epigeal (Chacko et al., 2002).

Germination percentage: Very low (0.05 to 4.62) (FRI, 1984; Chacko et al., 2002).

Germination period: 2 to 14 days (FRI, 1984; Rai, 1999; Chacko et al., 2002).

Nursery technique: The seeds are hard and mostly infertile. Therefore, they are sown densely on raised beds. The bed is well shaped at 44 cm above the ground. Germination is fairly quick (Chacko et al., 2002). Seedlings are raised in the nursery by transplanting the best looking germinants to 160 ml root trainers in a medium of FYM/red earth soil/sand (1:1:0.5), required about 20-30% culling in order to obtain uniformly good planting stock (Rao et al., 1998).

Propagation:

Method of propagation: Vegetative propagation through root cutting and by seeds.

Vegetative propagation:

Pests: No information (Chacko et al., 2002).

Diseases: Moderate (43 to 67 %). *Spermoplane microflora* detected includes 10 fungi and actinomycetes. *Aspergillus niger*, *Pencillium* sp., *Pithomyces* sp., are the important storage moulds. *Alternaria alternata*, *Drechslera* sp., *Fusarium* sp., *Pestalotia* sp., *Stemphylium* sp., etc. are associated with discoloured seeds (Chacko et al., 2001).

Medicinal properties: The roots are astringent, acrid and stomachic. It is useful in vitiated conditions of kapha and vata, wounds and ulcers.

Uses: The bark contains 12 to 18% tannins and it is bitter and astringent. Wood is preferred for cart-axles, shafts, frames of carts, wheels, agricultural implements, tool handle etc. A gum obtained from the bark is useful for cloth printing and dyeing. Seed germination decreases as the altitude of seed collection increases. In general, germination differences of up to 7% occur between

different altitudes (provenances) (Todaria and Negi, 1995). Improvement in germination by increasing temperature (Negi and Todaria, 1993). The best month of sowing for *A. latifolia* is June (Ram Prasad et al., 1988). Trees treated with 1600 mg ethephon during April-May, when the trees were leafless enhance gum production. Ethephon in solution is applied with a syringe into 5 x 1.5 cm holes made with an increment borer 1.5-2 m above ground. One hole is made in each tree twice a year for 3 yr. The holes are made slanting downwards, and new holes are made 4-6 cm lateral to the healed region of older holes. Holes are covered with sealing wax after treatment. Ethephon application leads to schizolysigenous formation of gum cavities in the axial parenchyma of the sapwood, and many of the secondary xylem vessels become clogged with gummy material at the same time. Gum of *Anogeissus latifolia* produce very stable emulsions. Decrease in rainfall is accompanied by a marked increase in the germinative capacity of the seeds of *A. latifolia* (Prasad, 1943).

Wood properties: Wood is grey, hard, shining and smooth, with a small purplish colour, irregularly shaped. *A. latifolia* wood is only moderately resistant (Sen Sarma and Chatterjee, 1968). *Anogeissus latifolia* is suitable for hardboard (Kumar, 1966).

References:

Aswathanarayana, S.C., Mahadevappa, M., Ranganathaiah, K.G., Kalappa, V.P. and Reddy, Y.A.N. 1997. Seed viability and microflora of forest tree species. *Indian Journal of Forestry*. 19: 326-329.

- Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 55.
- Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 60-61.
- FRI. 1984. Troup's Silviculture of Indian Trees. Vol. V. The Controller of Publications, Delhi.
- Kumar, V.B. 1966. Suitability of Indian hardwoods for the manufacture of hardboard., *Holzforsch. u. Holzverwert.* Wien. 18 (1): 11-5.
- Kumar, S.V. and Bhanja, M. 1992. Forestry Seed Manual of Andhra Pradesh. Andhra Pradesh Forest Department, Hyderabad, India.
- Negi, A.K. and Todaria, N.P. 1993. Improvement of germination of some Himalayan tree seeds by temperature treatment. *Seed Science and Technology.* 21: 675-678.
- Prasad, J. 1943. Seeding of Anogeissus latifolia., *Indian For.* 69: 193-196.
- Rai, S.N. 1999. Nursery and Planting Techniques of Forest Trees in Tropical South Asia. Eastern Press, Bangalore, India.
- Ram Parkash and Drake Hocking. 1986. Some favourite trees for fuel and fodder. Society for promotion of waste lands development, New Delhi.
- Ram Prasad, Chadhar, S.K. and Parvez Jalil. 1988. Some observations on germination of four useful but difficult forestry seeds. *Journal of Tropical Forestry.* 4: 395-398.
- Rao, G.M., Rao, A.R., Acharyulu and M.V.S.N. Prasad. 1998. NS Improvement of planting stock through culling in root trainer nursery. *Indian Forester.* 124: 9, 739-742.
- Sasidharan, N. 2004. Forest Trees of Kerala. Kerala Forest Research Institute, Peechi, Kerala, India.
- Sen Gupta, J.N. 1937. Seed weights, plant percents, etc. for forest plants in India. *Indian Forest Records (New Series) Silviculture,* 2:221pp. Manager of Publications, Delhi.
- Sen Sarma, P.K. and Chatterjee, P.N. 1968. Studies on the natural resistance of timbers to termite attack. V. Laboratory evaluation of the resistance of three species of Indian wood to *Microcerotermes beelsoni* Snyder (Termitidae: Amitermitinae). *Indian For.* 94 (9): 694-704.
- Todaria, N.P. and Negi, A.K. 1995. Effect of elevation and temperature on seed germination of some Himalayan tree species. *Plant Physiology and Biochemistry* New Delhi. 22: 178-182.

Antiaris toxicaria

Nomenclature:

Scientific name: *Antiaris toxicaria* (Pers.) Lesch.

Vernacular name: Aranthal, Maravuri (Malayalam) (Sasidharan, 2004); Aranthelli, Alli, Nettavil (Tamil); Jasund, Jungli lakuch (Hindi) (Bose et al., 1998).

Common name: Upas tree (Bose et al., 1998).

Synonyms: *Antiaris innoxia* Bl. (Gamble, 1922). *Antiaris saccidora*, *Ipo toxicaria* Pers. (Sasidharan, 2004).

Family: Moraceae

Subfamily:

Origin:

Distribution: In Kerala it occurs in Wyanad, Palghat, Idukki, Pathanamthitta and almost throughout the state, mainly in highlands.

Description: A very tall tree, up to 50 m high, trunk often buttressed; young shoots, petioles and midrib velvety (Bose et al., 1998).

Flowering season: September to October (Bose et al., 1998).

Fruiting season: January to May, December to February (Bose et al., 1998).

Flowers: Flowers are greenish, monoecious, with male flowers in axillary receptacles. Male flowers: crowded on the surface of flat

pedunculate and usually fascicled receptacle supported by imbricating bracts; sepals 3-4; stamens 3-8; female flower: solitary, enclosed in pear-shaped involucre of numerous confluent bracts; ovary adnate to involucre (Bose et al., 1998).

Fruits: Fruit is a drupe, red crimson when ripe, stalked, turning finally black and fleshy.



Twig

Fruit type: Drupe.

Seeds: Seed 1.5 cm long with crataceous, hard testa and thin endocarp.

Seed dimension:

Seed length: 1.5 cm

Seed width:

Seed thickness:

Seed weight:

Seed dispersal:

Seed collection:

Transportation of seeds:

Seed processing:

Seed storage: It can be stored in wet sand at a low temperature or under ventilated conditions (Guan ZhiBin et al., 2003).

Viability period: Thirty percent water content maintain the viability of the seeds (Guan ZhiBin et al., 2003).

Seed emptiness:

Seed pre treatment:

Germination type:

Germination percentage: Germination rate of fresh seeds 94 +or-6%. After 5 months of storage in wet sand at low temperature or under ventilated conditions, the seeds recorded 82 and 36% germination rate, respectively (Guan ZhiBin et al., 2003).

Germination period:

Nursery technique:

Propagation:

Method of propagation:

Vegetative propagation:

Pests:

Diseases:

Medicinal properties:The bark is medicinal as a cardiac, circulatory, intestinal stimulant, and against uterine contractions. Seeds are used as a febrifuge and for curing dysentery also. Latex is also used as an arrow poison, very toxic (Bose et al., 1998).

Uses: The wood is suitable for making packing cases, splints and paper pulp. The fibre is used to make sacks, garments, cordage and in mat weaving. Maravuri, a type of cloth from the bark of Aranjali [*Antiaris toxicaria* (Pers.) Lesch.] is prepared by the Muthuvan tribes of Idukki district by removing the cork with a knife and softening the bark by beating with wooden hammers and cured by sun drying. It is used as bed spread (Johncy Manithottam et al., 2002). Toxicarioside A derived from latex of the species is a dart poison (Carter et al., 1997).

Wood properties: Wood is white, soft and even grained. Pores are large and moderate sized.

References:

- Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 56.
- Carter, C.A., Forney, R.W., Gray, E.A., Gehring, A.M., Schneider, T.L., Young, D.B., Lovett, C.M. Scott, L., Messer, A.C., and Richardson, D.P. 1997. Toxicarioside A. A new cardenolide isolated from *Antiaris toxicaria* latex-derived dart poison. *Tetrahedron.*, 53(40): 13557-13566.
- Gamble, J.S. 1922. A manual of Indian timbers. London Sampson Low, Marton and Company Ltd, Calcutta, India.
- Guan ZhiBin., Peng ChaoZhong., and Guan Song Shan. 2003. Biological characteristics of *Antiaris toxicaria*. *Journal of Nanjing Forestry University.*, 27(5): 77-79.

Johny Manihottam. and Francis, M.S. 2008. Preparation of Maravuri from Antiaris toxicaria (Pers.) Lesch. by Muthuvans of Kerala. Indian Journal of Traditional Knowledge. 7(1): 74-76.

Sasidharan, N. 2004. Forest Trees of Kerala. Kerala Forest Research Institute, Peechi, Kerala, India.

Aporusa lindleyana

Nomenclature:

Scientific name: *Aporusa lindleyana*
(Wt.) Baill.

Vernacular name: Vetti, Aechil
(Malayalam) (Sasidharan, 2004).

Common name:

Synonyms: *Scepa lindleyana* Wt.
(Sasidharan, 2004).

Family: Euphorbiaceae

Subfamily:

Origin:

Distribution: Distributed in evergreen forests of Konkan and Western Ghats in India and in Sri Lanka (Bose et al., 1998).

Description: Small tree (Sasidharan, 2004). A small to medium-sized evergreen tree, 10-14 m high; youngest shoots more or less silky (Bose et al., 1998).

Flowering season: March to May (Bose et al., 1998).

Fruiting season:

Flowers: Male spikes: 2.5 cm or less in length, rather stout; sepals 4-6; stamens 2-3; female flowers in short, hairy, often clustered racemes; ovary silky pubescent (Bose et al., 1998).

Fruits: Fruits globose, cuspidate, pedicelled, 8-12 mm in diameter (Bose et al., 1998).

Fruit type:

Seeds:

Seed dimension:

Seed length:

Seed width:

Seed thickness:

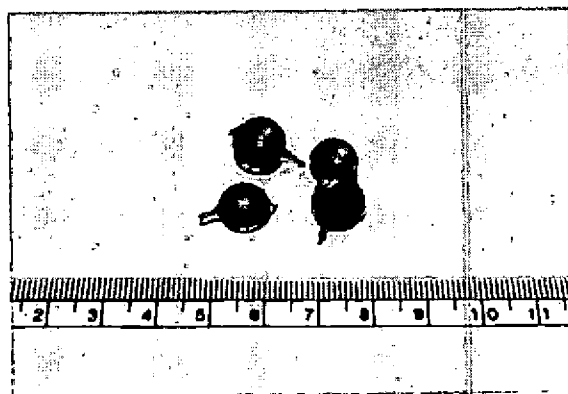
Seed weight:

Seed dispersal:

Seed collection:

Transportation of seeds:

Seed processing:



Fruit

Seed storage: Can be stored for about a year in air-tight polycarbonate bottles or polyethylene bags at 30°C and 85% relative humidity (RH) or in polycarbonate bottles in ambient conditions (Kumar et al., 1997).

Viability period: Normally remain viable only for 2 days in open room conditions and lose their viability when dried to 30% moisture content or stored at temperatures at

or below 15°C (recalcitrant) (Kumar et al., 1997).

Seed emptiness:

Seed pre treatment:

Germination type:

Germination percentage:

Germination period:

Nursery technique:

Propagation:

Method of propagation:

Vegetative propagation:

Pests:

Diseases:

Medicinal properties:

Uses: Fruit is edible and the wood is used for rafters (Bose et al., 1998).

Wood properties:

References:

Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 58.

Kumar, C.A., Thomas, J., and Pushpangadan, P. 1997. Storage and germination of seeds of *Aporosa lindleyana* (Wight) Baillon, an economically important plant of Western Ghats (India). *Seed Science and Technology*. 25(1): 1-6.

Sasidharan, N. 2004. Forest Trees of Kerala. Kerala Forest Research Institute, Peechi, Kerala, India.

Artocarpus communis

Nomenclature:

Scientific name: *Artocarpus communis* J. R. & G. Forst.

Vernacular name: Kadappilavu, Simaplavu, Kadachakka (Malayalam); Seema pila (Tamil); Barhal (Hindi) (Bose et al., 1998).

Common name: Bread fruit tree (Bose et al., 1998)

Synonyms: *Artocarpus incisus* Linn. f. (Sasidharan, 2004). *Artocarpus altilis* (Park.) Fosberg (Bose et al., 1998).

Family: Moraceae

Subfamily:

Origin: Pacific Islands.

Distribution: Native of the Pacific Islands, often planted in the warm humid regions, particularly in India and South-East Asian countries (Bose et al., 1998).

Description: A tall fast growing evergreen tree, 12 to 18 m in height (Prajapati et al., 2003).

Floweringseason: November to April (Bose et al., 1998).

Fruitingseason: November to April (Bose et al., 1998).

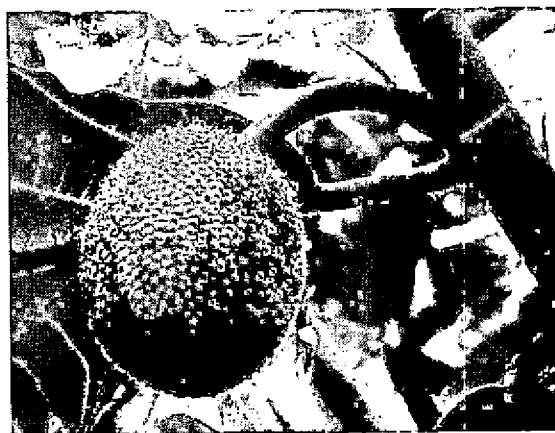
Flowers: Flowers in catkin. Monoecious with male and female flowers on the same tree and the male inflorescence appearing first. Male inflorescence cylindric-clavate; peduncles 3-6 cm long; female: apex of

perianth conical, shortly pubescent (Bose et al., 1998).

Fruits: Syncarp, globose, prickly, brownish or yellowish, composite, usually seedless. Syncarp globose or ellipsoid, 20-30 cm in diameter, prickles pyramidal (Bose et al., 1998).



Habit



Fruit

Fruittype:

Seeds: Usually seedless.

Seeddimension:

Seed length:

Seed width:

Seed thickness:

Seed weight:

Seed dispersal:

Seed collection:

Transportation of seeds:

Seed processing:

Seed storage:

Viability period:

Seed emptiness:

Seed pre treatment:

Germination type: Hypogeal.

Germination percentage:

Germination period:

Nursery technique:

Propagation:

Method of propagation: Root cutting and air layering.

Vegetative propagation:

Pests:

Diseases:

Medicinal properties: The fruits are bitter, sweet, acrid, cooling diuretic, stomachic, cardiogenic and galactagogue. The bark is used to treat headache. The latex is useful in external application for hyperadenosis and abscesses.

Uses: Latex is used for painting canoes and caulking boats. Wood is used for beams, posts, rafters and flooring. Bark yields a fibre used for ropes. Flavonoids isolated from this species possess anti inflammatory activities and has inhibitory effects on the chemical mediators released from mast cells, neutrophils, and macrophages (Wei BaiLuh et al., 2005). Prenylated flavonoids from the heartwood has inhibitory activity on lipopolysaccharide induced nitric oxide production. "3"dimethylpyrano[3',4']2,4,2'-trihydroxychalcone and several flavonoids were also isolated (Han AhReum et al., 2006).

Wood properties:

References:

Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 67.

Han AhReum., Kang YouJin., Windono, T., Lee SangKook., and Seo EunKyoung. Prenylated flavonoids from the heartwood of Artocarpus communis with inhibitory activity on lipopolysaccharide induced nitric oxide production. 2006. Journal of Natural Products., 69(4):719-721.

Prajapati, N.D., Purohit, S.S., Arun K. Sharma and Tarun Kumar. 2003. A Hand Book of medicinal plants. A complete source book. Agrobios. Jodhpur, India.

Sasidharan, N. 2004. Forest Trees of Kerala. Kerala Forest Research Institute, Peechi, Kerala, India.

Wei BaiLuh., Weng JingRu., Chiu PaoHui., Hung ChiFeng., Wang JihPyang., and Lin ChunNan. Anti inflammatory flavonoids from Artocarpus heterophyllus and Artocarpus communis. 2005. Journal of Agricultural and Food Chemistry. 53(10): 3867-3871.

Artocarpus heterophyllus

Nomenclature:

Scientific name: *Artocarpus heterophyllus* Lamk.

Vernacular name: Plavu, Pilavu, Chakka (Malayalam); Palamaram, Murasapilapalam (Tamil); Kathal (Hindi) (Bose et al., 1998).

Common name: Jackfruit tree, Kathal.

Synonyms: *Artocarpus integrifolius* auct. non L.f. (Sasidharan, 2004).

Family: Moraceae

Subfamily:

Origin: Western Ghats in India.

Distribution: Throughout India, Myanmar, Pakistan, Bangladesh and Sri Lanka. It is cultivated in humid tropics and abundantly in the eastern tropics. Native of Western Ghats in India (Bose et al., 1998).

Description: A large monoecious evergreen tree, 18-25 m in height (Bose et al., 1998).

Flowering season: December to March.

Fruiting season: March to June.

Flowers: Flowers are small, unisexual and regular. Male flowers crowded on cylindrical receptacles, female flowers crowded on globose receptacles-both cauliflorous. Flower heads at first covered with leathery stipules; male heads cylindric, 5-15 cm long (Bose et al., 1998).

Fruits: Fruits multiple, large, fleshy, globose or oblong. The fruit contains a yellowish juicy sheath with strong flavour in which large number of seeds are embedded. Fruits obovate, cylindric, greenish, sharply pointed tubercles, up to 60 cm long, hanging from large branches or trunk, containing soft, edible pulp and many kidney-shaped fruits (Bose et al., 1998).



Habit



Fruit

Fruit type:

Seeds: Seeds oval or kidney shaped, with membranous testa, cotyledons unequal (Raju, 2002).

Seed dimension:

Seed length:

Seed width:

Seed thickness:

Seed weight: 45-95 seeds/kg.

Seed dispersal: Birds, Squirrel, Rabbit.

Seed collection:**Transportation of seeds:****Seed processing:**

Seed storage: Seeds stored in saw dust or charcoal give 93% germination even after 20 days (Baghel et al., 2003). Seeds stored for long lose seed viability (Singh et al., 2003).

Viability period: Viability can be increased by storing seeds in a refrigerator for 45 days, compared with only 4 days viability in normal condition (Sharma and Mohan, 1991).

Seed emptiness:

Seed pre treatment: Removal of outer thin leathery seed coat and soaking in water for 8 hrs improves germination. Biotin (10 ppm) and kinetin (50 ppm) treatments of seeds have a positive influence on vigour index (Prakash, 1998). Treatment with 100 ppm GA shows positive influence on germination percentage (95.33%). In addition, seedling

height, span of germination, and speed of germination are also affected (Singh et al., 2002).

Germination type: Hypogeal.

Germination percentage: 75

Germination period:

Nursery technique:

Propagation:

Method of propagation: By seeds. Approach and bud grafting (Swaminath et al., 1989).

Vegetative propagation: Approach and bud grafting (Swaminath et al., 1989).

Pests:

Diseases:

Medicinal properties: The leaves and fruits have medicinal properties. The leaves are useful in fever, boils, wounds, skin diseases with vitiated conditions of vata and pitta. The ripe fruits are sweet, cooling, tonic and are useful in ulcers (Prajapati et al., 2003).

Uses: Unripe fruits are used as vegetable. Fruits constitute a rich source of carbohydrate and essential amino acids. A yellow dye extracted from wood is used for dyeing clothes (Prajapati et al., 2003).

Wood properties: The heartwood is bright yellow in colour but turns light brown on exposure. It is fairly strong and durable.

References:

- Baghel, B.S., Rajesh Tiwari and Pandey, L.P. 2003. Seed viability and seedlings vigour of jack fruit (Artocarpus heterophyllus Lam.) as influenced by different storage media. South Indian Horticulture. 51(1/6): 204-206.
- Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 67.
- Prajapati, N.D., Purohit, S.S., Arun K. Sharma and Tarun Kumar. 2003. A Hand Book of medicinal plants. A complete source book. Agrobios. Jodhpur, India.
- Prakash, M. 1998. Effect of plant growth regulators and chemicals on germination of jack-fruit. Annals of Plant Physiology. 12(1): 75-77.
- Raju, R.A. 2002. The spirit of beautiful trees. Agrobios. Jodhpur, India.
- Sasidharan, N. 2004. Forest Trees of Kerala. Kerala Forest Research Institute, Peechi, Kerala, India.
- Sharma, R. and Mohan, N.K. 1991. Studies on the viability and germination of jack fruit seeds in situ : Horticultural Journal. 4(2): 57-58.
- Singh, D.K., Bhattacharya, B. and Mondal, K. 2002. Role of pre-sowing seed treatment with different chemicals on germination behavior and seedling growth of jackfruit (Artocarpus heterophyllus Lam.) Environment and Ecology. 20(3): 741-743.
- Singh, D.K., Bhattacharya, B., Mondal, K. and Sen, S.K. 2003. Trials on the role of pre-sowing seed treatment with different chemicals on the seed viability of jackfruit (Artocarpus heterophyllus Lam). Orissa Journal of Horticulture. 31(1): 88-90.
- Swaminath, M.H. and Ravindran, D. 1989. Vegetative propagation of fruit yielding tree species. Myforest. 25(4): 357-360.

Artocarpus hirsutus

Nomenclature:

Scientific name: *Artocarpus hirsutus* Lam.

Vernacular name: Ayiniplavu, Anjili (Malayalam); Aini (Tamil); Anjili (Kannada) (Chacko et al., 2002).

Common name: Wild jack fruit (Chacko et al., 2002).

Synonyms:

Family: Moraceae

Subfamily:

Origin: Endemic to the Western Ghats of India (Chacko et al., 2002).

Distribution: Evergreen forest of the W. ghats from Konkan southwards (up to 1333 m). Also found in the deciduous forests. Medicinally *Artocarpus hirsutus* shows a wider ecological amplitude with presence in disturbed and undisturbed evergreen forests (Mathachen et al., 2004).

Description: A very tall handsome evergreen (50 m) with a straight clean stem and dense foliage (Prajapati et al., 2003).

Flowering season: December to March.

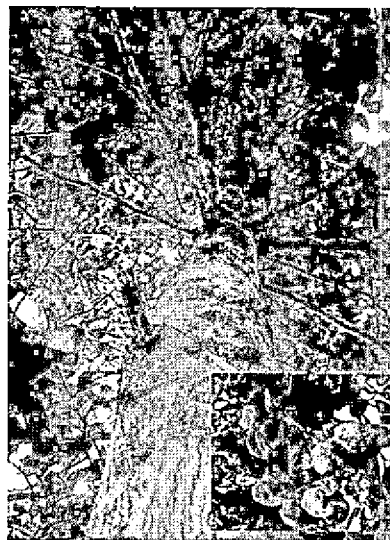
Fruiting season: Ripen during May to June, May to July (Sen Gupta, 1937; Chacko et al., 2002).

Flowers: Yellowish green flower heads. They are present on axillary, pedunculate receptacles, the sexes are separate. Male

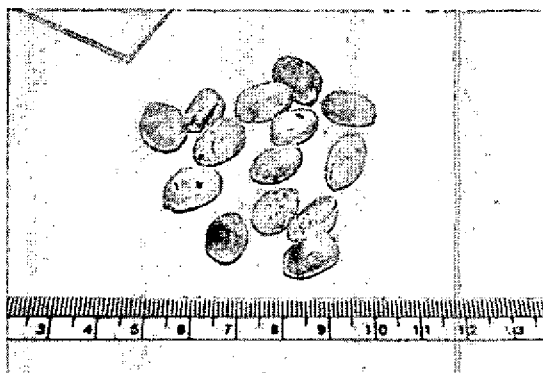
receptacle cylindrical, slender, pendulous, 5-10 cm long, sepals 2, united below (Bose et al., 1998).

Fruits: Yellow ovoid, about size of the lemon, covered with 6 mm spines. Fruit, a sorosis, yellow colour when ripe, spiny, tomentose, 8 to 12 x 6 to 8 cm size contains many oblong-globose white smooth seeds (Chacko et al., 2002).

Fruit type: Sorosis.



Habit and fruits



Seeds

Seeds: White numerous, 1.2-1.8 cm long

Seed dimension:

Seed length: 1.2-2 cm (Chacko et al., 2002).

Seed width:

Seed thickness:

Seed weight: 2,315 seeds/kg (Chacko et al., 2002); 1,400 seeds/kg (Carlowitz, 1991; Chacko et al., 2002).

Seed dispersal: Squirrel.

Seed collection: Fruits can either be collected from the tree or from the ground after fall. However, it is advisable to collect the fruits from the ground soon after they fall (Chacko et al., 2002).

Transportation of seeds: Fruits collected in cotton / plastic bags should be transported as early as possible; they should remain ventilated during transport (Chacko et al., 2002).

Seed processing: The seeds are extracted by hand, washed and air-dried (Chacko et al., 2002).

Seed storage: Recalcitrant (CABI, 1998; Chacko et al., 2002). Seeds can be stored only for one month (Chacko et al., 2002).

Viability period: Seed is viable for about a month under natural conditions (Chacko et al., 2002).

Seed emptiness: Low (Chacko et al., 2002).

Seed pre treatment: Not required (Chacko et al., 2002).

Germination type: Hypogeal (Troup, 1921; Chacko et al., 2002).

Germination percentage: 80 (Sen Gupta, 1937); 30 to 70 (Carlowitz, 1991; Chacko et al., 2002).

Germination period: 14 to 56 days (Sen Gupta, 1937; Chacko et al., 2002).

Nursery technique: Fresh seeds are sown in plastic trays with vermiculite and watered regularly. Seedlings, soon after germination are pricked out in poly bags of size 20 cm x 10 cm filled with potting mixture. Longer polythene bags are used if the seedlings are to be maintained in the nursery for longer periods (Chacko et al., 2002). *Artocarpus hirsutus* planted in polybags and arranged either under full sunlight or 50% shade (in a thatched shed) in a nursery (Gopikumar et al., 1999).

Propagation:

Method of propagation: By seeds.

Vegetative propagation:

Pests: No information (Chacko et al., 2002).

Diseases: Medium (41 to 55%). Eleven fungi and a bacterium are recorded. *Chatomium* sp., *Botryodiplodia theobromae*, Chalaropsis, are the important storage moulds (Mohanand and Anil Chandran, 2001; Chacko et al., 2002).

Medicinal properties: The ripe fruits are sweet, sour, cooling and are useful in vitiated conditions of vata and pitta. The unripe fruits are sour, astringent, sweet, indigestible and constipating.

Uses: Wood used for house and boat building, furniture and other purposes. Fruits constitute a rich source of carbohydrates and essential amino acids.

Wood properties: Moderately hard, heartwood yellowish brown, durable, of very good quality. Sapwood white (Gamble, 1922).

References:

- Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 67.
- CABI. 1998. The Forestry Compendium – A Silvicultural Reference. Module 1. CABI Publishing, CAB International, Wallingford, Oxon, OX108DE, UK.
- Carlowitz, P.G.V. 1991. Multipurpose Trees and Shrubs: Source of seeds and Inoculants. International Council for Research in Agroforestry, Nairobi, Kenya.
- Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 62-63.
- Gamble, J.S. 1922. A manual of Indian timbers. London Sampson Low, Marton and Company Ltd, Calcutta, India.
- Gopikumar, K. and Bindu, S. 1999. Effect of shade on the growth of selected tropical forest tree species under nursery condition. Journal of Tropical Forest Science. 11(3): 651-653.
- Mathachen, G.P., Vasudeva, R., Gowda, H.C.H., Ganeshaiyah, K.N. and Shaanker, R.U. 2004. Ecological amplitude and regeneration of medicinally important threatened trees in the Central Western Ghats. Indian Forester. 130(11): 1330-1338.
- Mohanan and Anil Chandran. 2001. Microorganisms associated with seeds of tropical forest species and their management for improving the storability and seedling production. Seed Science and Technology (in press).
- Prajapati, N.D., Purohit, S.S., Arun K. Sharma and Tarun Kumar. 2003. A Hand Book of medicinal plants. A complete source book. Agrobios. Jodhpur, India.
- Sen Gupta, J.N. 1937. Seed weights, plant percents, etc. for forest plants in India. Indian Forest Records (New Series) Silviculture, 2:221 pp. Manager of Publications, Delhi.
- Troup, R.S. 1921. The Silviculture of Indian Trees. Vol. III. Clarendon Press, Oxford.

Azadirachta indica

Nomenclature:

Scientific name: *Azadirachta indica* A. Juss.

Vernacular name: Neem (Hindi), Vepu, Aryaveppu (Malayalam), Vembu, Veppam (Tamil), Bevu, Kirri Bevu (Kannada) (Chacko et al., 2002).

Common name: Margosa tree, Neem tree, (Chacko et al., 2002); Indian Lilac (Bose et al., 1998).

Synonyms: *Melia azadirachta* Linn., *Melia indica* (A.Juss.) Brandis (Chacko et al., 2002).

Family: Meliaceae

Subfamily:

Origin: India.

Distribution: It grows throughout the greater parts of India, especially in the drier parts of the country. It grows in Gujarat, Rajasthan, Punjab, Maharashtra, Karnataka and Tamil Nadu.

Description: Moderate to large sized, evergreen (usually) tree with dense rounded crown, attaining a height of up to 15 to 20 m with a bole of 7 m (Bose et al., 1998).

Flowering season: March to May.

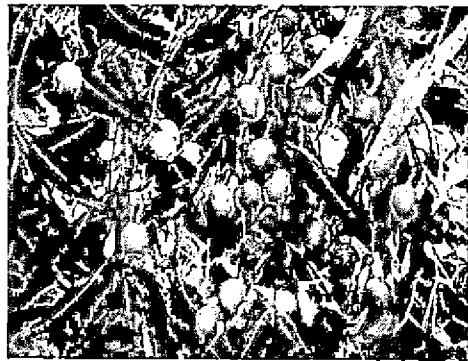
Fruiting season: Ripens during June to August, March to July (Sen Gupta, 1937; Chacko et al., 2002).

Flowers: Small white flower, smelling honey and sweet scented. White, scented, about 1 cm across, in axillary panicles, 12-

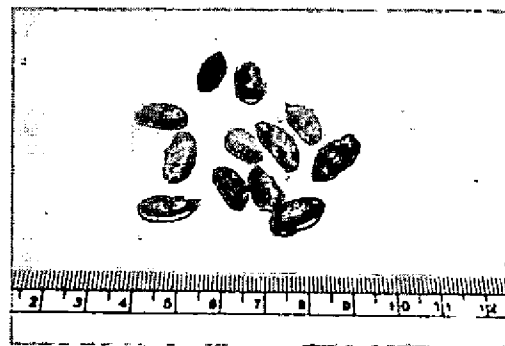
30 cm long; calyx 5-fid, lobes ovate; petals oblanceolate (Bose et al., 1998).



Habit



Fruits



Seeds

Fruits: Smooth, ellipsoidal drupe. The fruit is a drupe (1.2 to 2 cm), one celled, and one or two seeded (Chacko et al., 2002).

Fruit type: Drupe.

Seeds: Seeds ellipsoid, fleshy and oily. The true testa of the seed is a brown papery covering inside the cartilagenous putamen of the drupe (Chacko et al., 2002).

Seed dimension:

Seed length: 1 cm (Chacko et al., 2002).

Seed width: 0.63 cm (Chacko et al., 2002).

Seed thickness:

Seed weight: 5,700 to 6,350 seeds/kg (Sen Gupta, 1937; Chacko et al., 2002).

Seed dispersal: By birds.

Seed collection: Collect fruits turning yellow, from the tree by shaking the branches (Chacko et al., 2002).

Transportation of seeds: Fruits are collected in ventilated containers (cotton bags, gunny bags, woven plastic bags, etc.); should be taken to the processing unit as quickly as possible (Chacko et al., 2002).

Seed processing: If green fruits are collected, heap them for a day or 2 to make depulping easier. Ripe fruits are immediately depulped by squeezing in water and drying under shade (Chacko et al., 2002).

Seed storage: Recalcitrant (Kindt et al., 1997; Chacko et al., 2002). The seeds have short viability. The seeds extracted from

greenish yellow fruits can be stored in earthen pots and buried in sand. The earthen pots may be filled with seeds up to the neck leaving its mouth open. These pots are buried in sand up to the neck and the sand around the pot is kept moist by sprinkling water. These seeds retain 70% viability for 3 months (Rai, 1999; Chacko et al., 2002).

Viability period: Short; under ambient conditions viable up to 30 days (Rai, 1999; Chacko et al., 2002). Seeds with an initial germination capacity of 75% when stored in gunny bags have given 30% in the third week and 2% in the fifth week (Dent, 1948; Chacko et al., 2002).

Seed emptiness:

Seed pre treatment: De-pulped and air-dried seeds do not require any pre-sowing treatment. However, soaking in warm/cold water for 48 hrs improves germination (Kindt et al., 1997; Chacko et al., 2002).

Germination type: Epigeous (Chacko et al., 2002).

Germination percentage: Up to 90 (Kumar and Bhanja, 1992; Rai, 1999; Chacko et al., 2002).

Germination period: 10 to 30 days (Chacko et al., 2002).

Nursery technique: Seeds are sown in germination trays containing vermiculite or in nursery beds. Seedlings are pricked out to polythene bags of 20 x 10 cm size when they have a pair of leaves. Under moist conditions fungal attack in the form of leaf spot and the hole formation occur on the seedlings which can be controlled by

application of fungicide (Bavistin, 0.1%). Seedlings can be produced in root trainers also using weed or coir pith compost mixed with soil in 75:25 ratio and managed under foliar nutrient application (Chacko et al., 2002).

Propagation:

Method of propagation: By seeds and vegetatively by shoot and root cuttings.

Vegetative propagation:

Pests: Low. Infestation by *Araecerus suturalis* Boh. (Coleoptera: Anthribidae) is reported (Browne, 1968; Chacko et al., 2002).

Diseases: Low (20 to 26%). *Aspergillus* sp., and *Trichoderma* spp., are the important storage fungi and *Colletotrichum gloeosporioides* is the important field fungi recorded on seeds (Chacko et al., 2001).

Medicinal properties: The whole plant, bark, root bark, young fruits, nut or seeds, flowers, leaves, gum, toddy etc. are medicinally important. Its leaves are used to cure many diseases of the bladder, kidney, eyes and skin. The bark is bitter, astringent, acrid, depurative, vulnerary, liver tonic, expectorant, urinary astringent, anthelmintic, pectoral and tonic. The petrol ether leaf extract of an elutropic solvent series has the strongest effect on pathogenic fungal growth (Khan and Wassilew, 1987). Antidiabetic medicines are extracted from neem (Alam et al., 1990). Extracts have antimalarial activity also (Vasanth et al., 1990).

Uses: Every part of the tree from its roots, trunk, bark, flowers, fruits, seeds, sap and gum are known to have some use and have a place in the traditional folklore and medicine. Seeds yield margosa oil which is used in soap manufacture. Kernels contain azadirachtin (Govindachari et al., 1990). Neem extract at higher doses adversely affect survival, growth and development of *Tribolium castaneum* (Ramachandran et al., 1988). Neem, groundnut, castor [*Ricinus communis*], soyabean and sesame oils at 0.5 and 1.0 ml/100 g of chickpea seed [*Cicer arietinum*] reduce damage by *Callosobruchus chinensis*. Neem and groundnut oils are also effective at 0.25 ml/100 g seed (Choudhary, 1990). Neem oil gives good results against *B. tabaci* (Rao et al., 1990). Neem oil is as effective as monocrotophos at 0.05%, and can therefore be recommended for use in an integrated control scheme for the pest (Sardana and Kumar, 1990; Grewal, P.S.1988). The methanol extracts of seed kernels at a concentration of 0.02% repel larvae of *Spodoptera litura*. It is an ovipositional deterrent also (Ayyangar and Rao, 1989; Sundaram and Velayutham, 1988). Incorporating leaf meal in combination with fertilizer improve the soil fertility status in terms of organic C, total and available N contents (Murthy et al., 1990). Application of *Azadirachta indica* as green leaf manure give 6.8 and 5.7 t/ha of grain yield (Subramanian and Rangarajan, 1990). Coating of neem cake or shellac with urea reduce the ammoniacal N concentration of the flood water as well as ammonia volatilization but will not improve the nitrogen use efficiency (Mishra et al., 1990).

Soil drenches of 1.0 and 2.0 ppm azadirachtin applied to infested chrysanthemums (*Dendranthema morifolium*) significantly reduce female fecundity and longevity of males (Parkman and Peinkowski, 1990). Stem bark has three diterpenoids-nimbosodione, nimbisonol and demethylnimbionol (Iffat-Ara et al., 1990). Leaf extract of neem is effective against root-knot nematodes (*Meloidogyne incognita*) (Chhabra et al., 1988; Alam, 1990; Siddiqui and Alam, 1989). The application of nimbin (a triterpenoid from *Azadirachta indica*) as seed dressing significantly reduce the root-knot development/nematode population (*Meloidogyne incognita* and *Rotylenchulus reniformis*) (Siddiqui and Alam, 1990). Endomorphilic nematodes and neem should not be applied together in control programmes (Rovesti and Deseo, 1989). Addition of neem cake to soil reduce preemergence and postemergence mortality of cotton seedlings caused by *Rhizoctonia solani*. Populations of fungi, bacteria and Actinomycetes increase in unamended soils. Neem cake give similar reductions in root rot of soyabeans caused by *Macrophomina phaseolina* as soil drenching with quintozene. It is also effective in reducing wilt of coconut (*Ganoderma lucidum*), crossandra flowers (*Fusarium solani*) and

Piper betle (*Phytophthora capsici*). Nematode populations in Piper betle soils are also reduced by 59%. Aqueous neem seed kernel extract has larvicidal activity against *Sesamia nonagrioides* (Melamed-Madjar et al., 1989; Osman and Port, 1990). Treatment of rice seeds with neem extract before sowing reduce number of nymphs of *Nilaparvata lugens* becoming adults (Kareem et al., 1989). Leaf or kernel powder has insecticidal effects on the curculionid *Sitophilus zeamais* in stored maize (Kossou, 1989). Wood is used for building, furniture, carving, cigar boxes, cupboards and carts etc.

Wood properties: Weight 817 kg/m³, a strong and hard wood, the heartwood is reddish brown in colour and the sapwood is greyish white. Annual rings doubtful: the wood shows alternating bands with numerous and with fewer pores; also pale concentric lines, but whether these are annual rings is doubtful. Pores scanty, moderate-sized and large, often oval and sub-divided; visible on a vertical section. Medullary rays fine, numerous, white, prominent, bent outwards where they touch the pores; the distance between the rays less than the transverse diameter of the pores. The wood is scented; it much resembles mahogany (Gamble, 1922).

References:

- Alam, M.M. 1990. Neem in nematode control. Nematode bio control. 51-55.
- Alam, M.M., Siddiqui, M.B. and Husain, W. 1990. Treatment of diabetes through herbal drugs in rural India. Fitoterapia. 61(3): 240-242.

Ayyangar, G.S.G. and Rao, P.J. 1989. Azadirachtin effects on consumption and utilization of food and midgut enzymes of *Spodoptera litura* (Fabr.). *Indian Journal of Entomology*. 51(4): 373-376.

Ayyangar, G.S.G. and Rao, P.J. 1990. Neem (*Azadirachta indica* A. Juss) extracts as larval repellents and ovipositional deterrents to *Spodoptera litura* (Fabr.). *Indian Journal of Entomology*. 51(2): 121-124.

Bose, T.K., Das, P. and Maiti, G.G. 1998. *Trees of the world*, Vol. 1. Regional Plant Resource Centre, Orissa. India. 69-70.

Browne, F.G. 1968. *Pests and Diseases of Forest Plantation Trees*. An annotated list of the principal species occurring in the British Commonwealth. Clarendon Press, Oxford.

Chacko, K.C., Mohanan, C., Seethalakshmi, K.K. and George Mathew. 2001. Seed handling and nursery practices for selected forest trees of Kerala. Final Technical Report of ICFRE – World Bank Forestry Research Education and Extension Project. Kerala Forest Research Institute, Peechi.

Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. *Manual of Seeds of Forest Trees, Bamboos and Rattans*. Kerala Forest Research Institute, Peechi, Kerala. pp. 64-65.

Chhabra, H.K., Grewal, P.S. and Singh, A. 1988. Efficacy of some plant extracts on root-knot nematodes (*Meloidogyne incognita*). *Journal of Tree Sciences*. 7(1): 24-25.

Choudhary, B.S. 1990. Residual effect of eight vegetable oils in chickpea against pulse beetle, *Callosobruchus chinensis* (Linnaeus). *Indian Journal of Plant Protection*. 18(1): 89-92.

Dent, T.V. 1948. Seed storage with particular reference to the storage of seed of Indian forest plants. *Indian Forest Records (New Series) Silviculture*, 7: 134 pp. Manager of Publications, Delhi.

Gamble, J.S. 1922. *A manual of Indian timbers*. London Sampson Low, Marton and Company Ltd, Calcutta, India.

Govindachari, T.R., Sandhya, G., and Ganeshraj, S.P. 1990. Simple method for the isolation of azadirachtin by preparative high-performance liquid chromatography. *Journal of Chromatography*. 513: 389-391.

Grewal, P.S. 1988. Stimulation of fungal control of mycophagous nematodes and weed moulds in mushroom compost. *Crop Protection Conference Pests and Diseases*. 3: 1199-1204.

- Iffat-Ara, Siddiqui, B.S., Shaheen Faizi, and Salimuzzaman Siddiqui. 1990. Three new diterpenoids from the stem bark of Azadirachta indica. *Journal of Natural Products*. 53(4): 816-820.
- Kareem, A.A., Saxena, R.C., Boncodin, M.E.M., Krishnasamy, V., and Seshu, D.V. 1989. Neem as seed treatment for rice before sowing: effects on two homopterous insects and seedling vigor. *Journal of Economic Entomology*. 82(4): 1219-1223.
- Khan, M. and Wassilew, S.W. 1987. The effect of raw material from the neem tree, neem oil, and neem extracts on fungi pathogenic to humans. Natural pesticides from the neem tree Azadirachta indica A Juss and other tropical plants Proceedings of the 3rd International Neem Conference, Nairobi, Kenya. 645-650.
- Kindt, R., Mausya, S., Kimotho, J. and Waruhiu. 1997. Tree seed suppliers Directory: Sources of Seeds and Microsymbionts. International Centre for Research in Agro Forestry (ICRAF), Nairobi, Kenya.
- Kossou, D.K. 1989. Evaluation of different products of neem Azadirachta indica A. Juss for the control of *Sitophilus zeamais* Motsch on stored maize. *Insect Science and its Application*. 10(3): 365-372.
- Kumar, S.V. and Bhanja, M. 1992. Forestry Seed Manual of Andhra Pradesh. Andhra Pradesh Forest Department, Hyderabad, India.
- Melamed-Madjar, V., Meisner, J., and Ascher, K.R.S. 1989. Effects of neem on the corn borer, *Sesamia nonagrioides* Lefebvre (Lepidoptera: Noctuidae). *Zeitschrift fur Pflanzenkrankheiten und Pflanzenschutz*. 96(5): 521-525.
- Mishra, B., Sharma, R.D., and Murthy, J.R. 1990. Effect of neem cake and shellac coating of urea and green manure on ammonia volatilization and nitrogen use efficiency for rice. *Journal of the Indian Society of Soil Science*. 38(2): 224-228.
- Murthy, I.Y.L.N., Hazra, C.R. and Kumar, A. 1990. Effect of incorporation of tree leaves on soil fertility. *Journal of the Indian Society of Soil Science*. 38(2): 325-327.
- Osman, M.Z. and Port, G.R. 1990. Systemic action of neem seed substances against *Pieris brassicae*. *Entomologia Experimentalis et Applicata*. 54(3): 297-300.
- Parkman, P. and Peinkowski, R.L. 1990. Sublethal effects of neem seed extracts on adults of *Liriomyza trifolii* (Diptera: Agromyzidae). *Journal of Economic Entomology*. 83(4): 1246-1249.
- Rai, S.N. 1999. Nursery and Planting Techniques of Forest Trees in Tropical South Asia. Eastern Press, Bangalore, India.

Ramachandran, R., Mukherjee, S.N., and Sharma, R.N. 1988. Hormetic effect of azadirachtin on Tribolium castaneum (Herbst) (Coleoptera: Tenebrionidae). Indian Journal of Experimental Biology. 26(11): 913-914.

Rao, N.V., Reddy, A.S., and Reddy, P.S. 1990. Relative efficacy of some new insecticides on insect pests of cotton. Indian Journal of Plant Protection. 18(1): 53-58.

Rovesti, L and Deseo, K.V. 1989. Effect of neem [Azadirachta indica] kernel extract on steinernematid and heterorhabditid nematodes. Nematologica. 35(4): 493-496.

Sardana, H.R. and Kumar, N.K.K. 1990. Effectiveness of plant oils against leaf hopper and shoot and fruit borer on okra. Indian Journal of Entomology. 51(2): 167-171.

Sen Gupta, J.N. 1937. Seed weights, plant percents, etc. for forest plants in India. Indian Forest Records (New Series) Silviculture, 2:221 pp. Manager of Publications, Delhi.

Siddiqui, M.A. and Alam, M.M. 1989. Effect of root-exudates of neem and Persian lilac on plant parasitic nematodes. Anzeiger für Schadlingskunde, Pflanzenschutz, Umweltschutz. 62(2): 33-35.

Siddiqui, M.A. and Alam, M.M. 1990. Control of root-knot, reniform and stunt nematodes by nimbin seed dressing. Nematologia Mediterranea. 18(1): 19-22.

Subramanian, R. and Rangarajan, M. 1990. Response of rice to Azospirillum brasilense and organic manures on organic and chemical fertilized farms in India. International Rice Research Newsletter. 15(3): 27.

Sundaram, R. and Velayutham, B. 1988. Relative efficacy of some insecticides and neem [Azadirachta indica] cake in the control of Rotylenchulus reniformis and Helicotylenchus dihystra affecting garden bean. Indian Journal of Nematology. 18(2): 329-331.

Vasanth, S., Gopal, R.H., and Rao, R.B. 1990. Plant anti-malarial agents. Journal of Scientific and Industrial Research.; 49(2): 68-77.

Baccaurea courtallensis

Nomenclature:

Scientific name: *Baccaurea courtallensis* (Wight) Muell. - Arg.

Vernacular name: Mootilpazham, Mootilthoori (Malayalam) (Sasidharan, 2004), Mootapalam (Tamil), Kalikuki (Kannada) (Bose et al., 1998).

Common name:

Synonyms: *Pierardia courtallensis* Wt., *Baccaurea sapida* Bedd. (Sasidharan, 2004).

Family: Euphorbiaceae

Subfamily:

Origin:

Distribution: Western Ghats and common in evergreen forests.

Description: A middle sized tree, 15 to 20 m high; shoot and young petioles sparsely pubescent (Bose et al., 1998).

Flowering season: September to October (Bose et al., 1998).

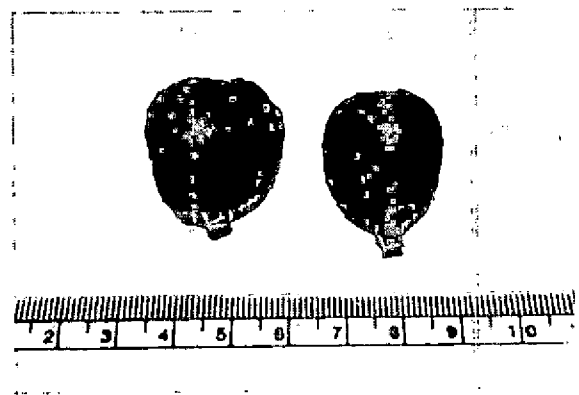
Fruiting season: March to April (Bose et al., 1998).

Flowers: Flowers unisexual, small in clusters on spikes which are in tufts on tubercles on the trunk and branches. Bracts minute; male flowers very small, reddish in long narrow racemiform panicles, densely crowded on the trunk; branch of the panicles short, 3-5 flowered; female flowers on short peduncles in slender racemes of 20-30 cm

long; sepals 3-4 mm long (Bose et al., 1998). Inflorescence reddish or yellow (Anil Kumar et al., 2005).

Fruits: Capsule globose or ellipsoid, bright crimson coloured, sub globose with 3 ridges, 2 cm in diameter, hanging in great profusion all round the trunk (Anil Kumar et al., 2005).

Fruit type: Capsule.



Fruits

Seeds:

Seed dimension:

Seed length:

Seed width:

Seed thickness:

Seed weight:

Seed dispersal:

Seed collection:

Transportation of seeds:

Seed processing:**Seed storage:****Viability period:****Seed emptiness:**

Seed pre treatment: Seed coat is not a mechanical barrier to the emergence of embryo but prevents water entry for initiating germination. The germinability of freshly collected seeds can be improved with scarification. Seeds are scarified mechanically by rubbing against sand paper at the micropylar end and soaking of seeds in hot water and through mechanical scarification opposite the micropylar end improve germination (Prasad, 2004).

Germination type:

Germination percentage: Untreated seeds give 40% and scarified seeds give 70-99% germination (Prasad, 2004).

References:

- Anil Kumar, N., Sivadasan, M. and Ravi, N. 2005. Flora of Pathanamthitta (Western Ghats, Kerala, India). Daya publishing house, New Delhi.
- Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp.70.
- Prasad, P. 2004. Effects of imbibition, scarification and moisture content on seed germination of Baccaurea sapida. Journal of Tropical Forest Science. 16(2): 173-178.
- Sasidharan, N. 2004. Forest Trees of Kerala. Kerala Forest Research Institute, Peechi, Kerala, India.

Germination period:**Nursery technique:****Propagation:****Method of propagation:****Vegetative propagation:****Pests:****Diseases:****Medicinal properties:**

Uses: Tree in full bloom is a wonderful sight. The fruits are edible and acidic in taste (Bose et al., 1998).

Wood properties: Wood white, moderately hard. Pores small, scanty, often in radial strings (Anil Kumar et al., 2005).

Bambusa bambos

Nomenclature:

Scientific name: *Bambusa bambos* (L.) Voss.

Vernacular name: Mullu mula, Ily (Malayalam); Mungil (Tamil); Kantabans (Hindi); Hebbiduru (Kannada) (Chacko et al., 2002).

Common name: Spiny bamboo (Chacko et al., 2002).

Synonyms: *Arundo bambos* L., *Bambusa arundinacea* (Retz.) Willd., *Bambusa spinosa* Roxb. (Chacko et al., 2002).

Family: Poaceae (Graminae)

Subfamily:

Origin: Native to South and South-East Asia.

Distribution: Native to South and South-East Asia, widely cultivated throughout tropics. It is common in the homesteads of Kerala and other Southern States (Chacko et al., 2002).

Description: Closely packed, clumps erect, reaching a height up to 30 m and 10 to 13 cm diameter (Chacko et al., 2002). A densely tufted bamboo with curving branches. Culms 15 to 25 m high, bright green; culm-sheaths 15 to 30 cm long, coriaceous, glabrous to pubescent with dark brown hairs, top rounded, margin plaited, blade up to 10 cm long, tip acute (Bose et al., 1998).

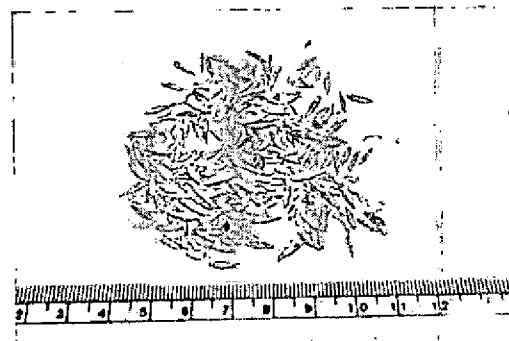
Flowering season: Flowering once in a life time.



Habit



Twig



Seeds

Fruiting season: Fruiting once in a life time. March to May (Chacko et al., 2002).

Flowers: Inflorescence a large panicle, branchlets spicate with loose clusters of about five pale spikelets; spikelets lanceolate, acute or mucronate, many-nerved; stamens exserted, anthers yellow; ovary elliptic-oblong (Bose et al., 1998).

Fruits: Caryopsis oblong, 4 to 8 mm long, grooved on one side (Bose et al., 1998).

Fruit type: Caryopsis.

Seeds: Caryopsis is oblong, fusiform, pale brown and always surrounded by persistent glumes and palea (Chacko et al., 2002).

Seed dimension:

Seed length: 7.2-8 mm (Chacko et al., 2002).

Seed width: 1.5-2 mm (Chacko et al., 2002).

Seed thickness:

Seed weight: 37,000 to 85,000 seeds/kg (Kindt et al., 1997; Chacko et al., 2002).

Seed dispersal:

Seed collection: Seeds are collected by cleaning the ground, spreading a canvas or tarpaulin sheet beneath the flowered clump and sweeping the fallen seeds. Seeds are then cleaned by winnowing (Chacko et al., 2002).

Transportation of seeds: Seeds collected in plastic / polythene / gunny bags and

transported to the processing centre (Chacko et al., 2002).

Seed processing: Seeds are cleaned by winnowing and dried (Chacko et al., 2002).

Seed storage: Orthodox (Kindt et al., 1997; Chacko et al., 2002). Seeds stored in airtight containers are generally viable for 12 months. Storage can be prolonged for about 2 to 3 years under low temperature and humidity (Chacko et al., 2002).

Viability period: Seeds retain viability up to one year if stored in airtight tins and up to three to five years under desiccated condition (Chacko et al., 2002).

Seed emptiness: No information (Chacko et al., 2002).

Seed pre treatment: Cold water soaking for 24 hrs (Kindt et al., 1997; Chacko et al., 2002).

Germination type: Epigeal (Chacko et al., 2002).

Germination percentage: 90 to 95 (Chacko et al., 2002).

Germination period: 6 to 15 days (Chacko et al., 2002).

Nursery technique: Seeds are sown directly in nursery bed during March to May and covered with soil. Partial shade is necessary for initial establishment of the seedlings. Seedlings are pricked out when they are 5 to 6 cm high, potted in polythene bags of size 22.5 cm x 17.5 cm and filled with three parts of forest top soil, one part sand and one part powdered farm yard manure. One year old

poly-potted seedlings are preferred for out-planting (Chacko et al., 2002).

Propagation:

Method of propagation:

Vegetative propagation:

Pests: No information (Chacko et al., 2002).

Diseases: Fungal and bacterial infections are common in bamboo seeds when they are on the plant and after seed fall, which reduces the amount of healthy seeds. Seeds are also attacked during storage. *Bipolaris* sp., *Exserohilum* sp., *Fusarium pallidoseum*,

Drechslera and *Phomopsis* are important seed borne fungi causing infection to the seedlings. Fungicidal seed treatment with (Mancozeb, Hexathir WP, Vitavax 70 WP @ the 4 g / kg seeds) is suggested as control measure (Mohanani, 1997; Chacko et al., 2002).

Medicinal properties:

Uses: An excellent raw material for paper pulp and panel boards. Used as scaffoldings, rafters, thatches and roofs, for basket making, furniture, cooking utensils and fencing. Seeds and tender shoots are edible. Leaves are used as fodder.

Wood properties:

References:

Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 75-76.

Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanani, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 66-67.

Kindt, R., Mausya, S., Kimotho, J. and Waruhiu. 1997. Tree seed suppliers Directory: Sources of Seeds and Microsymbionts. International Centre for Research in Agro Forestry (ICRAF), Nairobi, Kenya.

Mohanani, C. 1997. Diseases of Bamboo in Asia: An Illustrated Manual. International network for Bamboo and Rattan. Beijing, Eindhoven.

Barringtonia acutangula

Nomenclature:

Scientific name: *Barringtonia acutangula* (L.) Gaertn.

Vernacular name: Attu - pezhu, Neerpezhru (Malayalam); Adampa (Tamil); Mauvin-Kumbia (Kannada); Hijal (Hindi) (Chacko et al., 2002); Samudraphal (Hindi).

Common name: Indian oak (Chacko et al., 2002).

Synonyms: *Barringtonia edaphocarpa* Gagnep., *Eugenia acutangula* L., *Barringtonia pedicellata* Kidley (Chacko et al., 2002).

Family: Lecythidaceae (Sasidharan, 2004); Barringtoniaceae (Bose et al., 1998).

Subfamily:

Origin: The tree is a native of Australia, Malaysia and India.

Distribution: Common in tropical seasonal fresh water swamp forests in many parts of India. In Kerala, it occurs in evergreen and deciduous forests (Chacko et al., 2002). Native of Australia, Malaysia and India, grows wild in marshy areas and near the banks of streams and rivers in warm humid climate in many parts of India and East Asian countries (Bose et al., 1998).

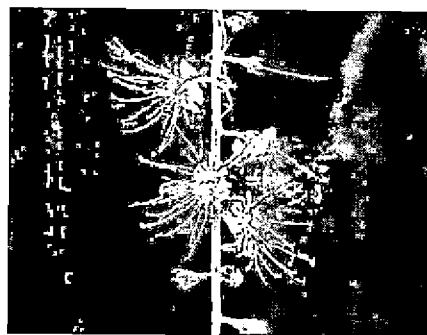
Description: A fairly growing tree, prefers moist soil, evergreen, medium size, 10 to 15 m high, breast height diameter 67 cm spreading and drooping branches (Bose et al., 1998).

Flowering season: April to May.

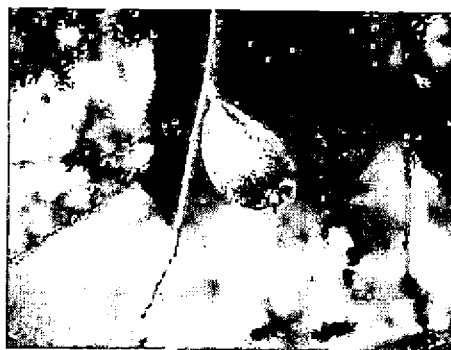
Fruiting season: December (Sen Gupta, 1937; Chacko et al., 2002).



Habit



Flower



Fruit

Flowers: Flowers are fragrant, dark scarlet, in pendulous many flowered racemes, pink to red, 8 to 10 mm diameter, on 20 to 30 cm long pendulous spike; calyx with 4 segments; petals about 6 mm long; stamens red or pink and numerous (Bose et al., 1998).

Fruits: Fruit oblong, bluntly, quadrangular, angles rounded, narrowed towards the end, crowned by small persistent calyx, 2 to 3 cm long and each containing a seed (Bose et al., 1998).

Fruittype:

Seeds: Solitary seed with thick embryo.

Seeddimension:

Seed length: 3.4 cm (Chacko et al., 2002).

Seed width: 1.18 cm (Chacko et al., 2002).

Seed thickness:

Seed weight: 120 to 180 seeds/kg (Kindt et al., 1997; Chacko et al., 2002); 640 to 1,400 seeds/kg (Kumar and Bhanja, 1992; Chacko et al., 2002).

Seed dispersal:

Seed collection: Ripe fruits are collected from the ground and also from the trees (Chacko et al., 2002).

Transportation of seeds: Fruits are transported to the processing centre soon after collection (Chacko et al., 2002).

Seed processing: Seeds can be extracted from shade-dried fruits by peeling off the rind (Chacko et al., 2002).

Seed storage: Intermediate (CABI, 1998). The seeds should be sown soon after collection as they lose viability quickly. If it is to be stored for a couple of months, the best method is to keep the fruits in a pit (Kumar and Bhanja, 1992; Chacko et al., 2002).

Viability period: Seeds are viable for about a month under natural conditions (Chacko et al., 2002).

Seed emptiness: Low (Chacko et al., 2002).

Seed pre treatment: Not required (Chacko et al., 2002).

Germination type: Germination of this species is peculiar. The shoot developed from one end of the horizontally lying fleshy embryo and the root from the other end. First the radicle comes out of the end, and when it is about 2.5 to 5 cm long, the shoot makes its appearance at the stalk end; a long taproot descends into the soil (FRI, 1984; Chacko et al., 2002).

Germination percentage: 90 (Kumar and Bhanja, 1992; Chacko et al., 2002).

Germination period: 42 days (Kumar and Bhanja, 1992; Chacko et al., 2002).

Nursery technique: Seeds are sown in sunken beds at 7.5 x 7.5 cm to a depth of about 0.5 cm, vertically. The beds remain wet throughout. Germination continues up to 6 weeks. The seedlings are ready for planting in the next year. Seedlings attain a

height of about 30 cm in a year (Kumar and Bhanja, 1992; Chacko et al., 2002).

Propagation:

Method of propagation: By seeds.

Vegetative propagation:

Pests: No information (Chacko et al., 2002).

Diseases: No information (Chacko et al., 2002).

Medicinal properties: The fruits, powdered seeds, juice of the leaves and roots are supposed to have medicinal properties. They are useful in skin diseases, ulcers, leprosy, cough. The fruit is used to cure colic, nasal catarrh and other diseases. The root has emetic value and it also cures

cold. The leaf extract is said to cure diarrhoea (Bose et al., 1998).

Uses: The bark contain tannin. Wood is suitable for agricultural implements, house building, boat, cabinet making and tool handles (Bose et al., 1998).

Wood properties: The wood is pale pink or brown without any distinct heartwood but wood near the centre is darker in colour, reddish grey. It is soft to moderately hard and light to moderately heavy wood. Pores small, often subdivided or in radial groups between the broad and very broad rarely fine and moderately broad, long medullary rays which form the greater part of the wood and show a handsome silver grain on a radial section (Gamble, 1922).

References:

Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 78.

CABI. 1998. The Forestry Compendium – A Silvicultural Reference. Module 1. CABI Publishing, CAB International, Wallingford, Oxon, OX108DE, UK.

Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 68-69.

FRI. 1984. Troup's The Silviculture of Indian Trees. Vol. V. The Controller of Publications, Delhi.

Gamble, J.S. 1922. A manual of Indian timbers. London Sampson Low, Marton and Company Ltd, Calcutta, India.

Kindt, R., Mausya, S., Kimotho, J. and Waruhiu. 1997. Tree seed suppliers Directory: Sources of Seeds and Microsymbionts. International Centre for Research in Agro Forestry (ICRAF), Nairobi, Kenya.

Kumar, S.V. and Bhanja, M. 1992. Forestry Seed Manual of Andhra Pradesh. Andhra Pradesh Forest Department, Hyderabad, India.

Sen Gupta, J.N. 1937. Seed weights, plant percents, etc. for forest plants in India. Indian Forest Records (New Series) Silviculture, 2:221 pp. Manager of Publications, Delhi.

Bauhinia malabarica

Nomenclature:

Scientific name: *Bauhinia malabarica* Roxb.

Vernacular name: Amlī, Kachnar (Hindi), Mandaram, Arampuli (Malayalam), Malayathi, Mandarai (Tamil) (Chacko et al., 2002); Vellathi (Tamil).

Common name: Kachnar (Chacko et al., 2002).

Synonyms: *Piliostigma malabarica* (Roxb.) Benth. var. *acidum* (Kirth.) de Wit. (Chacko et al., 2002).

Family: Leguminosae

Subfamily: Caesalpinioideae

Origin:

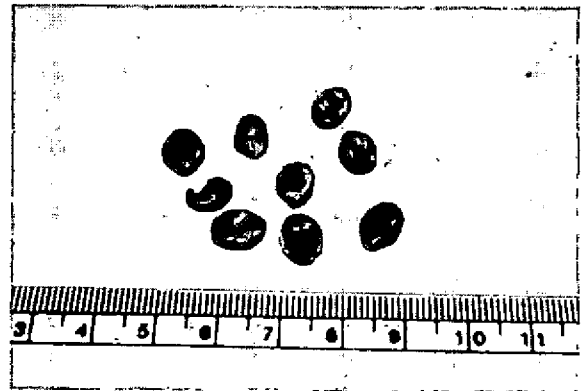
Distribution: It occurs in semi evergreen and moist deciduous forests up to 600 m in Kerala. It has a very wide distribution throughout India. It occurs in the Sub-Himalayan tract and the lower Himalayas from the Ravi River eastwards to Assam, going up to 600 m in the Kumaon and 670 m in the Assam hills. It is also found in the hilly tract of Chota Nagpur, Andhra Pradesh, Madhya Pradesh, Gujarat, Orissa and in the Western Peninsula (Troup, 1921).

Description: Slow growing, small to medium sized deciduous tree attaining a height of 15 m, breast height diameter 57 cm (FRI, 1983; Chacko et al., 2002).

Flowering season: September to January, August to October, flowering sometimes extending even to November (Troup, 1921).

Fruiting season: January to March; January to May (Sen Gupta, 1937; Chacko et al., 2002).

Flowers: Flowers 1.2 cm long, dull white, in small terminal paniculate racemes 3.8-7.9 cm long; pedicels 1.2-2.5 cm long; sepals 0.8-1.2 cm long, grey tomentose; petals oblong, spatulate, little exserted, bracts minute (Troup, 1921).



Seeds

Fruits: Pod 18-30 cm or even up to 46 cm long and 2-5 cm across, nearly straight, marked when dry with raised wavy lines (Troup, 1921).

Fruit type: Pod.

Seeds: Seeds 20-30 per pod, ovoid-globose, 5 mm long, dark brown, polished (Troup, 1921).

Seed dimension:

Seed length: 5 mm (FRI, 1983; Chacko et al., 2002).

Seed width:

Seed thickness:

Seed weight: 1,100 to 2,600 seeds /kg (Luna, 1996; Kindt et.al., 1997; Chacko et al., 2002); 11,290 seeds/kg (Troup, 1921).

Seed dispersal:

Seed collection: The ripe pods are collected from the trees or from the ground (FRI, 1983; Chacko et al., 2002).

Transportation of seeds: Pods gathered in cotton / plastic / polythene bags are transported to the processing centre soon after collection (Chacko et al., 2002).

Seed processing: The pods are dried under sun and gently beaten with a wooden mallet to release seeds which are then cleaned by winnowing (FRI, 1983; Chacko et al., 2002).

Seed storage: Orthodox (CABI, 1998; Chacko et al., 2002). The seeds are stored in gunny bags or earthen pots for about an year. Although, the seeds retain viability for about one year, the use of fresh seeds is recommended (FRI, 1983; Chacko et al., 2002).

Viability period: Seed is viable up to one year in sealed tins under natural conditions (Chacko et al., 2002).

Seed emptiness: Low (Chacko et al., 2002).

Seed pre treatment: Hot water treatment for one minute followed by cold water

soaking for 24 hrs (Kindt et.al., 1997; Chacko et al., 2002).

Germination type: Epigeal (Chacko et al., 2002).

Germination percentage: 14 to 18; 70 to 100 (FRI, 1983; Chacko et al., 2002).

Germination period: 6 to 30 days (Luna, 1996; Chacko et al., 2002).

Nursery technique: Pre-treated seeds are sown in germination trays, containing vermiculite and watered regularly. When the seedlings emerge, they are pricked out into polythene bags of size 20 x 10 cm filled with potting mixture (Chacko et al., 2002).

Propagation:

Method of propagation: Direct sowing.

Vegetative propagation:

Pests: Very low (Chacko et al., 2002).

Diseases: 12 fungi and bacterium are recorded. *Fusarium* sp., *Periconia* sp., *Botryodiplodia theobromae* were the important fungi recorded on seeds (Mohanan and Anil Chandran, 2001; Chacko et al., 2002).

Medicinal properties: The roots and bark are astringent, acrid, cooling, constipating, depurative, vulnerary and styptic. They are used in skin diseases, leprosy, worms, wounds and ulcers. Roots contain racemosol and demethylracemosol, together with their possible biogenetic precursors, preracemosol A and preracemosol B. Racemosol and demethylracemosol exhibit cytotoxicity against KB and BC cell lines

and also exhibit moderate antimalarial activity.

Uses: The timber is used as a fuel. It might be used as rafters and scantlings in cheap construction. The bark contains tannin (Troup, 1921).

Wood properties: The wood is reddish brown when freshly cut, with irregular black

or purplish patches near the centre. It turns to a light greyish brown colour on ageing. The heartwood is not clearly distinct. It is fairly straight grained and medium coarse textured (Troup, 1921). Pores are moderate sized to large, scanty, surrounded by a ring of soft tissue, often oval and subdivided. Medullary rays very numerous, very fine, and regular (Gamble, 1922).

References:

CABI. 1998. The Forestry Compendium – A Silvicultural Reference. Module 1. CABI Publishing, CAB International, Wallingford, Oxon, OX108DE, UK.

Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew, and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 70-71.

FRI. 1983. Troup's The Silviculture of Indian Trees. Vol. IV. The Controller of Publications, Delhi.

Gamble, J.S. 1922. A manual of Indian timbers. London Sampson Low, Marton and Company Ltd, Calcutta, India.

Kindt, R., Mausya, S., Kimotho, J. and Waruhiu. 1997. Tree seed suppliers Directory: Sources of Seeds and Microsymbionts. International Centre for Research in Agro Forestry (ICRAF), Nairobi, Kenya.

Luna, R.K. 1996. Plantation Trees. International Book Distributors, Dehra Dun, India.

Mohanan and Anil Chandran. 2001. Microorganisms associated with seeds of tropical forest species and their management for improving the storability and seedling production. Seed Science and Technology (in press).

Sen Gupta, J.N. 1937. Seed weights, plant percents, etc. for forest plants in India. Indian Forest Records (New Series) Silviculture, 2:221 pp. Manager of publications, Delhi.

Troup, R. S. 1921. The Silviculture of Indian Trees. (Vol VI) International Book Distributors, Dehra Dun.

Bauhinia racemosa

Nomenclature:

Scientific name: *Bauhinia racemosa* Lamk.

Vernacular name: Mandaram, Mala-athi (Malayalam), Vattaatti, Archi, Arais (Tamil), Makuna, Dhorana, Amlī (Hindi) (Chacko et al., 2002); Kachnal (Hindi) (Bose et al., 1998).

Common name: Kanchan (Chacko et al., 2002).

Synonyms: *Piliostigma racemosa* (Lam.) Benth. (Chacko et al., 2002).

Family: Leguminosae

Subfamily: Caesalpinioideae

Origin:

Distribution: The tree is indigenous in drier parts of India, Sri Lanka and Myanmar and distributed in China and Malaysia (Bose et al., 1998). Distributed throughout greater part of India in dry and moist deciduous forests. In Kerala, it occurs in the dry and moist deciduous forests up to 1200 m (Chacko et al., 2002).

Description: Slow growing, small to moderate sized deciduous tree attaining a height of 7.5 m and a breast height diameter of 41 cm (FRI, 1983; Chacko et al., 2002).

Flowering season: March to June (Bose et al., 1998).

Fruiting season: Ripens during November to December, January to March (Sen Gupta, 1937; Chacko et al., 2002).

Flowers: Flowers are white, small, in terminal, or leaf-opposed the raceme; bracts linear, acute; calyx tube 6 to 8 mm long pubescent; petals narrowly oblanceolate, about 8 to 10 mm long; stamens 10, all fertile (Bose et al., 1998).

Fruits: Pod 15 to 30 cm long, glabrous, blunt at the apex, tapering to the base, somewhat falcate, turgid dark brown when ripe (Bose et al., 1998).

Fruit type: Pod.

Seeds: Ovoid-oblong (Bose et al., 1998). 12 to 20 compressed black seeds per pod (Chacko et al., 2002); dark reddish brown, hard, smooth, shining. Seed flour contains protein (22.80 ± 0.49), total ash (5.20 ± 0.09), moisture (18.60 ± 0.05), fat (15.53 ± 0.64), crude fibre (1.91 ± 0.07) and carbohydrate (36.12 ± 0.93) (Amoo and Moza, 1999).



Seeds

Seed dimension:

Seed length: 1.0 cm (Chacko et al., 2002).

Seed width: 0.6 cm (Chacko et al., 2002).

Seed thickness: 0.4 cm (Chacko et al., 2002).

Seed weight: 6,440 to 8,000 seeds/kg (Sen Gupta, 1937; Kumar and Bhanja, 1992; Kindt et al., 1997; Chacko et al., 2002).

Seed dispersal:

Seed collection: When the pods are black in colour they are plucked off the trees (FRI, 1983; Chacko et al., 2002).

Transportation of seeds: Pods collected in cotton / plastic / polythene bags are transported to the processing centre soon after collection (Chacko et al., 2002).

Seed processing: The pods are sun dried and beaten with a wooden mallet to release the seeds. Seeds are then cleaned by winnowing and stored for use (FRI, 1983; Chacko et al., 2002).

Seed storage: Orthodox (CABI, 1998). The seeds are stored in gunny bags or earthen mud pots for about a year. Although, the seeds retain viability to some extent for one year, use of fresh seed is recommended (FRI, 1983; Chacko et al., 2002).

Viability period: Seed is viable up to one year in sealed tins under natural conditions (Chacko et al., 2002). Seed viability was calculated after performing tetrazolium test (Chitra Arya et al., 2006).

Seed emptiness: No information (Chacko et al., 2002).

Seed pre treatment: Hot water soaking for one minute followed by cold water for 24 hrs (Kindt et al., 1997 ; Chacko et al., 2002). The seeds should be soaked in cold water for 24 hrs.

Germination type: Epigeous (FRI, 1983; Chacko et al., 2002).

Germination percentage: 27 to 95 (FRI, 1983; Chacko et al., 2002); 60 to 95.

Germination period: 4 to 10 days (FRI, 1983; Chacko et al., 2002).

Nursery technique: Pre-treated seeds are sown in germination trays containing vermiculite and watered regularly. When the seedlings emerge, they are pricked out into polythene bags of size 20 x 10 cm (Chacko et al., 2002).

Propagation:

Method of propagation: By seeds.

Vegetative propagation:

Pests: Low (Chacko et al., 2002).

Diseases: Moderate (18 to 39%). Six storage moulds including four species of *Aspergillus* are recorded on seeds (Mohanan and Anil Chandran, 2001; Chacko et al., 2002).

Medicinal properties: Bark is astringent, used in dysentery. Leaves with onions are used in diarrhoea and the decoction of leaves is used in malaria (Bose et al., 1998).

Uses: The leaves of the plants are sold in the market to wrap tobacco for smoking (Bose et al., 1998).

It is moderately hard and moderately heavy wood with rather coarse texture and interlocked grain.

Wood properties: The wood is light brown with irregular dark patches near the centre.

References:

- Amoo, I.A. and Moza, L. 1999. Extraction and physico-chemical properties of oils from *Bauhinia racemosa* seeds. *Rivista Italiana delle Sostanze Grasse*. 76(9): 399-400.
- Bose, T.K., Das, P. and Maiti, G.G. 1998. *Trees of the world*, Vol. 1. Regional Plant Resource Centre, Orissa, India. pp. 80.
- CABI. 1998. *The Forestry Compendium – A Silvicultural Reference*. Module 1. CABI Publishing, CAB International, Wallingford, Oxon, OX108DE, UK.
- Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. *Manual of Seeds of Forest Trees, Bamboos and Rattans*. Kerala Forest Research Institute, Peechi, Kerala. pp. 72-73.
- Chitra Arya and Arun Arya. 2006. Effect of storage on seed viability and germination of certain leguminous trees. *Indian Forester*. 132(5): 601-608.
- FRI. 1983. *Troup's The Silviculture of Indian Trees*. Vol. IV. The Controller of Publications, Delhi.
- Kindt, R., Mausya, S., Kimotho, J. and Waruhiu. 1997. *Tree seed suppliers Directory: Sources of Seeds and Microsymbionts*. International Centre for Research in Agro Forestry (ICRAF), Nairobi, Kenya.
- Kumar, S.V. and Bhanja, M. 1992. *Forestry Seed Manual of Andhra Pradesh*. Andhra Pradesh Forest Department, Hyderabad, India.
- Mohanan and Anil Chandran. 2001. Microorganisms associated with seeds of tropical forest species and their management for improving the storability and seedling production. *Seed Science and Technology* (in press).
- Sen Gupta, J.N. 1937. Seed weights, plant percents, etc. for forest plants in India. *Indian Forest Records (New Series) Silviculture*, 2:221 pp. Manager of publications, Delhi.

Bischofia javanica

Nomenclature:

Scientific name: *Bischofia javanica* Bl.

Vernacular name: Cholavenga, Thiruppu, Neeli, Nira, Mlathethayan (Malayalam) (Sasidharan, 2004); Kaen, Punkain, Paniala (Hindi), Thondi, Malachithiyam (Tamil) (Gamble, 1922); Thiyan (Tamil) (Bose et al., 1998).

Common name: Bishop wood, Tiger tree, Java cedar, West Indian cedar, Javanese bishopwood (Bose et al., 1998).

Synonyms: *Andrachne trifoliata* Roxb. (Gamble, 1922); *Microelus raeperianus* Wight and Arn.

Family: Euphorbiaceae

Subfamily:

Origin:

Distribution: The species is distributed in the Sub Himalayan tracts from the Jumna eastwards in West Bengal, Sikkim, Assam, Meghalaya, Manipur and in Kerala, Tamil Nadu; Bangladesh; Myanmar; Malay Peninsula and Archipelago and the Pacific Islands (Bose et al., 1998).

Description: A large, deciduous tree, up to 25 m high, with spreading branches, rounded crown (Bose et al., 1998).

Flowering season: March to May (Troup, 1921).

Fruiting season: Ripens during December to February (Troup, 1921).

Flowers: Flowers green, apetalous, dioecious, in axillary panicles; male flowers: sepals 5, concave, hooded over the anthers; female flowers: sepals 5, ovate, caducous; style long (Bose et al., 1998). Minute flowers, which are unisexual and usually dioecious.

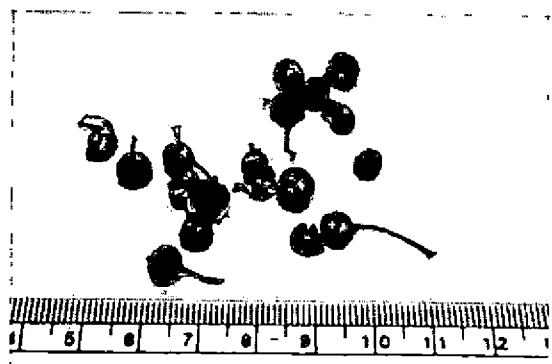
Fruits: Fruits globose, brown and fleshy, 3/4 seeded, about 8 mm in diameter containing few seeds (Bose et al., 1998).

Fruit type:

Seeds: Light brown, smooth, with hard testa and a papery thin albumen.



Branch



Seeds

Seed dimension:

Seed length:

Seed width:

Seed thickness:

Seed weight: 9174/100 g (Troup, 1921).

Seed dispersal:

Seed collection:

Transportation of seeds:

Seed processing:

Seed storage: *B. javanica* seeds exhibit intermediate storage behaviour characterized as being tolerant to desiccation but sensitive to freezing temperatures. Freshly mature seeds survive when they are desiccated to 5.3-12.5% MCs. Viability of seeds with 3.7-12.5% MCs drop significantly at -20°C after 24 months of hermetic storage. The optimum seed moisture contents of *B. javanica* are 8, 5-13, and 5-8% for -20, 4, and 15°C storage, respectively. Longevity of seeds stored at 4°C is better than those at -20 and 15°C (Yang-JengChuann et al., 2006).

Viability period:

Seed emptiness:

Seed pre treatment:

Germination type: Epigeous (Troup, 1921).

Germination percentage: The germination percentage of freshly collected mature seeds is 78% over 8 weeks under alternating temperatures of 30/20°C with 8 h of light (Yang-JengChuann et al., 2006).

Germination period: Between 10 and 18 days (Yang-JengChuann et al., 2006).

Nursery technique: Seedling survival in the first 2 yr is 16%. The high persistence of *Bischofia* in the shade, coupled to its rapid acclimation to high light levels, is an unusual combination.

Propagation:

Method of propagation: By seeds, vegetative method.

Vegetative propagation:

Pests: *Bischofia javanica* wood is susceptible to termite attack (Tarakanadha et al., 2006).

Diseases:

Medicinal properties: Liquid from the stem of the plant is used to treat children who have not waled by two years ago. The bark is used to treat stomach ulcers. The extracts from leaf is effective to cure ulcer, sores, toothache and some eye diseases (Bose et al., 1998). The ethanolic leaf extract of *Bischofia javanica*, partitioned with petrol, dichloromethane and ethyl acetate shows a broad spectrum of antibacterial (against e.g. *Bacillus cereus*, *Micrococcus luteus* and *Agrobacterium tumefaciens*) and antiprotozoal (against *Trichomonas vaginalis*) activity (Khan et al., 2001).

Uses: A beautiful wood that does not warp. Timber for various building purposes. The heartwood is suitable for making brown wrapping paper, writing and printing papers. Bark contains tannin and also yields a red dye employed to dye rattan baskets (Bose et

al., 1998). Wood is used for dyeing bamboo basket.

Wood properties: Wood red, rough, moderately hard, heartwood darker, having a strong scent of vinegar when fresh cut

(Gamble, 1922). Weight about 675 kg/m³. Growth rings absent. Tyloses present, often plugged with white substances (Anoop et al., 2005).

References:

Anoop, E.V., Finto Antony, Bhat, K.V., Lisha Davis, A. and Luckins C. Babu. 2005. Anatomical key for the identification of important timbers of Kerala. Kerala State Council for Science, Technology and Environment, Thiruvananthapuram. pp. 16.

Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 87.

Gamble, J.S. 1922. A manual of Indian timbers. London Sampson Low, Marton and Company Ltd, Calcutta, India.

Khan, M.R., Kihara, M., and Omoloso, A.D. 2001. Anti-microbial activity of Bidens pilosa, Bischofia javanica, Elmerillia papuana and Sigesbekia orientalis. *Fitoterapia*. 72(6): 662-665.

Sasidharan, N. 2004. Forest Trees of Kerala. Kerala Forest Research Institute, Peechi, Kerala, India.

Tarakanadha, B., Prasad, N.R.R., and Rao, K.S. 2006. Natural durability of Indian timbers under marine environment at Krishnapatnam harbour, East Coast of India, Andhra Pradesh. *Journal of the Institute of Wood Science*. 17(2): 75-84.

Troup, R. S. 1921. The Silviculture of Indian Trees. (Vol III) International Book Distributors, Dehra Dun.

Yang-JengChuann, Lin TsanPiao, and Kuo ShingRong. 2006. Seed storage behavior of Sapium discolor Muell.-Arg. and Bischofia javanica Blume. *Taiwan Journal of Forest Science*. 21(4): 433-445.

Bombax ceiba

Nomenclature:

Scientific name: *Bombax ceiba* L.

Vernacular name: Elavu, Pulamaram, Mullilavu, Poola (Malayalam); Mulelavu, Illavam (Tamil); Semal (Hindi); Burla, Sauvi (Kannada) (Chacko et al., 2002).

Common name: Silk cotton tree, Indian bombax (Chacko et al., 2002); Red silk cotton tree, Cotton tree (Bose et al., 1998); Semul.

Synonyms: *Bombax malabaricum* DC., *Salmalia malabarica* (DC.) Schott & Endl. (Bose et al., 1998; Sasidharan, 2004); *Gossampinus malabarica* (DC.) Merr. (Chacko et al., 2002). *Bombax heptaphyllum* Cav., (Gamble, 1922).

Family: Bombacaceae

Subfamily:

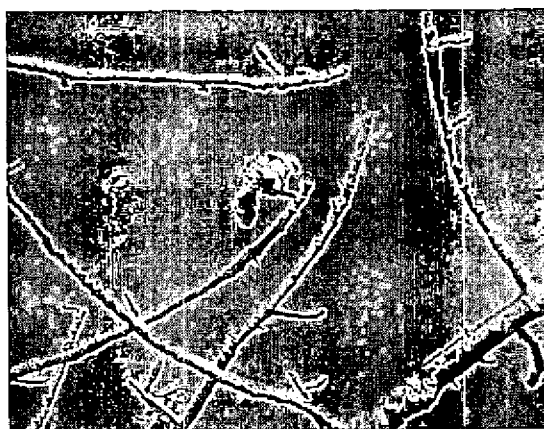
Origin:

Distribution: Distributed throughout India in deciduous forests and evergreen forests. In Kerala it occurs in Thrissur, Palghat, Ernakulam and Trivandrum districts. Widespread in the subcontinent, in the Himalaya up to 1300 m, also in Myanmar and Sri Lanka and as far as Northern Australia (Sahni, 2000).

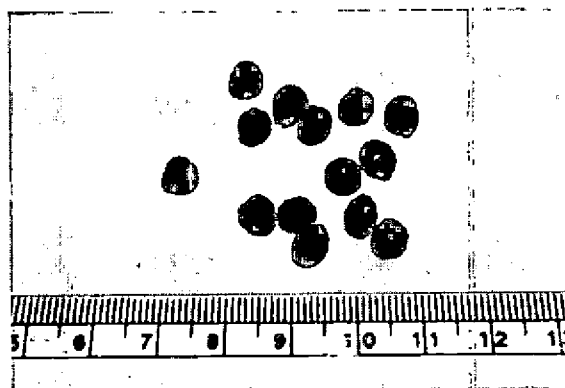
Description: Fast growing, large sized armed deciduous tree reaching a height of 40 m and diameter of 191 cm with whorled horizontal branches; trunk of young tree is covered with stout, conical, prickles, mature tree develop large buttresses (Bose et al., 1998; FRI, 1981; Chacko et al., 2002).

Flowering season: January to March (Brandis), February to March (Bose et al., 1998).

Fruiting season: April to May (Sahni, 2000).



Branch with flowers



Seeds

Flowers: Flowers scarlet, reddish-orange and shades of red and orange, rarely yellow, 8 to 12 cm long; calyx leathery, cup shaped, slightly lobed; petals 5, thick; stamens many; filaments in 5 to 6 bundles opposite the petals (Bose et al., 1998). Flowers numerous, large, 10-30 cm in diameter, fleshy bright crimson, yellow or orange, clustered at the end of branches.

Fruits: Fruit is a capsule, oblong, tapering to both ends (Bose et al., 1998); 10 to 18 cm long, valves woody, lined with silky hairs within. Fruit ovoid, 5 angled, short stalked, downy 10-15 cm long, black when ripe (Sahni, 2000).

Fruit type: Capsule.

Seeds: Many, obovoid, smooth, 6-9 mm long, oily, with dense silky hairs. Seeds small. Innumerable, embedded in silky cotton dispersed by wind (Sahni, 2000).

Seed dimension:

Seed length: 6-9 mm (Chacko et al., 2002).

Seed width:

Seed thickness:

Seed weight: 23,986 to 52,911 seeds/kg (Sen Gupta, 1937 from Chacko et al., 2002); 11,000 to 22,000 seeds/kg (Kindt et al., 1997; Chacko et al., 2002); 2,14,000 to 3,85,000 seeds/kg (Carlowitz, 1991; Chacko et al., 2002).

Seed dispersal: By wind, Birds.

Seed collection: Knock off the mature capsules just before they are about to open (Chacko et al., 2002).

Transportation of seeds: Capsules are gathered in cotton / polythene bags and transported to the processing centre at the earliest (Chacko et al., 2002).

Seed processing: Pods are dried under the sun until they burst. Care should be taken to prevent the seeds from being blown away. Seeds are separated from the floss by churning in a drum using a locally made churn stick (Chacko et al., 2002).

Seed emptiness: Low (Chacko et al., 2002).

Seed pre treatment: Soak the seeds in cold water (Kindt et al., 1997; Chacko et al., 2002).

Germination type: Epigeal (FRI, 1981; Chacko et al., 2002). 30°C is the optimum temperature for germination.

Germination percentage: 14 to 100 (Sen Gupta, 1937; Chacko et al., 2002).

Germination period: 5 to 33 days (Sen Gupta, 1937; Chacko et al., 2002).

Nursery technique: Seeds are sown in germination trays containing vermiculite and watered regularly. The seedlings are potted in polybags of size 22.5 cm x 17.5 cm. The seedling develops vigorous root system and therefore the potted seedlings need frequent shifting and root pruning (Chacko et al., 2002).

Propagation:

Method of propagation: By seeds and budding.

Vegetative propagation:

Pests: Moderate to heavy. The bug *Dysdercus ingulatus* Fb. (Heteroptera: Pyrrhocoridae) cause serious damage to seeds in the field. Nymphs and adult of this insect feed by sucking sap from pods, fruits and seeds (Beeson, 1941; Chacko et al., 2002).

Diseases: Moderate (40 to 66.5%); 20 fungi, actinomycetes and a bacterium are recorded. *Cercospora* sp., *Fusarium* sp., *Pestalotiopsis* sp., *Alternaria* sp. are the important field fungi recorded on seeds (Sharma and Mohanan, 1980; Mohanan and Anil Chandran, 2001 from Chacko et al., 2002).

Medicinal properties: Leaves, stem bark, root of young plants, flowers, fruits, and

seeds have different medicinal uses in indigenous system of medicine (FRI, 1981 from Chacko et al., 2002). The roots and bark are emetic, astringent, tonic, haemostatic, aphrodisiac in nature and useful in diarrhoea and dysentery.

Uses: It is one of the first trees to appear on alluvial ground. The inner bark yields a good fibre suitable for cordage. Fruit yield cotton. Floss from fruits and seeds used for stuffing pillows and mattresses. Wood is used in match industry, packing cases, brush candles, boarding, planking, shingles, toys etc. Immature calyx is used as vegetable (Chacko et.al.,2002).

Wood properties: It is very soft, light, straight grained, even and coarse textured. The wood is creamy white but turns pale greyish brown on exposure. Heartwood is usually absent but in some logs occasionally central portion is reddish brown in colour. Average air dry weight 385 kg/m³. Wood white when fresh cut, turning dark on exposure, very soft, perishable; no heartwood; no annual rings. Pores very scanty, very large, often oval or divided into compartments. Medullary rays fine to broad, numerous, not prominent. Pores and silver-grain prominent on a vertical section (Gamble, 1922).

References:

- Beeson, C.F.C. 1941. The Ecology and Control of the Forest Insects of India and the Neighbouring Countries. Govt of India, New Delhi.
- Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 89.
- Carlowitz, P.G.V. 1991. Multipurpose Trees and Shrubs: Source of seeds and Inoculants. International council for research in Agroforestry, Nairobi, Kenya.
- Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 76-77.
- FRI. 1981. Troup's The Silviculture of Indian Trees. Vol. III. The Controller of Publications, Delhi.
- Gamble, J.S. 1922. A manual of Indian timbers. London Sampson Low, Marton and Company Ltd, Calcutta, India.
- Kindt, R., Mausya, S., Kimotho, J. and Waruhiu. 1997. Tree seed suppliers Directory: Sources of Seeds and Microsymbionts. International Centre for Research in Agro Forestry (ICRAF), Nairobi, Kenya.
- Luna, R.K. 1996. Plantation Trees. International Book Distributors, Dehra Dun, India.

Mohan and Anil Chandran. 2001. Microorganisms associated with seeds of tropical forest species and their management for improving the storability and seedling production. Seed Science and Technology (in press).

Sahni, K.C. 2000. The Book of Indian Trees. BNHS, Mumbai.

Sasidharan, N. 2004. Forest Trees of Kerala. Kerala Forest Research Institute, Peechi, Kerala, India.

Sen Gupta, J.N. 1937. Seed weights, plant percents, etc. for forest plants in India. Indian Forest Records (New Series) Silviculture, 2:221 pp. Manager of publications, Delhi.

Sharma, J.K. and Mohan, C. 1980. Spermophyte microflora of stored seeds of *Tectona grandis*, *Bombax ceiba*, and *Eucalyptus* spp. in relation to germinability. In: B.S.P. Wang and J.A. Pitel(eds.). Proceedings of International Symposium on Forest Tree Seed Storage. Canadian Forest Service. pp. 107-125.

Bombax insigne

Nomenclature:

Scientific name: *Bombax insigne* Wall.

Vernacular name:

Kallelavu, Mullilavu (Malayalam); Kalilavu, Seem-poolai, Kattu elavam (Tamil); Semul (Hindi) (Chacko et al., 2002).

Common name: Semul (Chacko et al., 2002), Silk cotton tree (Bose et al., 1998).

Synonyms: *Salmalia insignis* (Wall.) Schott & Endl. (Sasidharan, 2004; Chacko et al., 2002; Bose et al., 1998).

Family: Bombacaceae

Subfamily:

Origin:

Distribution: Occurs in the forests of Western Ghats from North Kanara Southwards through Konkan and Anamalai hills to Kerala. It also extends to the Deccan districts. It is rarely common in the Andamans, Bangladesh, Myanmar and Malay Peninsula (FRI, 1981 from Chacko et al., 2002).

Description: Fast growing, large prickly deciduous tree attaining a height of 30 m and a breast height diameter of 159 cm (FRI, 1981 from Chacko et al., 2002).

Flowering season: December and continues up to February.

Fruiting season: Fruits mature in March.

Flowers: Flowers 10 to 15 cm long, solitary, calyx 3 cm long, silky inside; petals red; stamens numerous, filaments, united into 4

or 5 bundles (Bose et al., 1998), scarlet or white, scattered on leafless branches.

Fruits: Fruit is a capsule up to 25 cm long and 5 cm in diameter (Bose et al., 1998) oblong, 5-angled, tomentose.

Fruit type: Capsule.

Seeds: Seeds many, obovoid, dark brown coloured seed enveloped in dense silky floss (Chacko et al., 2002).



Branch with flower

Seed dimension:

Seed length: 0.9 cm (Chacko et al., 2002).

Seed width: 0.5 cm (Chacko et al., 2002).

Seed thickness:

Seed weight: 11,640 to 20,110 seeds/kg (Sen Gupta, 1937; FRI, 1981 from Chacko et al., 2002).

Seed dispersal: Wind dispersal, Bees.

Seed collection: Ripe capsules are collected from the tree well before they begin to dehisce (Chacko et al., 2002).

Transportation of seeds: Capsules collected in cotton / polythene bags are packed and transported, and no special care is suggested during transport (Chacko et al., 2002).

Seed processing: Capsules are spread out in the sun on a mat to dry and split open. The floss is separated from the seeds by churning with a bamboo stick (FRI, 1981 from Chacko et al., 2002).

Seed storage: Recalcitrant (CABI, 1998). Seeds can be stored in a gunny bag after drying in the sun (FRI, 1981 from Chacko et al., 2002).

Viability period: Seeds are viable for about one month under ambient room temperature (Chacko et al., 2002).

Seed emptiness: No information (Chacko et al., 2002).

Seed pre treatment: Soak the trees in cold water for about 12 hrs (FRI, 1981 from Chacko et al., 2002).

Germination type: Epigeal (FRI, 1981 from Chacko et al., 2002).

Germination percentage: 60 to 90 (FRI, 1981 from Chacko et al., 2002).

Germination period: 12 to 21 days (FRI, 1981 from Chacko et al., 2002).

Nursery technique: The pretreated seeds are sown in germination trays containing vermiculite and watered. Seedlings are

transplanted to polythene containers filled with potting mixture. Seedlings grow very fast and are used for planting in the same year (FRI, 1981 from Chacko et al., 2002).

Propagation:

Method of propagation:

Vegetative propagation:

Pests: Moderate to heavy due to sap sucking by the bug *Dysdercus cingulatus* Fb. (Heteroptera: Pyrrhocoridae). Nymphs and adults of this insect feed by sucking sap from pods, fruits and seeds (Beeson, 1941 from Chacko et al., 2002).

Diseases: Low (Chacko et al., 2002).

Medicinal properties: Practically every part of the plant is used by Ayurveda practitioners, but only the gum is recognized by yunani doctors.

Uses: Wood is used in match industry for boxes as well as splints. It also used for packing cases, drum, pencils etc. (Chacko et al., 2002). Fruits yield floss called silk cotton. Tree exudes a gum. The inner bark of the tree yields a good fibre suitable for cordage.

Wood properties: The wood is more durable than that of ordinary semul, and the wood is only slightly discoloured when cut up. Wood structure similar to that of *Bombax malabaricum*, but pores smaller or more scanty (Gamble, 1922).

References:

- Beeson, C.F.C. 1941. The Ecology and Control of the Forest Insects of India and the Neighbouring Countries. Govt of India, New Delhi.
- Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 89-90.

CABI. 1998. The Forestry Compendium – A Silvicultural Reference. Module 1. CABI Publishing, CAB International, Wallingford, Oxon, OX108DE, UK.

Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 78-79.

FRI. 1981. Troup's The Silviculture of Indian Trees. Vol. III. The Controller of Publications, Delhi.

Gamble, J.S. 1922. A manual of Indian timbers. London Sampson Low, Marton and Company Ltd, Calcutta, India.

Sasidharan, N. 2004. Forest Trees of Kerala. Kerala Forest Research Institute, Peechi, Kerala, India.

Sen Gupta, J.N. 1937. Seed weights, plant percents, etc. for forest plants in India. Indian Forest Records (New Series) Silviculture, 2:221 pp. Manager of publications, Delhi.

Bridelia retusa

Nomenclature:

Scientific name: *Bridelia retusa* (Linn.) Spreng.

Vernacular name: Kaini, Mulkkayini (Malayalam), Kaj, Khaja (Hindi), Mullu maruthu, Mullu vengai (Tamil) (Bose et al., 1998).

Common name: Muljane

Synonyms: *Chytia spinosa* Willd. (Troup, 1921), *Bridelia squamosa* Lam. (Bose et al., 1998).

Family: Euphorbiaceae

Subfamily:

Origin:

Distribution: Throughout India in mixed deciduous forests. Widely distributed in India - Sub-Himalayan tracts in Sikkim, Meghalaya and central and south India; Myanmar (Bose et al., 1998).

Description: A deciduous, middle-sized tree, 10 to 15 m high; young shoots spinous (Bose et al., 1998).

Flowering season: May to August (Troup, 1921). April to July (Bose et al., 1998).

Fruiting season: Ripens during January to February (Troup, 1921).

Flowers: Small yellow monoecious or dioecious flower. Flowers dioecious, yellow, about 6 mm in diameter, in lateral sessile, clusters and in long spikes, axillary or terminal, of which males very slender; calyx 4 mm in diameter, tube pubescent, lobes glabrous; petals of male orbicular crenate; of female subspathulate (Bose et al., 1998).

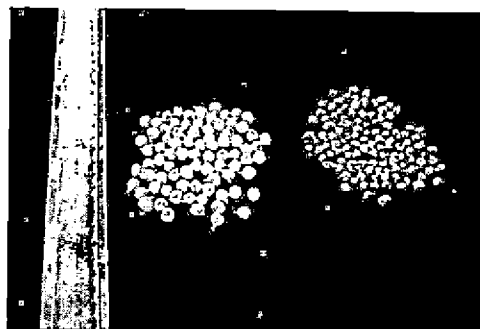
Fruits: Fruit is globose, fleshy sweetish drupe, about the size of a pea, purple-black, seated on a hard enlarged calyx, dark purple when ripe, edible, cocci dehiscent (Bose et al., 1998).



Habit



Branch with fruits



Fresh and dried fruits

Fruit type: Drupe.

Seeds: 1 or 2 seeds with fairly thick bony shells. The seeds have brownish papery testa.

Seed dimension:

Seed length:

Seed width:

Seed thickness:

Seed weight: 1588 - 1764 / 100 g.

Seed dispersal: Birds like parrots, hornbills, green pigeon and other birds (Troup, 1921).

Seed collection:

Transportation of seeds:

Seed processing:

Seed storage:

Viability period:

Seed emptiness:

Seed pre treatment: The seeds should be soaked in cold water for 24 hrs. The seeds after sterilizing with mercuric chloride and soaking in solutions of IAA, IBA and GA at 5, 10, 20 or 100 ppm for 24 or 48 h. 20% IAA will give best results (Chaturvedi and Bajpai, 1999).

Germination type: Epigeous (Troup, 1921).

Germination percentage: 75. The IAA treatments give 72 to 75% (Chaturvedi and Bajpai, 1999).

Germination period:

Nursery technique: Seedlings can be most successfully raised in the nursery if the beds are kept shaded from the sun in the heat of the day and regularly watered (Troup, 1921).

Propagation:

Method of propagation: By seeds.

Vegetative propagation:

Pests:

Diseases:

Medicinal properties: The roots are crushed and used for treating stomach aches, tapeworms, diarrhoea, headaches, and sore joints. The leaf sap is used for sore eyes.

Uses: The bark is used for tannin (Troup, 1921). The wood is of good quality and colour and it is used for rafters, posts, floor boards, cart-shafts, wheels and agricultural implements (Bose et al., 1998). Fruits are edible and leaves are used as fodder. Cyanogenic glycosides occur in the young leaves of *Bridelia retusa* (Mali and Borges, 2003). Solvent extracts of the stem bark of *Bridelia retusa* show fungicidal activity against *Cladosporium cladosporioides* (Lalith-Jayasinghe et al., 2003).

Wood properties: Wood moderately hard to hard, grey to olive brown, close-grained, seasons well. Annual rings are marked by pale lines (Gamble, 1922).

References:

- Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 92.
- Chaturvedi, S.K., and Bajpai, S.P. 1999. Studies on the effect of growth regulators on seed germination and growth performance of Bridelia retusa (Spreng.). Journal of Tropical Forestry. 15(4): 253-257.
- Gamble, J.S. 1922. A manual of Indian timbers. London Sampson Low, Marton and Company Ltd, Calcutta, India.
- Lalith-Jayasinghe, Kumarihamy, B.M.M., Jayarathna, K.H.R.N., Udishani, N.W.M.G., Bandara, B.M.R., Hara, N., and Fujimoto, Y. 2003. Antifungal constituents of the stem bark of Bridelia retusa. Phytochemistry. 62(4): 637-641.
- Mali, S and Borges, R.M. 2003. Phenolics, fibre, alkaloids, saponins, and cyanogenic glycosides in a seasonal cloud forest in India. Biochemical Systematics and Ecology. 31(11): 1221-1246.
- Troup, R. S. 1921. The Silviculture of Indian Trees. (Vol III) International Book Distributors, Dehra Dun.

Butea monosperma

Nomenclature:

Scientific name: *Butea monosperma* (Lam.) Taub.

Vernacular name: Brehma vriksham, Plash, Chamatha (Malayalam); Sindoorapoovu, Elai porasa (Tamil); Dhak, Palas (Hindi) (Chacko et al., 2002).

Common name: Flame of the forest (Chacko et al., 2002)

Synonyms: *Erythrina monosperma* Lam., *Butea frondosa* Koenig ex Roxb. (Chacko et al., 2002 and Sasidharan, 2004).

Family: Leguminosae

Subfamily: Faboideae

Origin:

Distribution: Found in most parts of India in the tropical and subtropical zones ascending to 1000 m in the outer Himalayas and on the hill ranges of South India up to 1300 m. It is common in the grassy blanks, especially along the edges of the forests in moist areas. Also found in the dry deciduous and open scrub forests, as well as in the waterlogged areas and saline soils (Luna, 1996). In Kerala it occurs in Kasaragod, Wayanad, Calicut and Thrissur (Chacko et al., 2002).

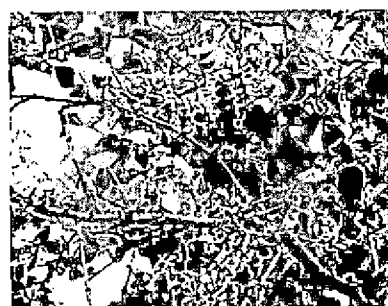
Description: Small to medium sized deciduous tree attaining a height of 12 m and a breast height diameter of 64 cm. Branches irregular and tomentose (Chacko et al., 2002; Nair, 2000).

Flowering season: February to March (Sahni, 2000); March to April.

Fruiting season: May to June (Sahni, 2000).



Habit



Branch with flowers



Fruits



Seeds

Flowers: Flowers bright orange-red sometimes yellow in 15 cm long racemose on bare branches. Pedicel: up to 2.5 cm long, brown velvety. Calyx: up to 1.5 cm long, dark olive green, densely velvety externally, silky hairy within. Corolla: 4-5 cm long with standard petal lanceolate, wing petal falcate and adnate and keel petal incurved. Stamens: 6, filaments up to 2 cm in length united to a staminal column. Pistil: with ovary up to 2.5 cm length.

Fruits: Fruit is a pod up to 15 x 5 cm, falcate-oblong, pubescent, compressed and long stalked. Single seed in each pod (Prasad and Reshmi, 2003).

Fruit type: Pod.

Seeds: Seeds flat reniform. The seed is characterized by finely ridged seed coat and palisade-like malpighian cells, discontinuous transparent linear lucida in upper half of malpighian layer and simple and oblong hilum (Manjoosha-Srivastava et al., 2002).

Seed dimension:

Seed length: 3.3-3.8 cm (Luna, 1996 from Chacko et al., 2002).

Seed width: 2.3-2.5 cm (Luna, 1996 from Chacko et al., 2002).

Seed thickness:

Seed weight: 400 to 1,500 pods/kg (Sen Gupta, 1937; Kindt et al., 1997); 9,850 to 14,790 seeds/kg (Luna, 1996; Chacko et al., 2002).

Seed dispersal: Birds.

Seed collection: Collect the pods from the tree either by lopping or by shaking the branches manually (Chacko et al., 2002).

Transportation of seeds: Pods collected in cotton/ plastic/ gunny/ polythene bags are transported. No special care is suggested for transporting (Chacko et al., 2002).

Seed processing: Pods are dried under shade and the wings are removed by hand (Chacko et al., 2002).

Seed storage: Orthodox (CABI, 1998). The de-winged pods are stored in a dry place in sealed plastic containers for about a year (Dent, 1948; Chacko et al., 2002).

Viability period: No information (Chacko et al., 2002).

Seed emptiness: Low (Chacko et al., 2002).

Seed pre treatment: De-winging (Chacko et al., 2002).

Germination type: Hypogeal (Chacko et al., 2002).

Germination percentage: 70 to 100 (Sen Gupta, 1937 ; Carlowitz, 1991; Chacko et al., 2002).

Germination period: 8 to 14 days (Chacko et al., 2002).

Nursery technique: De-winged seeds are sown horizontally in germination trays containing vermiculite and watered regularly. The seedlings are picked out into polythene bags of size 20 cm x 10 cm filled with soil-based potting mixture (Chacko et al., 2002).

Propagation:

Method of propagation: By seeds and vegetative method.

Vegetative propagation:

Pests: Low (Chacko et al., 2002).

Diseases: Low (Chacko et al., 2002).

Medicinal properties: The bark is acrid, bitter, astringent, thermogenic, emollient, digestive, constipating and tonic. It is useful in dyspepsia, diarrhoea, dysentery, intestinal worms, bone fractures, rectal diseases, ulcers, tumours and diabetes. The leaves, flowers, seeds, gums are also medicinal. The powdered seeds have medicinal and insecticidal properties. The bark contain ruby red gum and it is highly medicinal for snake bites, tumour, bleeding piles and ulcers. The seeds are used as anthelmintic, aperient, digestive, and to treat piles, skin diseases, and abdominal troubles. They also have the property of reducing 'Kapha' and 'Vata' (in Ayurveda) (Manjoosha-Srivastava et al., 2002). The plant parts are mainly used fresh; most commonly used parts are roots, leaves, bark, fruits and even whole plant (Singh, 2007). Extract of stem bark has anti-diarrhoeal potential (Gunakkunru et al., 2005; Amit-Tomar, 2007). Ethanolic extracts has antiinflammatory and analgesic activities (Muruganandan et al., 2001). *Butea monosperma* used to cure threadworm infestation spread among children of Ranchi, Jharkhand, Bihar, India (Bondya et al., 2002). Petroleum ether, chloroform and benzene extracts of leaves of *B. monosperma* reduce the oedema volume in the case of inflammation (Lakshmayya et al., 2000).

Uses: *Butea monosperma* is an indispensable tree. Tribals use its flowers

and young fruits. The plant is used in Ayurvedic, Unani and Siddha medicine for various ailments. Almost all parts of the plant, namely roots, leaves, fruits, stem bark, flowers, gum and young branches are used as medicine, food, fibre and for other miscellaneous purposes such as fish poison, dye, fodder and utensils. Approximately 45 medicinal uses are associated with the plant, half of which have already been scientifically studied and reported (Burli and Khade, 2007). The tree is silviculturally important, used as host for lac insect. The leaves are classed as a good fodder. It is also used by the different tribal societies in West Bengal, India for thatching roofs (Chakraborty and Alope-Bhattacharjee, 2003). A ruby gum exudate from the tree is largely used in medicine and also in tanning and dyeing. Wood is used for gun powder charcoal. The methanol extract from seeds consisting of santonin and ivermectin, show potent anthelmintic activity against *Caenorhabditis elegans* (Prashanth et al., 2001). Stems contain stigmasterol, stigmasterol- beta D-glucopyranoside and nonacosanoic acid (Mamta-Mishra et al., 2000).

Wood properties: The wood is white and not very strong, it is easy to work either by hand or on machine. Wood grey or grey brown, white or brown if cut up fresh and quickly season, soft not durable; no annual rings. Pores large often subdivided, extremely scanty. Medullary rays broad and moderately broad, pale; the darker tissue between the rays is broken up into oblong patches by broad concentric bands of pale tissue similar in appearance to the medullary rays, alternating with dark patches, both distinctly visible on a radial section as long irregular alternate dark and light bands (Gamble, 1922).

References:

- Amit-Tomar. 2007. Some medicinal plants used to cure diarrhoea in Meerut District (U.P.), India. *Plant Archives*. 7(1): 365-366.
- Bondya, S.L., Sharma, H.P., Jyoti Kumar, and Sahu, H.B. 2002. Native medical uses of plants for anthelmintic (Kirmi) at Ranchi District of Jharkhand. *Journal of Phytological Research*. 15(1): 109-110.
- Burli, D.A. and Khade, A.B. 2007. A comprehensive review on Butea monosperma (Lam.) Kuntze. *Pharmacognosy Reviews*. 1(2): 333-337.
- CABI. 1998. *The Forestry Compendium – A Silvicultural Reference*. Module 1. CABI Publishing, CAB International, Wallingford, Oxon, OX108DE, UK.
- Carlowitz, P.G.V. 1991. *Multipurpose Trees and Shrubs: Source of Seeds and Inoculants*. International council for research in Agroforestry, Nairobi, Kenya.
- Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. *Manual of Seeds of Forest Trees, Bamboos and Rattans*. Kerala Forest Research Institute, Peechi, Kerala. pp. 80-81.
- Chakraborty, M.K. and Alope Bhattacharjee. 2003. Plants used for thatching purpose by the tribals of Purulia District, West Bengal, India. *Journal of Economic and Taxonomic Botany*. 27(3): 571-572.
- Dent, T.V. 1948. Seed storage with particular reference to the storage of seed of Indian forest plants. *Indian Forest Records (New Series) Silviculture*, 7: 134 pp. Manager of Publications, Delhi.
- Gamble, J.S. 1922. *A manual of Indian timbers*. London Sampson Low, Marton and Company Ltd, Calcutta, India.
- Gunakkunru, A., Padmanaban, K., Thirumal, P., Pritila, J., Parimala, G., Vengatesan, N., Gnanasekar, N., Perianayagam, J.B., Sharma, S.K., and Pillai, K.K. Anti-diarrhoeal activity of Butea monosperma in experimental animals. 2005. *Journal of Ethnopharmacology*. 98(3): 241-244
- Kindt, R., Mausya, S., Kimotho, J. and Waruhiu. 1997. *Tree seed suppliers Directory: Sources of Seeds and Microsymbionts*. International Centre for Research in Agro Forestry (ICRAF), Nairobi, Kenya.
- Lakshmayya, Meenakshi Sharma, Pramod Kumar, Sreenivasulu, N., and Setty, S.R. 2000. Preliminary phytochemical, anti-inflammatory and antibacterial activity of the leaves of Butea monosperma. *Indian Journal of Natural Products*. 16(2): 22-24.

- Luna, R. K. 1996. Plantation Trees. International Book Distributors, Dehra Dun, India.
- Mamta-Mishra, Shukla, Y.N. and Sushil Kumar. 2000. Euphane triterpenoid and lipid constituents from Butea monosperma. *Phytochemistry*. 54(8): 835-838
- Manjoosha-Srivastava, Srivastava, S.K., Sayyada Khatoon, Rawat, A.K.S., and Shanta Mehrotra. 2002. Pharmacognostical evaluation of seed of Butea monosperma Kuntze. *Natural Product Sciences*. 8(3): 83-89.
- Muruganandan, S., Srinivasan, K., Tandan, S.K., Jawahar Lal, Suresh Chandra, and Raviprakash, V. 2001. Anti-inflammatory and analgesic activities of some medicinal plants. *Journal of Medicinal and Aromatic Plant Sciences*. 22/23(4A/1A): 56-58
- Nair, K.K.N. 2000. Manual of non-wood forest produce plants of Kerala. KFRI, Peechi, Kerala, India.
- Prasad, G., and Reshmi, M.V.A. 2003. Manual of medicinal trees. Agrobios. pp. 26.
- Prashanth, D., Asha, M.K., Amit, A., and Padmaja, R. 2001. Anthelmintic activity of Butea monosperma. *Fitoterapia*. 72(4): 421-422.
- Sahni, K.C. 2000. The Book of Indian Trees. BNHS, Mumbai.
- Sasidharan, N. 2004. Forest Trees of Kerala. Kerala Forest Research Institute, Peechi, Kerala, India.
- Sen Gupta, J.N. 1937. Seed weights, plant percents, etc. for forest plants in India. Indian Forest Records (New Series) *Silviculture*, 2:221 pp. Manager of Publications, Delhi.
- Singh, N.K. 2007. Ethno botanical studies on indigenous medicinal flora of Terai Belt of U.P. *International Journal of Forest Usufructs Management*. 8(1): 29-34

Caesalpinia coriaria

Nomenclature:

Scientific name: *Caesalpinia coriaria* Willd.

Vernacular name: Dividivi (Malayalam), Divi divi (English) (Chacko et al., 2002). Inkimaram (Tamil), Divi-divi (Telugu).

Common name: American sumac, Dividivi (Bose et al., 1998).

Synonyms:

Family: Leguminosae

Subfamily: Caesalpinioideae

Origin: South America (Sasidharan, 2004).

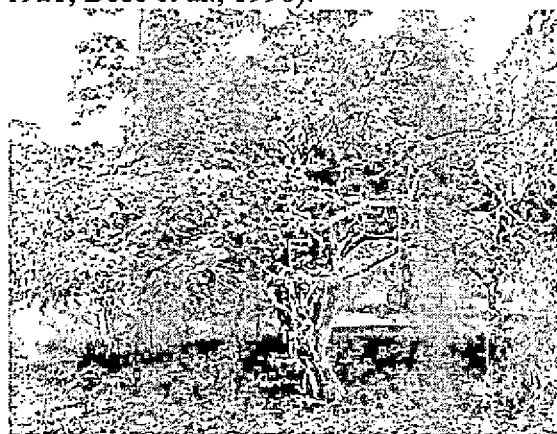
Distribution: Exotic from the lowlands of Central America and north of South America. In India it was introduced in 1834 in Calcutta. Now widely cultivated throughout the country as shade tree, but now got naturalised in the hedges along roads and in dry thorn forests (Chacko et al., 2002).

Description: A small or medium-sized evergreen unarmed tree, attaining a height of 9 m with a dense low spreading crown, somewhat similar to babul (*Acacia nilotica*) in appearance. Trunk short, and often crooked (Troup, 1921; FRI, 1983; Bose et al., 1998; Chacko et al., 2002).

Flowering season: May to June (Troup, 1921); September to October. Sweet-scented flowers appear at intervals in summer and rains which are visited by numerous bees and butterflies (Bose et al., 1998).

Fruiting season: August or cold season (Troup, 1921).

Flowers: Small, whitish or yellowish sweet scented, 2-2.5 mm across, in short dense terminal panicle, petals 5 mm long (Troup, 1921; Bose et al., 1998).



Habit



Branch with flowers



Fruits

Fruits: Pods are glabrous, without prickles, 5.0 to 7.5 cm long, 1.8 cm broad and 0.3 cm thick, in different shades of brown to black, spirally twisted while drying (Troup, 1921).

Fruit type: Pod.

Seeds: Encloses about 7 brown to black seeds.

Seed dimension:

Seed length: 0.58 mm (Chacko et al., 2002).

Seed width: 0.3 mm (Chacko et al., 2002).

Seed thickness:

Seed weight: 4,200 to 1,700 seeds/kg (Kindt et al., 1997; Chacko et al., 2002).

Seed dispersal:

Seed collection: Pods are collected from the ground. It is not necessary to collect the pods from the tree as plenty of pods are available on the ground during the season (Chacko et al., 2002).

Transportation of seeds: Pods are collected in cotton/ plastic/ polythene bags. No special care is suggested while transporting (Chacko et al., 2002).

Seed processing: Dry the pods under the sun and the seeds are extracted by hand or using a mechanical scarifier (Chacko et al., 2002).

Seed storage: Orthodox (Kindt et al., 1997; CABI, 1998). Seeds can be stored in a dry place in sealed tins, plastic containers, polythene bags for more than a year (Chacko et al., 2002).

Viability period: Seeds retain viability for more than a year in sealed tins (Chacko et al., 2002).

Seed emptiness: Low (Chacko et al., 2002).

Seed pre treatment: Soak the seeds in boiled water for about 1 to 2 min followed by soaking in cold water for 24 hrs (Chacko et al., 2002).

Germination type: Epigeal (Chacko et al., 2002).

Germination percentage: 60 to 80 (Chacko et al., 2002).

Germination period: Germination commences on the third day of sowing (Chacko et al., 2002).

Nursery technique: Pretreated seeds are sown in germination trays filled with vermiculite and watered regularly. When the seedlings emerge, they are pricked out into polythene bags of size 20 x 10 cm filled with soil-based potting mixture and kept under shade till they establish (Chacko et al., 2002).

Propagation:

Method of propagation: By seeds.

Vegetative propagation:

Pests: Low (Chacko et al., 2002).

Diseases: Low (Chacko et al., 2002).

Medicinal properties: Pods are astringent and often used to relieve periodic fever, bark is also used in similar ailment (Bose et al., 1998).

Uses: One of the richest tannin bearing trees in India, also an avenue species. Timber is hard and very heavy (Bose et al., 1998).

Wood properties: Wood hard, heavy with fine texture. Sapwood greyish white or pale yellow and the heartwood is very small, is deep purple or nearly black and close grained. It is diffuse porous wood with very

small, moderately numerous pores. Pores small, scanty, enclosed in pale tissue which spreads into concentric interrupted often anastomizing narrow bands. Medullary rays

fine, white, narrow, regular and conspicuous. Annual rings distinct (Gamble, 1922).

References:

Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 100.

CABI. 1998. The Forestry Compendium – A Silvicultural Reference. Module 1. CABI Publishing, CAB International, Wallingford, Oxon, OX108DE, UK.

Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 82-83.

FRI. 1983. Troup's The Silviculture of Indian Trees. Vol. IV. The Controller of Publications, Delhi.

Gamble, J.S. 1922. A manual of Indian timbers. London Sampson Low, Marton and Company Ltd, Calcutta, India.

Kindt, R., Mausya, S., Kimotho, J. and Waruhiu. 1997. Tree seed suppliers Directory: Sources of Seeds and Microsymbionts. International Centre for Research in Agro Forestry (ICRAF), Nairobi, Kenya.

Sasidharan, N. 2004. Forest Trees of Kerala. Kerala Forest Research Institute, Peechi, Kerala, India.

Troup, R. S. 1921. The Silviculture of Indian Trees. (Vol II) International Book Distributors, Dehra Dun.

Caesalpinia sappan

Nomenclature:

Scientific name: *Caesalpinia sappan* L.

Vernacular name: Chappangam (Malayalam), Sappan, Parthangi (Tamil), Pattaranjka (Sanskrit), Bakam (Hindi).

Common name: Sappan wood, Brazil wood, East Indian redwood (Kennedy et al., 2004).

Synonyms:

Family: Leguminosae

Subfamily: Caesalpinioideae

Origin: Indo-Malaysia (Sasidharan, 2004).

Distribution: Indigenous to Myanmar, Philippines, parts of Africa and Central America. In Kerala, it occurs in Calicut, Trichur, and Quilon districts.

Description: A middle sized thorny tree, reaching a height of 12 m and a girth of up to 45-75 cm, with a few small or scattered prickles. Branches lenticellate (Troup, 1921).

Flowering season: March to May, sometime extending to August (Nair, 2001).

Fruiting season: November to December (Nair, 2001).

Flowers: Yellow in axillary and terminal panicle of raceme 30-40 cm long; petals orbicular, 0.8 cm long, yellow; base of upper petal pink (Troup, 1921).

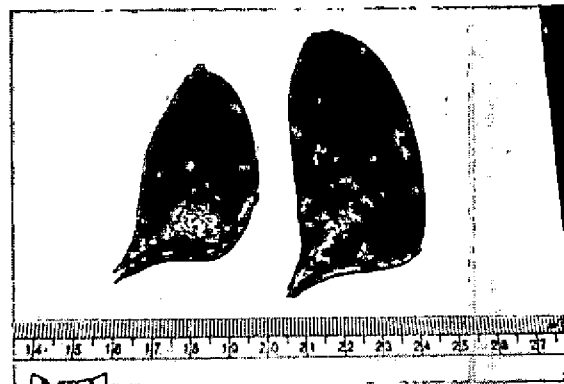
Fruits: Pods 8-10 cm long; yellowish green turning blackish brown later; glabrous, thick, flattened, woody, indehiscent (Troup, 1921).

Fruit type: Pods (Troup, 1921).

Seeds: 3-4; greenish brown, compressed, smooth (Nair, 2001).



Branch with fruits



Fruits



Seeds

Seed dimension:

Seed length:

Seed width:

Seed thickness:

Seed weight: 1,760-2,260 seeds/kg (Nair, 2001).

Seed dispersal:

Seed collection:

Transportation of seeds:

Seed processing:

Seed storage:

Viability period:

Seed emptiness:

Seed pre treatment: Soaking the seeds in water for 12 to 24 hrs may be beneficial in accelerating germination. Concentrated sulfuric acid treatment for 6 min improve germination (48.86%) by removing seed coat dormancy. The treatment with GA3 300 ppm show 71.10% germination (Channegowda et al., 2001).

Germination type: Epigeal (Nair, 2001).

Germination percentage:

Germination period:

Nursery technique:

Propagation:

Method of propagation: By seeds.

Vegetative propagation:

Pests:

Diseases:

Medicinal properties: Wood is an astringent, a decoction of the wood is used against dysentery, diarrhoea and in certain cases of skin affection (Troup, 1921). The active antibacterial principle of *Caesalpinia sappan* is brasilin (Xu-HongXi and Lee, 2004). Its heartwood has long been used in Chinese medicines for treating a variety of immune-mediated pathology and inflammatory disease. Brazilein and *Caesalpinia sappan* ethanol extract (SME) could distinctly inhibit the proliferation of T lymphocyte stimulated by Concanavalin A (Con A) and the proliferation of B lymphocyte stimulated by lipopolysaccharides (LPS) (Ye-Min et al., 2006). The methanol extract of heartwood has growth-inhibiting activity against *Clostridium perfringens*. *C. sappan* heartwood-derived material could be useful as a preventive agent against diseases caused by *C. perfringens* (Lim-MiYoun et al., 2007). Water and methanol extract of *C. sappan* shows both cytotoxicity and topoisomerase I inhibition activity in vitro (99.9% of enzyme activity is inhibited by 100 micro g/ml water extract and by 400 micro g/ml methanol extract) (Jeon-WonKyung et al., 1999).

Uses: *Caesalpinia sappan* is a multipurpose tree used primarily as a source of medicine and dye (Kennedy et al., 2004). Wood is used for cabinet making, scabbards and walking sticks. A red dye called Brazilin is extracted and used for colouring cotton, silk, and woollen fabrics. Pods contain tannin. The wood takes a good polish and is likely to be useful in inlay work.

Wood properties: It is very hard and very heavy wood with diffuse porous structure. The sapwood is white and heartwood is orange red. It is straight-grained and fine textured. Wood is hard, sapwood white, heartwood orange yellow. Pores isolated, small, in narrow pale rings, scanty, between

the fine, wavy, numerous medullary rays (Gamble, 1922).

References:

Chanegowda, S., Farooqi, A.A., Srinivasappa, K.N. and Vasundhara, M. 2001. Studies on pre-germination seed treatment in natural dye yielding tree (Caesalpinia sappan L.). Indian Journal of Forestry. 24(3): 320-323.

Gamble, J.S. 1922. A manual of Indian timbers. London Sampson Low, Marton and Company Ltd, Calcutta, India.

Jeon-WonKyung, Park KapJoo, Kim SooYoung, Ma JinYeul, and Sung HyunJea. 1999. In vitro studies on the anticancer effect and topoisomerase I inhibition activity of Caesalpinia sappan L. extract. Korean Journal of Pharmacognosy. 30(1): 1-6.

Kennedy, R.R., Srinivasappa, K.N., and Farooqi, A.A. 2004. Sappan wood - a multipurpose tree. Indian Journal of Arecanut, Spices and Medicinal Plants. 6(3): 93-94, 97.

Lim-MiYoun, Jeon JuHyun, Jeong EunYoung, Lee ChiHoon, and Lee HoiSeon. 2007. Antimicrobial activity of 5-hydroxy-1,4-naphthoquinone isolated from Caesalpinia sappan toward intestinal bacteria. Food Chemistry. 100(3): 1254-1258.

Nair, K.K.N. 2001. Manual of non-wood forest produce plants of Kerala. KFRI, Peechi.

Sasidharan, N. 2004. Forest Trees of Kerala. Kerala Forest Research Institute, Peechi, Kerala, India.

Troup, R. S. 1921. The Silviculture of Indian Trees. (Vol VI) International Book Distributors, Dehra Dun.

Xu-HongXi and Lee, S.F. 2004. The antibacterial principle of Caesalpinia sappan. Phytotherapy Research. 18(8): 647-651.

Ye-Min, Xie WeiDong, Lei Fan, Meng Zhen, Zhao YuNan, Su Hui, and Du LiJun. 2006. Brazilein, an important immunosuppressive component from Caesalpinia sappan L. International Immunopharmacology. 6(3): 426-432.

Calamus brandisii

Nomenclature:

Scientific name: *Calamus brandisii* Becc.

Vernacular name: Kalakkadan, Vanthal (Malayalam), Vanthai (Tamil) (Chacko *et al.*, 2002).

Common name:

Synonyms:

Family: Arecaceae / Palmae

Subfamily:

Origin:

Distribution: Endemic to the Western Ghats and occurs in the evergreen forests from 700 to 1,200 m (Renuka, 2000; Chacko *et al.*, 2002). It is also found in Thirunelveli and Travancore.

Description: Clustering small diameter cane growing more than 10 m long. The cane with sheath measures 1.5 cm in diameter and without sheath, measures 0.8 cm (Chacko *et al.*, 2002).

Flowering season:

Fruiting season: March to May.

Flowers: Unisexual, male spadix very long, flagelliferous spathes are elongated, tubular, female flowers scattered slender branches of the spadix.

Fruits: Fruits are ovate, scales are brown with dark brown border. Measures 1.8 x 0.8 cm (Chacko *et al.*, 2002).

Fruit type:

Seeds:

Seed dimension:

Seed length:

Seed width:

Seed thickness:

Seed weight: 3,800 to 4,500 seeds/kg (Chacko *et al.*, 2002).

Seed dispersal:

Seed collection: Fruits are collected from plants when they attain golden yellow colour, by slowly pulling down the fruit-bearing branch (Chacko *et al.*, 2002).

Transportation of seeds: Fruits are transported to the nursery immediately after collection. It is advisable to carry them in bunches in moist gunny bags (Chacko *et al.*, 2002).

Seed processing: The fruits are de-pulped by soaking in water for 24 to 48 hrs and removing the fleshy disintegrated pericarp by rubbing between the palms. The seeds are then cleaned by washing in water several times and stored in moist sawdust so that seeds do not dry up (Chacko *et al.*, 2002).

Seed storage: Recalcitrant. Seed storage is not recommended. Seeds store well in moist sawdust for two weeks (Chacko *et al.*, 2002).

Viability period: Two weeks (Chacko *et al.*, 2002).

Seed emptiness: No information (Chacko *et al.*, 2002).

Seed pre treatment: No pretreatment, other than de-pulping, is needed (Chacko *et al.*, 2002).

Germination type: Adjacent ligular (Chacko *et al.*, 2002).

Germination percentage: 80 to 90 (Chacko *et al.*, 2002).

Germination period: 30 to 120 days (Chacko *et al.*, 2002).

Nursery technique: Seeds are sown in raised nursery beds filled with soil-sand mixture. After sowing, seeds are covered with a thin layer of sawdust (Chacko *et al.*, 2002).

Propagation:

References:

Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 84-85.

Renuka, C. 2000. Field identification key for rattans of Kerala. Kerala Forest Research Institute, Peechi. pp. 34.

Method of propagation:

Vegetative propagation:

Pests: No information (Chacko *et al.*, 2002).

Diseases: No information (Chacko *et al.*, 2002).

Medicinal properties: The roots are astringent, acrid, bitter, cooling, febrifuge and tonic. They are useful in vitiated conditions of pitta, cough, dysentery, leprosy, skin diseases.

Uses: Climber. Canes slender. It produce best quality small diameter cane, extensively used for furniture making (Chacko *et al.*, 2002).

Wood properties:

Calamus hookerianus

Nomenclature:

Scientific name: *Calamus hookerianus* Becc.

Vernacular name: Velichural, Vanthal, Kakka chural, Kallan chural, Chenthakara (Malayalam) (Chacko et al., 2002).

Common name:

Synonyms:

Family: Arecaceae / Palmae

Subfamily:

Origin:

Distribution: Occurs in the evergreen forests up to 1000 m throughout the Western Ghats in Kerala, Tamil Nadu and Karnataka (Renuka, 2000; Chacko et al., 2002).

Description: Spiny, clustering, medium sized, climbing canes. Stem with sheath measures about 4 cm in diameter and 2.5 cm without sheath (Chacko et al., 2002).

Flowering season: January to July.

Fruiting season: April to December (Chacko et al., 2002).

Flowers: Inflorescence branched, dioecious up to 5 m long, with 3 sepals; male flower in 3 order branched inflorescence, with 3 sepals, 3 petals and 6 stamens.

Fruits: Fruits are sub-globose, scales are arranged in 18 rows, yellowish-brown with a dark brown border. Endosperm not ruminant (Chacko et al., 2002).

Fruit type:

Seeds: 1 seeded.

Seed dimension:

Seed length: 1.0 cm (Chacko et al., 2002).

Seed width: 0.8 cm (Chacko et al., 2002).

Seed thickness:

Seed weight: 4980 seeds/kg (Chacko et al., 2002).

Seed dispersal:

Seed collection: Fruits are collected from the plant by slowly pulling down the fruit-bearing branches when the fruits attain golden yellow colour (Chacko et al., 2002).

Transportation of seeds: Fruits are transported to the nursery immediately after collection. It is advisable to carry them as bunches in moist gunny bags (Chacko et al., 2002).

Seed processing: The fruits are de-pulped after soaking in water for 24 to 48 hrs and removing the fleshy disintegrated pericarp by rubbing between the palms. The seeds are then cleaned by washing in water several times and stored in moist sawdust so that seeds do not dry up (Chacko et al., 2002).

Seed storage: Recalcitrant. Seed storage is not recommended. However, seeds store well in moist sawdust for one month (Chacko et al., 2002).

Viability period: Seeds retain viability for one month (Chacko et al., 2002).

Seed emptiness: No information (Chacko et al., 2002).

Seed pre treatment: No pretreatment, other than de-pulping is needed (Chacko et al., 2002).

Germination type: Adjacent ligular (Chacko et al., 2002).

Germination percentage: Up to 90 (Chacko et al., 2002).

Germination period: 3 to 4 months (Chacko et al., 2002).

Nursery technique: Seeds are sown in raised nursery beds filled with soil-sand mixture. After sowing, seeds are covered with a thin layer of sawdust (Chacko et al., 2002).

Propagation:

Method of propagation:

Vegetative propagation:

Pests: No information (Chacko et al., 2002).

Diseases: No information (Chacko et al., 2002).

Medicinal properties:

Uses: It produces medium diameter rattan extensively used for furniture and basket making (Chacko et al., 2002).

Wood properties:

References:

Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 86-87.

Renuka, C. 2000. Field identification key for rattans of Kerala. Kerala Forest Research Institute, Peechi. pp. 34.

Calamus latifolius

Nomenclature:

Scientific name: *Calamus latifolius* Roxb.

Vernacular name: Kattu chooral (Malayalam).

Common name:

Synonyms: *Calamus macracanthus*,
Calamus inermis (Gamble, 1922).

Family: Arecaceae / Palmae

Subfamily:

Origin:

Distribution: It occurs in the hilly tracts of Malabar.

Description: Clustering, medium sized slender canes with slender culms.

Flowering season:

Fruiting season:

Flowers: Flowers in pendulous inflorescence; primary sheath split open; partial inflorescence shorter than the sheath.

Fruits: Fruit up to 2 cm long, ovoid or ellipsoid.

Fruit type:

Seeds:

Seed dimension:

Seed length:

Seed width:

Seed thickness:

Seed weight:

Seed dispersal:

Seed collection:

Transportation of seeds:

Seed processing:

Seed storage:

Viability period:

Seed emptiness:

Seed pre treatment: Scaly epicarp and fleshy sarcotesta of *C. latifolius* fruits are removed and treated with ash (Mohiuddin *et al.*, 1986).

Germination type: Adjacent ligular.

Germination percentage: 28-42% (Mohiuddin *et al.*, 1986).

Germination period: 12-35 weeks (Mohiuddin *et al.*, 1986).

Nursery technique: Scaly epicarp and fleshy sarcotesta of fruits are removed by treating with ash and are sown in nursery beds in soil, sand and sawdust (2:1:1). Nursery bed is covered with bamboo mats and with an air temperature of 20-28°C after the long germination period, (germination of 28-42%) seedlings (with a single shoot) are transferred to polythene bags containing nursery soil and cow dung (3:1). Bags are kept in the open nursery (Mohiuddin *et al.*, 1986).

Propagation:

Method of propagation:

Vegetative propagation:

Pests:

Diseases:

Medicinal properties: Powdered seeds of plant are used as a curative for ulcers.

Uses: It is highly favoured for furniture, sports items, umbrella handles, walking sticks, and for rattaning chairs.

Wood properties:

References:

Gamble, J.S. 1922. A manual of Indian timbers. London Sampson Low, Marton and Company Ltd, Calcutta, India.

Mohiuddin, M., Rashid, M.H. and Rahman, M.A. 1986. Seed germination and optimum time of transfer of seedlings of *Calamus* spp. from seed bed to polyethylene bag. *Bano Biggyan Patrika*. 15: 21-24.

Calamus pseudotenuis

Nomenclature:

Scientific name: *Calamus pseudotenuis*
Becc. ex Becc. & Hook.f.

Vernacular name: Chooral (Malayalam);
Perumperambu (Tamil); Betta
(Kannada) (Chacko *et al.*, 2002).

Common name:

Synonyms:

Family: Arecaceae / Palmae

Subfamily:

Origin:

Distribution: Occurs in the evergreen forests, generally above 750 m in the Western Ghats region of Kerala, Tamil Nadu and Karnataka. Also found in Sri Lanka (Renuka, 2000; Chacko *et al.*, 2002).

Description: Clustering moderate sized canes. Stem with sheath measures up to 3.5 cm in diameter and without sheath about 2.5 cm (Chacko *et al.*, 2002).

Flowering season: October to April.

Fruiting season: April to November (Chacko *et al.*, 2002).

Flowers: Flowers dioecious in very long, branched inflorescence.

Fruits: Greenish yellow fruits with dark brown border. Fruit size is 1.5 x 0.8 cm (Chacko *et al.*, 2002).

Fruit type:

Seeds: 1 seeded.

Seed dimension:

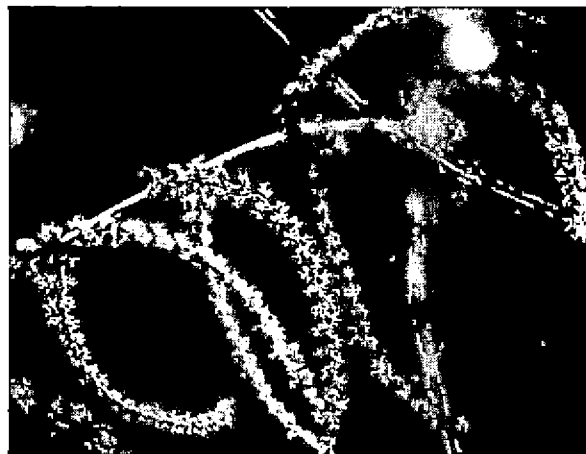
Seed length:

Seed width:

Seed thickness:

Seed weight: 4714 seeds/kg (Chacko *et al.*, 2002).

Seed dispersal:



Flowers

Seed collection: Fruits are collected from the plant when they are golden yellow, by slowly pulling down the fruit-bearing branches after cutting them at the base (Chacko *et al.*, 2002).

Transportation of seeds: Fruits are transported to the nursery immediately after collection. It is better to carry them as bunches in moist gunny bags (Chacko *et al.*, 2002).

Seed processing: The fruits are de-pulped by soaking in water for about 24 to 48 hrs and remove the fleshy disintegrated pericarp by rubbing between the palms. The seeds are then cleaned by washing in water several times and can be stored in moist sawdust up to one week (Chacko *et al.*, 2002).

Seed storage:Recalcitrant. Seed storage is not recommended; however, seeds can be stored in moist sawdust for a short period (Chacko *et al.*, 2002).

Viability period:Seeds retain viability up to a month (Chacko *et al.*, 2002).

Seed emptiness:No information (Chacko *et al.*, 2002).

Seed pre treatment:No pretreatment other than de-pulping, is needed (Chacko *et al.*, 2002).

Germination type:Adjacent ligular, a short plug emerges from the seed from which roots are produced along with an erect swelling (Chacko *et al.*, 2002).

Germination percentage:Up to 85 (Chacko *et al.*, 2002).

Germination period:30 to 40 days (Chacko *et al.*, 2002).

Nursery technique:Seeds are sown in raised nursery beds filled with soil-sand mixture (3:1). After sowing, seeds are

covered with a thin layer of sawdust. Partial shade is necessary. Seedlings are potted in polythene bags during the 4-leaved stage when the seedlings attain around 3-4 cm height, ie., usually for this species it takes up to 1 to 1 1/2 months, after germination. No major disease or pest problem is encountered. One year old polypotted seedlings of 20 to 30 cm length are outplanted in the field (Chacko *et al.*, 2002).

Propagation:

Method of propagation:

Vegetative propagation:

Pests:No information (Chacko *et al.*, 2002).

Diseases:No information (Chacko *et al.*, 2002).

Medicinal properties:

Uses:It is mainly used to make basket weaving and furniture (Chacko *et al.*, 2002).

Wood properties:

References:

Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 88-89.

Renuka, C. 2000. Field identification key for rattans of Kerala. Kerala Forest Research Institute, Peechi. pp. 34.

Calamus rotang

Nomenclature:

Scientific name: *Calamus rotang* L.

Vernacular name: Cheruchooral (Malayalam); Sothuperumbu (Tamil) (Chacko et al., 2002).

Common name: Rattan, Cane (Chacko et al., 2002).

Synonyms:

Family: Arecaceae / Palmae

Subfamily:

Origin:

Distribution: Occurs in the coastal regions of Alappuzha and Kollam districts of Kerala and also in Sri Lanka (Renuka, 2000; Chacko et al., 2002).

Description: Armed, clustering, slender, climbing canes. Stem with sheaths measures up to 1.3 cm in diameter and without sheath up to 1 cm (Chacko et al., 2002).

Flowering season: October to December.

Fruiting season: March to April (Chacko et al., 2002).

Flowers: Unisexual, spadix very long, female scattered along the slender branches of the spadix.

Fruits: Fruits are straw yellow in colour, ovoid with scale arranged in 21 rows. Measures about 1.2-1.3 cm length (Chacko et al., 2002).

Fruit type:

Seeds: 1 seeded.

Seed dimension:

Seed length:

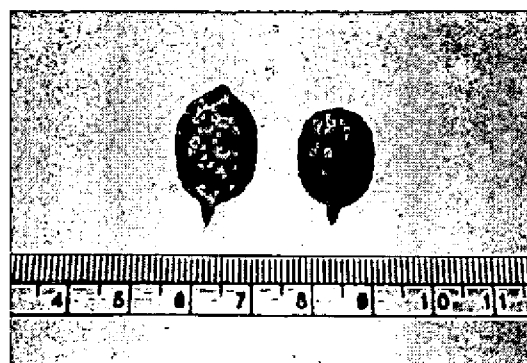
Seed width:

Seed thickness:

Seed weight: 4002 seeds/kg (Chacko et al., 2002).



Habit



Fruits

Seed dispersal:

Seed collection: Fruits are collected from plant by slowly pulling down the fruit-bearing branch (Chacko et al., 2002).

Transportation of seeds: Fruits are transported to the nursery immediately after collection. It is better to carry them as bunches in moist gunny bags (Chacko et al., 2002).

Seed processing: Fruits are de-pulped after soaking in water for 24 to 48 hrs and removing the fleshy disintegrated pericarp by rubbing between the palms. Seeds are then cleaned by washing in water several times and then stored in moist sawdust so that seeds do not dry off (Chacko et al., 2002).

Seed storage: Probably recalcitrant. Seed storage is not recommended; however, seeds can be stored in moist sawdust up to one month (Chacko et al., 2002).

Viability period: Seeds remain viable for one month (Chacko et al., 2002).

Seed emptiness: No information (Chacko et al., 2002).

Seed pre treatment: No pretreatment other than de-pulping (Chacko et al., 2002). Rubbing with sand and ash (removing outer scaly pericarp, fleshy sarcotesta and hilum) mechanically give 65% germination taking 35 days to start germination. Removal of the micropyle give 100% germination (Singh et al., 1999).

Germination type: Adjacent ligular (In this type, a short plug emerges from the seed

from which roots are produced along with an erect swelling which is the first foliar organ that develops into a leaf) (Chacko et al., 2002).

Germination percentage: 80 to 90 (Chacko et al., 2002).

Germination period: 30 to 40 days (Chacko et al., 2002).

Nursery technique: Seeds are sown in raised nursery beds filled with soil-sand mixture (3:1). After sowing, seeds are covered with a thin layer of sawdust. Partial shade is necessary. Seedlings are potted in polythene bags during the 4-leaved stage when the seedlings attain around 3-4 cm height, ie., usually 1 to 1 1/2 months, after the date of germination (Chacko et al., 2002).

Propagation:

Method of propagation: By seeds and vegetative method.

Vegetative propagation:

Pests: No information (Chacko et al., 2002).

Diseases: No information (Chacko et al., 2002).

Medicinal properties: The roots are astringent, acrid, bitter, febrifuge and tonic. They are useful in vitiated conditions.

Uses: It produces excellent cane useful for basket work, chairs, mats, blinds, etc.

Wood properties:

References:

Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 90-91.

Renuka, C. 2000. Field identification key for rattans of Kerala. Kerala Forest Research Institute, Peechi. pp. 34.

Singh, S., Ray, B.K., Gogoi, S., and Deka, P.C. 1999. Germination of rattan seeds in vivo and in vitro conditions. *Annals of Biology Ludhiana*. 15(1): 9-12.

Calamus thwaitesii

Nomenclature:

Scientific name: *Calamus thwaitesii*
Becc. & Hook.f.

Vernacular name: Pannichural, Thadiyan chural, Vandi chural (Malayalam); Tadiperumbu (Tamil); Handibetha (Kannada) (Chacko et al., 2002).

Common name:

Synonyms:

Family: Arecaceae / Palmae

Subfamily:

Origin:

Distribution: Occurs in the evergreen and semi-evergreen and moist deciduous forests between 75 to 900 m throughout the Western Ghats from Maharashtra to Kerala. It is also reported from Sri Lanka (Renuka, 2000 from Chacko et al., 2002).

Description: Very robust clump-forming large cane. Stem with sheath measures up to 6 cm in diameter and up to 3.5 cm without sheath (Chacko et al., 2002).

Flowering season: October to June.

Fruiting season: April to May (Chacko et al., 2002).

Flowers: Flowers distichous, male-rachilla, 15 cm long, involucre cup shaped.

Fruits: Fruit is a capsule, ovoid, scales are with median grooves and are arranged in 12 vertical rows, yellow with deep brown margins. Measures 2 x 1.5 cm (Chacko et al., 2002).

Fruit type: Capsule.

Seeds:

Seed dimension:

Seed length:

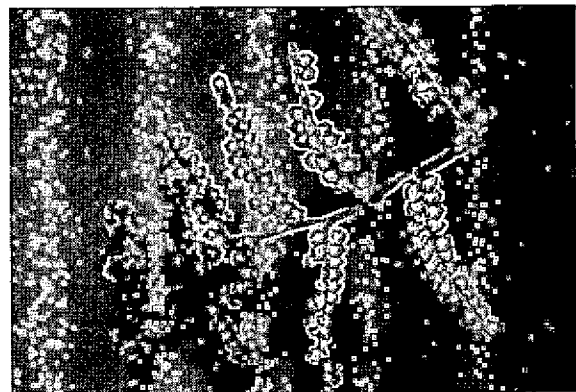
Seed width:

Seed thickness:

Seed weight: 852 seeds/kg (Chacko et al., 2002).

Seed dispersal:

Seed collection: Fruits are collected from the plant when they attain golden yellow in colour, by slowly pulling down the fruit-bearing branch (Chacko et al., 2002).



Branch with fruits

Transportation of seeds: Fruits are transported to the nursery immediately after collection. It is better to carry them as bunches, in moist gunny bags (Chacko et al., 2002).

Seed processing: The fruits are de-pulped after soaking in water for about 24 to 48 hrs and removing the fleshy disintegrated pericarp by rubbing between the palms. The seeds are then cleaned by washing in water several times and stored in moist sawdust so that seeds do not dry off (Chacko et al., 2002).

Seed storage: Recalcitrant. Storage is not recommended; however, seeds can be stored in moist sawdust for about a month without loss of viability (Chacko et al.,2002).

Viability period: Seeds retain viability for about a month (Chacko et al.,2002).

Seed emptiness: No information (Chacko et al.,2002).

Seed pre treatment: No pretreatment other than de-pulping (Chacko et al., 2002).

Germination type: Adjacent ligular (Chacko et al.,2002).

Germination percentage: 90 to 95 (Chacko et al.,2002).

Germination period: 36 to 120 days (Chacko et al.,2002).

Nursery technique: Seeds are sown in raised nursery beds filled with soil-sand mixture (3:1). After sowing, seeds are covered with a thin layer of sawdust. Partial

References:

Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 92-93.

Renuka, C. 2000. Field identification key for rattans of Kerala. Kerala Forest Research Institute, Peechi. pp. 34.

shade is necessary. Seedlings are potted in polythene bags during the 4-leaved stage when the seedlings attain around 3-4 cm height, ie., usually for this species it takes 1 to 1 1/2 months, after germination (Chacko et al., 2002).

Propagation:

Method of propagation:

Vegetative propagation:

Pests: No information (Chacko et al.,2002)

Diseases: No information (Chacko et al.,2002).

Medicinal properties: Stem sap of *Calamus thwaitesii* is used as an antifertility drug

Uses: It produces best quality large diameter cane used extensively for furniture making (Chacko et al., 2002).

Wood properties:

Calamus travancoricus

Nomenclature:

Scientific name: *Calamus travancoricus*
Bedd.ex Becc. & Hook.f.

Vernacular name: Arichural
(Malayalam); Kiribetha (Kannada)
(Chacko et al.,2002).

Common name: Cane (Chacko et al.,2002).

Synonyms:

Family: Arecaceae / Palmae

Subfamily:

Origin:

Distribution: Occurs in the evergreen forests of Western Ghats between 200 to 500 m in southern and central Kerala (Renuka, 2000; Chacko et al., 2002).

Description: Very slender clustering cane, stem with sheath measures up to 0.8 cm in diameter and 0.4 cm without sheath (Chacko et al., 2002).

Flowering season: October to November.

Fruiting season: May to June (Chacko et al.,2002).

Flowers: Flowers dioecious, in up to 50 cm long, branched inflorescence.

Fruits: Fruit globose, 1cm across, scales in 24 rows (Chacko et al.,2002).

Fruit type:

Seeds: 1 seeded.

Seed dimension:

Seed length: 1.2 cm (Chacko et al., 2002).

Seed width: 1.0 cm (Chacko et al., 2002).

Seed thickness:

Seed weight: 6,500 to 7,500 seeds/kg (Chacko et al., 2002).

Seed dispersal:

Seed collection: Fruits, when they attain golden yellow colour are collected from the plant by slowly pulling down the fruit bearing branch (Chacko et al., 2002).

Transportation of seeds: Fruits are transported to the nursery immediately after collection. It is better to carry them as bunches in moist gunny bags (Chacko et al.,2002).

Seed processing: The fruits are de-pulped after soaking in water for 24 to 48 hrs and removing the fleshy disintegrated pericarp by rubbing between the palms. The seeds are then cleaned by washing in water several times and then stored in moist sawdust so that seeds do not dry up (Chacko et al.,2002).

Seed storage: Probably recalcitrant. Seed storage is not recommended; however, the seeds can be stored in moist sawdust for about one month without loss of viability (Chacko et al., 2002).

Viability period: Seeds retain viability up to a month (Chacko et al., 2002).

Seed emptiness: No information (Chacko et al., 2002).

Seed pre treatment: No pretreatment other than de-pulping (Chacko et al., 2002).

Germination type: Adjacent ligular (Chacko et al.,2002).

Germination percentage: 85 to 95 (Chacko et al.,2002).

Germination period: 30 to 120 days (Chacko et al.,2002).

Nursery technique: Seeds are sown in raised nursery beds filled with soil-sand mixture (3:1). After sowing, seeds are covered with a thin layer of sawdust. Partial shade is necessary. Seedlings are potted in polythene bags during the 4-leaved stage when the seedlings attain around 3-4 cm height, ie., usually for this species it takes 1 to 1 1/2 months, after germination (Chacko et al., 2002).

Propagation:

Method of propagation:

Vegetative propagation:

Pests: No information (Chacko et al.,2002).

Diseases: No information (Chacko et al.,2002).

Medicinal properties: The leaves of this cane species are medicinal, used in the treatment of biliousness, worms and ear complaints.

Uses: It produces good quality small diameter cane used for handicrafts and furniture (Chacko et al., 2002).

Wood properties:

References:

Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 94-95.

Renuka, C. 2000. Field identification key for rattans of Kerala. Kerala Forest Research Institute, Peechi. pp. 34.

Callistemon lanceolatus

Nomenclature:

Scientific name: *Callistemon lanceolatus* DC.

Vernacular name: Lal bottle Brush (Hindi); Seesa Brush (Telugu).

Common name: Bottle Brush.

Synonyms: *Callistemon citrinus* (Curt.) Stapf

Family: Myrtaceae

Subfamily:

Origin: Australia (Sasidharan, 2004).

Distribution: Bottle brush tree is introduced from Australia. It is well distributed in North India particularly in UP, Punjab and Haryana.

Description: A very handsome evergreen tree up to 10 m high with a group of leaves at the end of small branch willow, with slender, drooping twigs (Bose et al., 1998).

Flowering season: February to May.

Fruiting season: January to November.

Flowers: Flowers are scarlet in colour, in sub-cylindrical, terminal spikes, 5-10 cm long, the apex develops as a leafy shoot and floral tufts or inflorescence appears like bottle brush (Bose et al., 1998).

Fruits: Fruits capsular, cup-shaped, hard, woody, greyish brown in colour about 0.5 cm long, 3-celled, dehiscent.

Fruit type: Capsule.

Seeds: Seeds are minute.

Seed dimension:

Seed length:

Seed width:

Seed thickness:

Seed weight: More than one lakh per kg.

Seed dispersal:

Seed collection:

Transportation of seeds:

Seed processing:

Seed storage:

Viability period:

Seed emptiness:

Seed pre treatment: Not required.

Germination type:

Germination percentage: 70

Germination period:

Nursery technique:

Propagation:

Method of propagation: By seeds and cuttings. Shoot-tip cuttings of 15 cm length, with 2 leaves are treated with 6000 ppm IBA (Balakrishna and Bhattacharjee, 1991; Mishra and Majumdar, 1983).

Vegetative propagation:

Pests:

Diseases:

Medicinal properties:

Uses: Wood can be used for making boxes, tool handle and other agricultural

implements. It is one of the popular ornamental trees in tropical and subtropical regions. On steam distillation the leaves yield a pleasant-smelling essential oil (Bose et al., 1998).

Wood properties: Wood is pinkish brown, hard, heavy, and very fine textured. It is a

diffuse porous wood. Pores small to moderate sized, roughly arranged in concentric fashion. Medullary rays very fine, numerous, distance between them equal to the diameter of the pores (Gamble, 1922).

References:

- Balakrishna, M. and Bhattacharjee, S.K. 1991. Studies on propagation of ornamental trees, through stem cuttings. *Indian Journal of Horticulture*. 48(1): 87-94.
- Bose, T.K., Das, P. and Maiti, G.G. 1998. *Trees of the world*, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 102.
- Gamble, J.S. 1922. *A manual of Indian timbers*. London Sampson Low, Marton and Company Ltd, Calcutta, India.
- Mishra, A.K. and Majumdar, A. 1983. Vegetative propagation studies in some ornamental trees by air layers. *South Indian Horticulture*. 31: 218-222.
- Sasidharan, N. 2004. *Forest Trees of Kerala*. Kerala Forest Research Institute, Peechi, Kerala, India.

Calophyllum inophyllum

Nomenclature:

Scientific name: *Calophyllum inophyllum*
Linn.

Vernacular name: Sulthanachampa
(Hindi) (Gamble, 1922); Punna
(Malayalam), Punnai (Tamil), Wuma
(Kannada) (Chacko et al., 2002).

Common name: Alexandrian laurel,
Borneo mahogany (Chacko et al., 2002);
Poon, Dilo oil tree (Bose et al., 1998).

Synonyms: *C. guttiferæ*

Family: Clusiaceae (Guttiferae) (Chacko et
al., 2002).

Subfamily:

Origin:

Distribution: Along the east and west coast
of Indian Peninsula (Chacko et al., 2002).
In Kerala it occurs in Kasaragod, Wyanad,
Calicut, Malappuram, Thrissur, Ernakulam,
and Trivandrum districts, mostly along the
backwaters and river banks in the plains. It
is also planted as an ornamental tree
(Bourdillon, 1908) (Chacko et al., 2002).
The tree is distributed in Southern parts of
India; Sri Lanka; Malaysia; East African
Islands; Polynesia and Australia, more
common near the sea (Bose et al., 1998).

Description: A moderate sized evergreen
tree attaining a height of 15 m and a breast
height diameter of 45 cm (Chacko et al.,
2002), with dense shiny foliage.

Flowering season: Cold season, March to
April (Bourdillon, 1908).

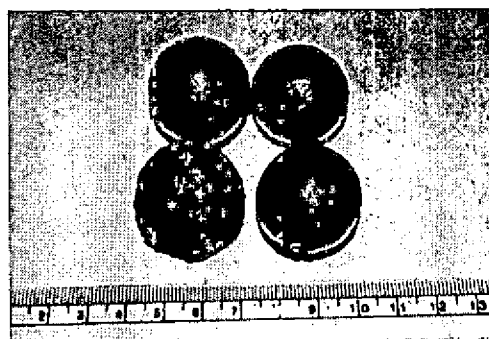
Fruiting season: Ripens in about March
(Bourdillon, 1908).



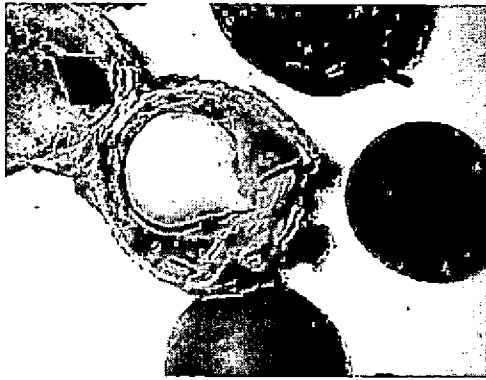
Branch with flowers



Branch with fruits



Fruits



Seeds

Flowers: Handsome white, scented, fragrant with variable numbers of perianth parts, polygamous 2.0-2.5 cm across, in lax, axillary racemes; petals 4; stamens numerous in 4 bunches and yellow anthers (Bose et al., 1998).

Fruits: Fruits spherical drupes, 2.5 cm in diameter, pulpy, yellow when ripe (Bose et al., 1998).

Fruit type: Drupe.

Seeds: Oily and lose their germinative power early.

Seed dimension:

Seed length:

Seed width: 1.5 cm (Chacko et al., 2002).

Seed thickness:

Seed weight: 195 seeds/kg, 137 to 212 fruits/kg (Nair, 2000; Chacko et al., 2002).

Seed dispersal: Bats.

Seed collection: Fruits are collected from the tree by lopping off the branches. Fallen mature seeds are also collected (Chacko et al., 2002).

Transportation of seeds: Fruits are collected in cotton / jute bags, packed and

transported. No special care is suggested (Chacko et al., 2002).

Seed processing: Fleshy pericarp is removed before sowing and storage (Chacko et al., 2002).

Seed storage: Recalcitrant (CABI, 1998). The oily seeds lose viability quickly and therefore storage is not recommended (FRI, 1975; Chacko et al., 2002).

Viability period: The seeds lose viability on storage due to their oily nature (Nair, 2000; Chacko et al., 2002).

Seed emptiness: No information (Chacko et al., 2002)

Seed pre treatment: Remove the seed coat before sowing (Chacko et al., 2002). Removal of the testa increase the germination percentage and seedling growth (Vanangamudi et al., 1984).

Germination type: Hypogeal (Chacko et al., 2002; Vanangamudi et al., 1984).

Germination percentage: 90 (Nair, 2000; Chacko et al., 2002).

Germination period: No information (Chacko et al., 2002).

Nursery technique: Seeds are dibbled in vermiculite or river sand maintained moist in germination trays. Seedlings are pricked out into polythene bags of 22.5 x 17.1 cm filled with potting mixture (Chacko et al., 2002).

Propagation:

Method of propagation: By seeds.

Vegetative propagation:

Pests: No information (Chacko et al., 2002).

Diseases: No information (Chacko et al., 2002).

Medicinal properties: The seeds yield an oil in soap manufacture and the decoction of flowers is given to cure venereal diseases. The bark of the tree is applied to stop internal haemorrhages. The seeds yield a dark green, scented, thick oil known as pinnay, domba or dillo oil which is employed as medicine for the cure of rheumatism, ulcers and skin diseases (Bose et al., 1998). Seeds of *C. inophyllum* contain several known coumarins, including the potent HIV [human immunodeficiency virus] reverse transcriptase inhibitors

costatolide and inophyllum (Spino et al., 1999). Extracts show antibacterial activity (Bibitha-Babu et al., 2002).

Uses: Timber is useful and seed yields an oil which is used for burning and manufacture of soaps. Wood is used for posts, beams, furniture and cabinet works.

Wood properties: Wood reddish brown, hard, close grained. Pores moderate sized, scanty arranged in groups or oblique strings. Medullary rays very fine and numerous, bent round the pores (Gamble, 1922).

References:

- Bibitha-Babu, Jisha, V.K., Salitha, C.V., Mohan, S. and Valsa, A.K. 2002. Antibacterial activity of different plant extracts. *Indian Journal of Microbiology*. 42(4): 361-363.
- Bose, T.K., Das, P. and Maiti, G.G. 1998. *Trees of the world*, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 103.
- Bourdillon, T.F. 1908. *Forest trees of Travancore*. International Book Distributors, Dehradun. pp. 27.
- CABI. 1998. *The Forestry Compendium – A Silvicultural Reference*. Module 1. CABI Publishing, CAB International, Wallingford, Oxon, OX108DE, UK.
- Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. *Manual of Seeds of Forest Trees, Bamboos and Rattans*. Kerala Forest Research Institute, Peechi, Kerala. pp. 96-97.
- FRI. 1975. *Troup's The Silviculture of Indian Trees*. Vol. I. The Controller of Publications, Delhi.
- Gamble, J.S. 1922. *A manual of Indian timbers*. London Sampson Low, Marton and Company Ltd, Calcutta, India.
- Nair, K.K.N. 2000. *Manual of non-wood forest produce plants of Kerala*. KFRI, Peechi, Kerala, India.
- Spino, C., Dodier, M. and Sotheeswaran, S. 1999. Anti-HIV coumarins from calophyllum seed oil. *Bio-organic and Medicinal Chemistry Letters*. 8(24): 3475-3478.

Vanangamudi, K., Karivaratharaju, T.V. and Ponnusamy, A.S. 1984. Seed germination studies in Punnai (Calophyllum inophyllum Linn). South Indian Horticulture. 32: 352-355.

Calophyllum polyanthum

Nomenclature:

Scientific name: *Calophyllum polyanthum* Wall. ex Choisy

Vernacular name: Kattupunna, Punnapai, Poon-spar (Malayalam) (Sasidharan, 2004); Kattupinnai (Tamil).

Common name: Spar tree, Poon (Gamble, 1922), Poonspar tree.

Synonyms: *C. elatum* Bedd., *C. tomentosum* auct. non Wt. (Sasidharan, 2004).

Family: Clusiaceae

Subfamily:

Origin:

Distribution: Evergreen and semievergreen forests of Western Ghats from North Kanara to Kanyakumari and Sri Lanka. Seen in the Western ghats, from North Kanara southwards. It is found up to 1670 m in Anamalai and Palani Hills.

Description: An evergreen tree of enormous height. A very large evergreen tree with a straight cylindrical stem.

Flowering season: In North Kanara the flowers appear in January to February.

Fruiting season: May to June; the fruit ripens in June to July.

Flowers: White, scented, fragrant, axillary and terminal panicles, sepals 4, petals 4, oblong.

Fruits: Ovoid, 2 cm long, pointed. Ovoid drupe about 2.5 cm long, smooth, apiculate, dark purple.

Fruit type: Drupe.

Seeds:

Seed dimension:

Seed length:

Seed width:

Seed thickness:

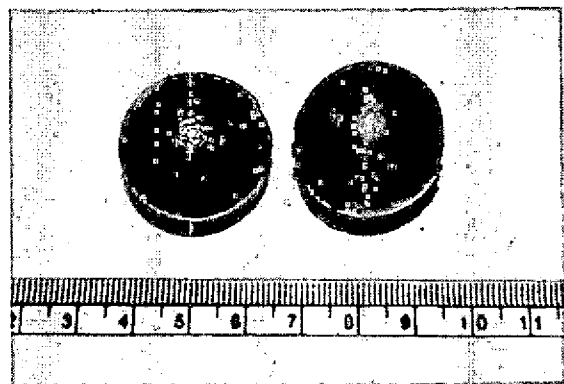
Seed weight:

Seed dispersal:

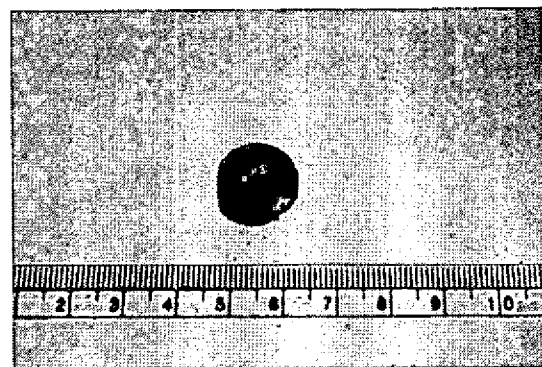
Seed collection:

Transportation of seeds:

Seed processing:



Fruits



Seed

Seed storage: *C. polyanthum* seeds are considered typical recalcitrant seeds (He HuiYing and Song SongQuan, 2003).

Viability period:

Seed emptiness:

Seed pre treatment: Temperature fluctuation treatment and removing the seed coats by partially excising the cotyledons improve the germination percentage and germination rate of seeds (He-HuiYing and Song-SongQuan, 2003).

Germination type: Hypogeal.

Germination percentage:

Germination period:

Nursery technique:

Propagation:

Method of propagation: By seeds. Germinates early in the rain soon after falling.

Vegetative propagation:

Pests:

Diseases:

Medicinal properties: The leaves of the plant are soaked in water to make an eyewash for removing foreign objects from

the eyes. An infusion of the leaves is ingested for diarrhoea.

Uses: An excellent wood, strong and good. It is largely used for spars, rafters, and sometimes for building boats and canoes. The seeds give an orange coloured oil probably used for burning. The fatty acids in the seed oil of *Calophyllum polyanthum* has linoleic acid (38.75%), palmitic acid (22.42%), oleic acid (22.11%) and stearic acid (9.81%) (Na-Zhi, 2005). The hydrocarbon fractions were also analysed to determine the type of isoprene present (Augustus et al., 2001). Ethanolic extract of the seeds of *Calophyllum polyanthum* contains pyranocoumarin diastereoisomers, calopolyanolides C (1) and D (2) (Ma-ChunHui, et al., 2004). Seeds of *C. polyanthum* are found to have two dihydrocoumarins named calopolyanolide A and calopolyanolide B together with calanolide E2, voleneol and gallic acid (Chen-JiJun et al., 2001).

Wood properties: Wood is similar in structure to that of the other species, reddish brown, moderately hard, streaked on the vertical section by the dark concentric lines and the pores. Pores large, scanty, in oblique strings. Medullary rays fine, very numerous, bent round the pores. Concentric lines long or short, interrupted dark (Gamble, 1922).

References:

Augustus, G.D.P.S. and Seiler, G.J. 2001. Promising oil producing seed species of Western Ghats (Tamil Nadu, India). *Industrial Crops and Products*. 13(2): 93-100.

Chen JiJun, Xu Min, Luo ShiDe, Wang HuiYing, and Xu JianChu. 2001. Chemical constituents of *Calophyllum polyanthum*. *Acta Botanica Yunnanica*. 23(4): 521-526.

Gamble, J.S. 1922. A manual of Indian timbers. London Sampson Low, Marton and Company Ltd, Calcutta, India.

He HuiYing and Song SongQuan. 2003. Desiccation sensitivity of Calophyllum polyanthum seeds and factors affecting their germination. *Acta Botanica Yunnanica*. 25(6): 687-692.

Ma-ChunHui, Chen Bin, Qi HuaYi, Li BoGang, and Zhang GuoLin. 2004. Two pyranocoumarins from the seeds of Calophyllum polyanthum. *Journal of Natural Products*. 67(9): 1598-1600.

Na-Zhi. 2005. Fatty acids in the seed oil of Calophyllum polyanthum (Guttiferae). *Journal of Tropical and Subtropical Botany*. 13(6): 505-506.

Sasidharan, N. 2004. *Forest Trees of Kerala*. Kerala Forest Research Institute, Peechi, Kerala, India.

Carallia brachiata

Nomenclature:

Scientific name: *Carallia brachiata* (Lour.) Merr.

Vernacular name: Vallabham, Vankana (Malayalam) (Sasidharan, 2004); Karalli (Telugu).

Common name: False Kelat

Synonyms: *Diatoma brachiata* Lour., *Carallia integerrima* DC. (Sasidharan, 2004)

Family: Rhizophoraceae

Subfamily:

Origin:

Distribution: Distributed throughout India, including the Andaman Islands, Sri Lanka, Myanmar, Malaya Peninsula and Archipelago, China and Australia (Bose *et al.*, 1998).

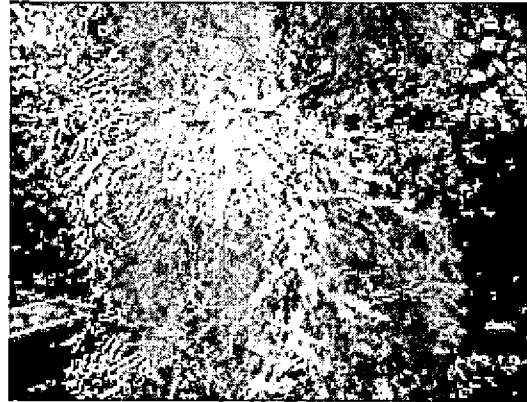
Description: A moderate-sized evergreen tree, up to 15 m high, compact crown with numerous and shining, dark green foliage (Bose *et al.*, 1998).

Flowering season: December to March (Bose *et al.*, 1998).

Fruiting season:

Flowers: Flowers greenish yellow, 5 to 6 mm across, in axillary trichotomous cymes, peduncles stout, short, pedicels almost absent, calyx campanulate, about 6 mm long, petals as many as the sepals (Bose *et al.*, 1998).

Fruits: Fruits globose, 6 to 10 mm across, smooth, red (Bose *et al.*, 1998).



Stem



Twig

Fruit type:

Seeds: Seed one, testa thick (Bose *et al.*, 1998).

Seed dimension:

Seed length:

Seed width:

Seed thickness:

Seed weight:

Seed dispersal:

Seed collection:

Vegetative propagation:

Transportation of seeds:

Pests:

Seed processing:

Diseases:

Seed storage:

Medicinal properties:

Viability period:

Uses: Timber is fairly durable, takes a high polish and used for house building, furniture, cabinet and other ornamental work and agricultural implements. The leaves are used for the preparation of tea-like beverage (Bose *et al.*, 1998).

Seed emptiness:

Seed pre treatment:

Germination type:

Wood properties: Wood hard, red. Pores moderate sized or large, often subdivided and filled with resin. Medullary rays of two kinds: regular very broad ones prominent, with few fine short ones between, silver prominent and handsome (Gamble, 1922)

Germination percentage:

Germination period:

Nursery technique:

Propagation:

Method of propagation:

References:

Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 106, 111.

Gamble, J.S. 1922. A manual of Indian timbers. London Sampson Low, Marton and Company Ltd, Calcutta, India.

Sasidharan, N. 2004. Forest Trees of Kerala. Kerala Forest Research Institute, Peechi, Kerala, India.

Cassia fistula

Nomenclature:

Scientific name: *Cassia fistula* Linn.

Vernacular name: Amaltas (Hindi), Sarakonnai (Tamil), Kanikonna (Malayalam) (Chacko et al., 2002); Konna (Malayalam) (Troup, 1921).

Common name: Indian laburnum, Raj brikh, (Chacko et al., 2002); Amaltas, Golden shower, pudding pipe tree (Bose et al., 1998); The purging fistula (Troup, 1921).

Synonyms: *Cassia rhombifolia* Roxb. (Chacko et al., 2002); *Cathartocarpus fistula* (L.) Persoon

Family: Leguminosae

Subfamily: Caesalpinioideae

Origin:

Distribution: Common in deciduous forests throughout India, Myanmar and Burma ascending to 1500 m in the Himalayas and in Sri Lanka. In Kerala it occurs in dry and moist deciduous forests. It is often grown as an ornamental tree (FRI, 1983; Chacko et al., 2002).

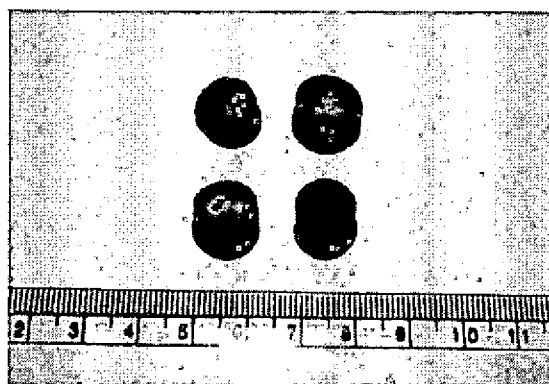
Description: A moderate sized deciduous tree with an open crown about 5 m high with a straight bole (Bose et al., 1998). Slow growing medium sized deciduous tree attaining a height of more than 15 m and a breast height diameter of 48 cm (Chacko et al., 2002).

Flowering season: April - June and September.

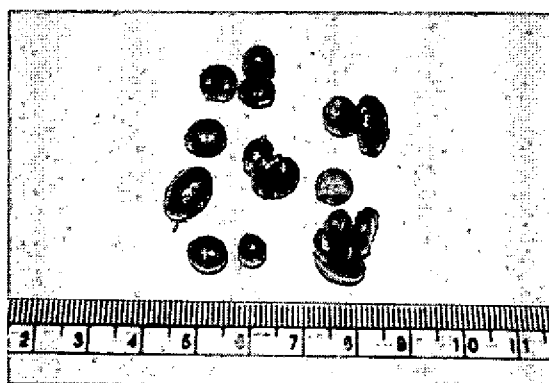
Fruiting season: January - May (Sen Gupta, 1937 from Chacko et al., 2002)



Habit



Fruit segment



Seeds

Flowers: Flowers bright yellow in lax pendulous racemes with a long glabrous pedicel. Flowers yellow, about 3 cm across, pendulous racemes of up to 40 cm long;

calyx 6 to 8 mm long; petals 5, obovate; stamens 10, 3 long, curved, 4 with short filaments, 3 small, without pollen (Bose et al., 1998). Flowers 4-6 cm across, bright yellow in lax drooping axillary racemes 30-60 cm long; pedicels 2.5-5 cm long; slender; calyx 8 to 10 mm long, divided almost to the base; petals 1.8-2.5 cm long, obovate, shortly clawed (Troup, 1921).

Fruits: Fruit is a pod, woody, oblong brown coloured, cylindrical, and about 20 to 50 cm long, with a diameter of about 1.5-3 cm. Pod 30-60 cm long, 2.5 cm diameter, indehiscent cylindrical, smooth, pendulous, dark brownish black when ripe (Troup, 1921). Dark green coloured pods with brown strips in between, with the fruit coat turning brown from the distal end towards the proximal end and nearly 1/4 of the lower pod turning brown is the maturity index for *Cassia fistula* (Sharma et al., 1998).

Fruit type: Pod.

Seeds: Ovate, compressed, light brown, hard, smooth, shiny, with a moderately hard testa and a horny albumen. Seeds 40-100 immersed in dark coloured, sweetish pulp and separated from one another by transverse septa, about 1 cm diameter, flattened (Troup, 1921).

Seed dimension:

Seed length: 1.0 cm diameter (Chacko et al., 2002).

Seed width:

Seed thickness:

Seed weight: 5,640 to 7,055 seeds/kg (Sen Gupta, 1937; Chacko et al., 2002). 2,600 seeds/kg (Carlowitz, 1991; Chacko et al., 2002).

Seed dispersal: Ants and other animals.

Seed collection: Collect brownish black fruits from the tree (Chacko et al., 2002).

Transportation of seeds: No special care is needed (Chacko et al., 2002).

Seed processing: The fruits are dried in the sun and broken to extract the seeds. The seeds are separated from the soft pulp and washed with cold water before drying (FRI, 1983; Chacko et al., 2002).

Seed storage: Orthodox (Kindt et al., 1997; Chacko et al., 2002). The seeds can be stored in sealed tins or gunny bags for many years (Dent, 1948; Chacko et al., 2002). *C. fistula* shows 100% viability up to two years of storage. The use of storage media helps to increase the percentage of seed viability (Khomane and Bhosale, 2003).

Viability period: Seeds are viable for long period, even up to 13 years (Dent, 1948; Chacko et al., 2002).

Seed emptiness: Low (Chacko et al., 2002).

Seed pre treatment: Boiling seeds for 5 min before sowing. Seeds from 1 year old pods germinated more quickly than that from the fresh pods. Boil for 5 min before sowing, or file-off testa and soak in cold water for 2 hrs (Edwards and Naithani, 1999). Pretreatment of seeds with hot water along with light incubation (in 8 h daily cycle) improve germination. Pretreatment with hormone and nitrogenous substances also show limited improvement (Sinhbababu et al., 2007). Mechanical scarification and soaking in sulphuric acid for 60 min are the two best methods to break the dormancy of *C. fistula* seeds (Lopes et al., 2003; Sreerama et al., 2000).

Germination type: Epigeous (FRI, 1983; Chacko et al., 2002).

Germination percentage: 25 to 70 (Chacko et al., 2002).

Germination period: 9 to 97 days (Sen Gupta, 1937; Chacko et al., 2002).

Nursery technique: The pre-treated seeds are sown in seedbeds in drills about 25 cm part in March or April and regularly watered. The seedlings are pricked out and planted in polybags of 22.5 x 17.5 cm size (Chacko et al., 2002).

Propagation:

Method of propagation: By seed.

Vegetative propagation:

Pests: Mild damage due to *Bruchus pisorum* L. and *Caryedon gonagra* Fb. (Coleoptera:Bruchidae). Incidence of *Corcyra cephalonica* Stainton (Lepidoptera:Galleriidae) to ripe pods is also observed. In addition to these, a caterpillar, *Nephopteryx rhodobasalis* Hamp. (Lepidoptera:Phycitidae) is reported to bore in young pods (Beeson, 1941; Chacko et al., 2002).

Diseases: Moderate (35.5 to 53%). Spermoplane microbes recorded include 10 fungi and a bacterium. *Aspergillus*, *Chaetomium*, *Mucor*, *Penicillium*, *Trichoderma* are the important storage fungi and *Fusarium* and *Periconia* are the field fungi recorded (Chacko et al., 2002). *Alternaria cassiae* cause leaf spot of Cassia or sicklepod. The disease can also affect seedlings (David, 1991). Leaf blight caused by *Rhizoctonia solani* (Mehrotra, 1998).

Medicinal properties: Pods are strong purgative. The bark is laxative, diuretic and depurative and is useful in boils, leprosy, ringworm, colic, fever and cardiopathy. The leaves are useful in ulcers and intermittent fevers and the flowers are used in skin diseases, dry cough and bronchitis. Leaf extracts (at 50%) of *Cassia fistula* show antifungal property (Masih and Singh, 2005).

against *Trichophyton mentagrophytes* (MIC 0.5 mg/ml) and *Epidermophyton floccosum* (MIC 0.5 mg/ml) (Duraipandiyam and Ignacimuthu, 2007). Extracts of *Cassia fistula* show antioxidant activities (Luximon-Ramma et al., 2002). *Cassia fistula* used for the treatment of diabetes (Bondya and Sharma, 2004). The methanol extracts of *C. fistula* is effective against both Gram-positive (*Bacillus subtilis*, *B. cereus*, *B. megaterium*, *Staphylococcus aureus*, *S. epidermidis*, *Enterococcus faecalis* and *Micrococcus luteus*) and Gram-negative bacteria (*Escherichia coli*, *Salmonella typhi*, *S. paratyphi*, *Pseudomonas aeruginosa* and *Klebsiella pneumoniae*) (Yogesh-Mahida and Mohan, 2006; Ali et al., 2003; Samy et al., 1998). *Cassia fistula* used in formulations, useful in the treatment of heart disease (angina, hypertension, heart attack/myocardial infarction, cardiomyopathy, congenital heart disease and cardiovascular diseases) (Lokhande et al., 2006).

Uses: Bark is in demand for tanning the hides and dyeing of leather and jute fibres. Pulp of pods are largely used in Bengal to flavour native tobacco. From the stem exudes a red juice which hardens into a gummy substances and the wood ash is used as a mordent in dyeing. The timber is used for camp furniture, turnery, and boat building, particularly boat spars. It is an excellent fuel and yields first-class charcoal (Troup, 1921). Flower and leaf essential oil of *Cassia fistula* L. comprise forty-four compounds (92.6% and 90.7% of the flower and leaf oil, respectively). The main components of the flower oil are (E)-nerolidol (38.0%), and 2-hexadecanone (17.0%), while the leaf oil consists mainly of phytol (16.1%) (Tzakou et al., 2007). Pods of *Cassia fistula*, contain an anthraquinone derivative, 3-formyl-1-hydroxy-8-methoxy-anthraquinone (Meena-Rani and Kalidhar, 1998).

Wood properties: The heartwood is yellowish to brick red, very hard. It is medium coarse textured, somewhat straight grained and heavy. The heartwood is very durable. The sapwood is very liable to attack by borers (not to fungi). The calorific value of the wood for completely dried material is 5164 calories (9296 B.T.U) for sapwood as also for the heartwood (Krishna *et al.*,1932 from Troup,1921). Pores

moderate sized to large, often subdivided, often filled with resin, scanty, uniformly distributed, enclosed in, and joined by, white, wavy irregular, often interrupted, often anastomosing concentric bands of soft tissue. Medullary rays very fine, numerous, uniform, slightly bend, prominent in the dark, firm tissue which separates in the wavy bands (Gamble, 1922).

References:

- Ali, M.A., Sayeed, M.A., and Nurul Absar. 2003. Antibacterial activity and cytotoxicity of three lectins purified from Cassia fistula Linn. seeds. *Journal of Medical Sciences Pakistan*. 3(3): 240-244.
- Beeson, C.F.C. 1941. *The Ecology and Control of the Forest Insects of India and the Neighbouring Countries*. Govt. of India, New Delhi.
- Bondya, S.L. and Sharma, H.P. 2004. Ethnobotanical studies on plants used in diabetes (Madhumeha) under the Baharagora Block of Jharkhand. *Ethnobotany*. 16(1/2): 139-140.
- Bose, T.K., Das, P. and Maiti, G.G. 1998. *Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa, India*. pp. 114.
- Carlowitz, P.G.V. 1991. *Multipurpose Trees and Shrubs: Source of Seeds and Inoculants*. International council for research in Agroforestry, Nairobi, Kenya.
- Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. *Manual of Seeds of Forest Trees, Bamboos and Rattans*. Kerala Forest Research Institute, Peechi, Kerala. pp. 100-101.
- David, J.C. 1991. Alternaria cassiae. [Descriptions of Fungi and Bacteria]. *IMI Descriptions of Fungi and Bacteria*.
- Dent, T.V. 1948. Seed storage with particular reference to the storage of seed of Indian forest plants. *Indian Forest Records (New Series) Silviculture*, 7: 134 pp. Manager of Publications, Delhi.
- Duraipandiyan, V. and Ignacimuthu, S. 2007. Antibacterial and antifungal activity of Cassia fistula L.: an ethnomedicinal plant. *Journal of Ethnopharmacology*. 112(3): 590-594.
- Edwards, D.G. and Naithani, S.C. 1999. *Seed and Nursery Technology of forest trees*. New Age, New Delhi.
- FRI. 1983. Troup's *The Silviculture of Indian Trees*. Vol. IV. The Controller of Publications, Delhi.

- Gamble, J.S. 1922. A manual of Indian timbers. London Sampson Low, Marton and Company Ltd, Calcutta, India.
- Khomane, B.V. and Bhosale, L.J. 2003. Effect of storage medium on viability of seed in some fuelwood species. *International Journal of Forest Usufructs Management*. 4(1): 55-58.
- Kindt, R., Mausya, S., Kimotho, J. and Waruhiu. 1997. Tree seed suppliers Directory: Sources of Seeds and Microsymbionts. International Centre for Research in Agro Forestry (ICRAF), Nairobi, Kenya.
- Lokhande, P.D., Jagdale, S.C., and Chabukswar, A.R. 2006. Natural remedies for heart diseases. *Indian Journal of Traditional Knowledge*. 5(3): 420-427.
- Lopes, J.C., Silva, G.F.da., Posse, S.C.P., and Ruy, J. 2003. Germination and dormancy of seeds of Cassia fistula L. *Brasil Florestal*. 22(78): 67-74.
- Luximon-Ramma, A., Bahorun, T., Soobrattee, M.A. and Aruoma, O.I. 2002. Antioxidant activities of phenolic, proanthocyanidin, and flavonoid components in extracts of Cassia fistula. *Journal of Agricultural and Food Chemistry*. 50(18): 5042-5047.
- Masih, S.E. and Singh, B.G. 2005. Studies of fungistatic properties of leaf extract of some plants against dermatophytes. *Advances in Plant Sciences*. 18(1): 435-438.
- Meena-Rani and Kalidhar, S.B. 1998. A new anthraquinone derivative from Cassia fistula Linn. pods. *Indian Journal of Chemistry Section B, Organic including Medicinal*. 37(12): 1314-1315.
- Mehrotra, M.D. 1998. Rhizoctonia aerial blight - a destructive nursery disease and its management. *Indian Forester*. 124(8): 637-645.
- Samy, R.P., Ignacimuthu, S., and Sen, A. 1998. Screening of 34 Indian medicinal plants for antibacterial properties. *Journal of Ethnopharmacology*. 62(2): 173-182.
- Sen Gupta, J.N. 1937. Seed weights, plant percents, etc. for forest plants in India. *Indian Forest Records (New Series) Silviculture*, 2:221 pp. Manager of Publications, Delhi.
- Sharma, U.S., Sharma, S., and Upadhyaya, S.D. 1998. Seed dormancy in relation to fruit maturity of amaltas (Cassia fistula L.). *JNKVV Research Journal*. 28/29(1/2): 67-70.
- Sinhababu, A., Banerjee, A., and Kar, R.K. 2007. Seed germination and seedling growth in some selected fast growing fuelwood plants. *Indian Forester*. 133(4): 534-546.
- Sreerama, R., Krishnappa, N., Reddy, T.V. and Reddy, M.A.N. 2000. Effect of pre-sowing treatments on seed germination of ornamental trees. *Current Research University of Agricultural Sciences Bangalore*. 29(7/8): 127-128.
- Troup, R. S. 1921. The Silviculture of Indian Trees. (Vol II) International Book Distributors, Dehra Dun.
- Tzakou, O., Loukis, A., and Said, A. 2007. Essential oil from the flowers and leaves of Cassia fistula L. *Journal of Essential Oil Research*. 19(4): 360-361.

Yogesh Mahida and Mohan, J.S.S. 2006. Screening of Indian plant extracts for antibacterial activity. *Pharmaceutical Biology*. 44(8): 627-631.

Cassia javanica

Nomenclature:

Scientific name: *Cassia javanica* Linn.

Vernacular name: Java-ki-Rani (Hindi);
Konne, Vakai (Tamil) (Bose et al., 1998)

Common name: The java pink cassia,
Apple blossom shower, Javamese cassia
(Troup, 1921).

Synonyms: *Cassia bacillus*

Family: Leguminosae

Subfamily: Caesalpinioideae

Origin:

Distribution: Native of Java, Malaya,
Hawai, Mauritius and the Philippines,
Mumbai and other parts of India. Planted in
tea gardens (Troup, 1921).

Description: A medium sized and beautiful
tree almost horizontal, spreading long
branches, forming an umbrella like canopy,
trunk short (Bose et al., 1998).

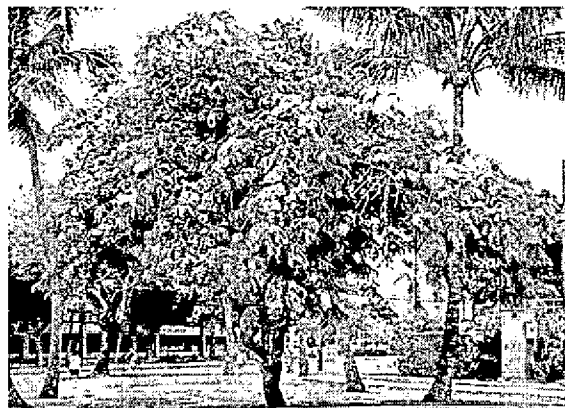
Flowering season: April - May.

Fruiting season: December - April. They
commence ripening in December - January
and continue ripening till March - April
(Troup, 1921).

Flowers: Bright rose or pink, fragrant, 2 cm
across, in open clusters, mostly on short,
leafless branches; calyx segments 5, reddish
petals oblong, deep pink or dull reddish;
stamens 10, 3 of which much longer, with an
ovoid swelling in middle of the filament
(Bose et al., 1998).

Fruits: Pods are like that of *Cassia fistula*
cylindrical, 45 to 60 cm long, dark brown,
rather smooth, flesh dry, not pulpy (Troup,
1921).

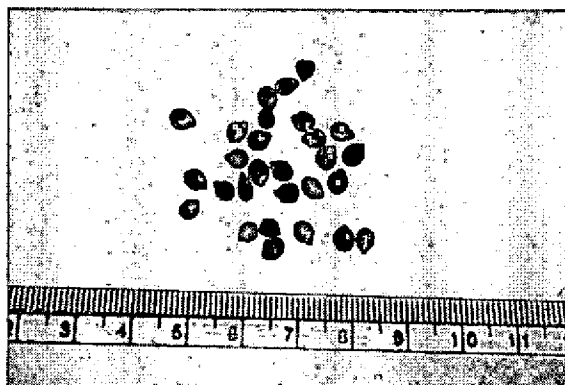
Fruit type: Pod.



Habit



Branch with inflorescence



Seeds

Seeds: Seeds 70 to 80, flattened, smooth and shiny brown. The water pervious capacity of the seeds of *Cassia javanica* is directly proportional to the presence and absence of waxy deposition on their seed surface. This nature of seeds is useful in assessing germination capacity (Kanak-Sahai, 2004).

Seed dimension:

Seed length:

Seed width:

Seed thickness:

Seed weight: 5460-6400 seeds /kg (Madras seed) (Troup, 1921).

Seed dispersal:

Seed collection:

Transportation of seeds:

Seed processing:

Seed storage:

Viability period: Seed viability was calculated after performing tetrazolium test and seed germinability was tested using Blotter method. Percentage of viability varied from species to species even under the same storage conditions. Seed health at low temperature storage condition and prevailing relative humidity is responsible for enhanced viability and more germinability of seeds (Chitra-Arya et al., 2006).

Seed emptiness:

Seed pre treatment: Presoaking in hot water for 48 h give 35% germination. Sulfuric acid treatment for 10 min is effective in bringing about germination of 53%. Treatment with KNO_3 and thiourea are also effective in breaking seed dormancy. Approximately 50% of the seeds germinate 30 days after treatment. Treatment with gibberellic acid also enhance the total germination percentage (Khan, 2001).

Germination type: Epigeal.

Germination percentage: 25 to 52

Germination period:

Nursery technique:

Propagation:

Method of propagation: By seeds.

Vegetative propagation:

Pests:

Diseases:

Medicinal properties: It is used medicinally as a substitute for *Cassia fistula*.

Uses: The bark can be used as tanning material in leather processing and has ornamental value. Stem bark of *Cassia javanica* contains glucoside (3-carbomethoxynaphtho [1,2-b]-3',3'-dimethylpyran-4-O- beta -glucopyranoside) (Rashmi-Sanghi et al., 2000).

Wood properties: The wood is hard and and mainly used for handles and tools of agricultural implements.

References:

Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 114-115.

Chitra-Arya and Arun Arya. 2006. Effect of storage on seed viability and germination of certain leguminous trees. Indian Forester. 132(5): 601-608 .

Kanak-Sahai. 2004. Water pervious capacity of seeds of some Cassia species in relation to waxy deposition on their seed surface. Indian Journal of Forestry. 27(3): 309-311.

Khan, M.R. 2001. Seed dormancy in Cassia javanica Linn. Advances in Plant Sciences. 14(2): 597-599

Rashmi-Sanghi, Rahul Singh, and Singh, J. 2000. A novel naphthalene glucoside from Cassia javanica stem bark. Indian Journal of Chemistry Section B, Organic including Medicinal. 39(4): 321-322.

Troup, R. S. 1921. The Silviculture of Indian Trees. (Vol II) International Book Distributors, Dehra Dun.

Cassia siamea

Nomenclature:

Scientific name: *Cassia siamea* Lamk.

Vernacular name: Manja konna (Malayalam), Manje - konne, Ponavari, simaivari (Tamil) (Troup, 1921; Bose et al., 1998).

Common name: Yellow cassia, Kassod tree, Ironwood tree, Siamese senna (Bose et al., 1998).

Synonyms: *Cassia florida* Vahl., *Senna sumatrana* Roxb. (Troup, 1921).

Family: Leguminosae

Subfamily: Caesalpinioideae

Origin: Myanmar (Sasidharan, 2004).

Distribution: The tree is distributed in Indonesia; Malaysia; India; Sri Lanka and Myanmar. It is now grown in most of the tropical countries (Bose et al., 1998).

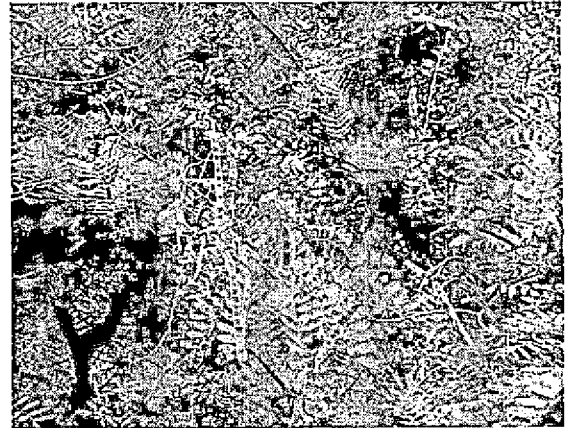
Description: A moderate sized evergreen tree, height 15-18 m, with a dense crown, trunk often short or medium in length and not uniformly straight (Bose et al., 1998).

Flowering season: Flowering season is from June to December, but the best display is in October (Bose et al., 1998).

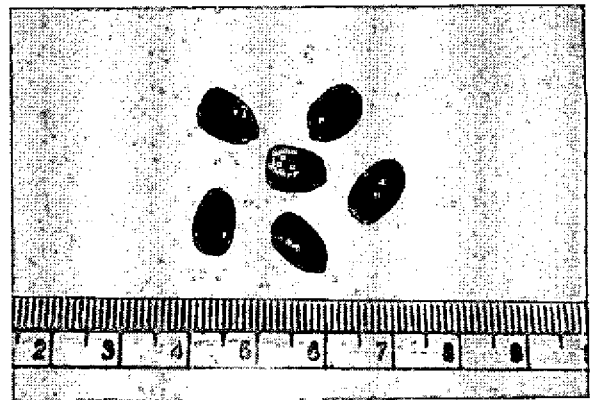
Fruiting season: Ripens towards the end of the hot season. Fruits are produced abundantly for several months.

Flowers: Flowers yellow, up to 3 cm in diameter, in large panicles at the ends of the branches with almost equal five petals, 20 to 40 cm long; sepals downy, very obtuse; stamens 7, almost equal, 3 absent, or small or sterile (Bose et al., 1998).

Fruits: Pod flat 15 to 25 cm long soft and ribbon like when young, purplish and brown when ripe, apicule deciduous, thickened at suture, indented between the seeds (Troup, 1921).



Branch with flowers and fruits



Seeds

Fruit type: Pod.

Seeds: Many minute velvety seeds.

Seed dimension:

Seed length:

Seed width:

Seed thickness:

Seed weight: 35000 - 37000 seeds/kg.

Seed dispersal:

Seed collection: Ripe pods are collected from the trees during March to April and seeds are extracted, cleaned, graded and stored (Edwards and Naithani, 1999).

Transportation of seeds:

Seed processing:

Seed storage: Orthodox (Edwards and Naithani, 1999). Use of storage media help to increase the percentage of seed viability (Khomane and Bhosale, 2003).

Viability period:

Seed emptiness:

Seed pre treatment: Scarification with conc. sulphuric acid for 10 to 30 min can result in 90% or more germination in 6 days. Soaking in cold or warm water can also be advantages to some extent (Edwards and Naithani, 1999). 100% germination is obtained with 400 ppm of GA3 (Ghyare, 2005). The seeds exhibit physical dormancy due to hard seed coat. Dormancy in *C. siamea* is terminated by soaking of seeds in conc. sulphuric acid for 10-15 minutes; wet heat at 100°C for 30-60 seconds; dry heat at 80-100°C for 5-10 min, respectively (Agboola, 2005).

Germination type: Epigeal.

Germination percentage: 98

Germination period:

References:

Agboola, D.A., Ebofin, A.O., Aduradola, A.M. and Ajiboye, A.A. 2005. The effect of presowing treatments on the germination of seeds of two Savannah tree legumes. *Indian Forester*. 131(5): 701-710.

Nursery technique: The growth of seedlings is very fast. Either the seed can be put into polythene bags directly or sown in mother bed. Later pricked out to the polybags (Edwards and Naithani, 1999).

Propagation:

Method of propagation: By seeds.

Vegetative propagation:

Pests:

Diseases:

Medicinal properties: Stem bark extract of *Cassia siamea* has antiplasmodial property (Ajaiyeoba et al., 2008).

Uses: Ornamental plant, avenue tree. Wood pulp is suitable for paper. The flowers eaten in curries. The leaves are used as manure. The heart wood is dark brown and often used for wood works including furniture (Bose et al., 1998).

Wood properties: The sapwood is yellowish white or pale greyish brown and the heartwood is dark brown to black. It is hard and heavy wood with shallowly interlocked grain and coarse texture. It is a diffuse porous wood with indistinct growth rings. Pores large and moderate sized, scanty, embedded in pale, nearly continuous, broad, wavy bands of soft texture, which alternate with very hard almost black bands of very close texture. Medullary rays fine, scanty, irregular (Gamble, 1922).

- Ajaiyeoba, E.O., Ashidi, J.S., Okpako, L.C., Houghton, P.J. and Wright, C.W. 2008. Antiplasmodial compounds from Cassia siamea stem bark extract. *Phytotherapy Research*. 22(2): 254-255.
- Bose, T.K., Das, P. and Maiti, G.G. 1998. *Trees of the world*, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 116.
- Edwards, D.G. and Naithani, S.C. 1999. *Seed and Nursery Technology of forest trees*. New Age, New Delhi.
- Gamble, J.S. 1922. *A manual of Indian timbers*. London Sampson Low, Marton and Company Ltd, Calcutta, India.
- Ghyare, B.P. 2005. Effect of gibberellic acid on germination of five timber tree species. *Indian Forester*. 131(6): 844-846.
- Khomane, B.V. and Bhosale, L.J. 2003. Effect of storage medium on viability of seed in some fuelwood species. *International Journal of Forest Usufructs Management*. 4(1): 55-58.
- Sasidharan, N. 2004. *Forest Trees of Kerala*. Kerala Forest Research Institute, Peechi, Kerala, India.
- Troup, R. S. 1921. *The Silviculture of Indian Trees*. (Vol II) International Book Distributors, Dehra Dun.

Casuarina litorea

Nomenclature:

Scientific name: *Casuarina litorea* L.

Vernacular name: Choolamaram, Kattadi (Malyalam); Cavukku maram, Kattadi maram (Tamil) (Chacko et al., 2002); Sura (Marathi), Jangli jhar (Hindi) (Bose et al., 1998).

Common name: Coast She-oak (Chacko et al., 2002). Choolamaram, Iron wood, Beef wood, Janglisaru, Australian oak (Bose et al., 1998).

Synonyms: *Casuarina littoralis* Salisb. (Chacko et al., 2002); *Casuarina equisetifolia* L. (Sasidharan, 2004).

Family: Casuarinaceae

Subfamily:

Origin: Andamans to Polynesia (Sasidharan, 2004).

Distribution: Indigenous on sandy shores and dunes along the coast of North-east and North Australia, the Pacific Islands, the Malay Archipelago and Peninsula, Myanmar, the Andamans and Nicobars, on beaches and sand dunes close to the sea (Luna, 1996; Chacko et al., 2002).

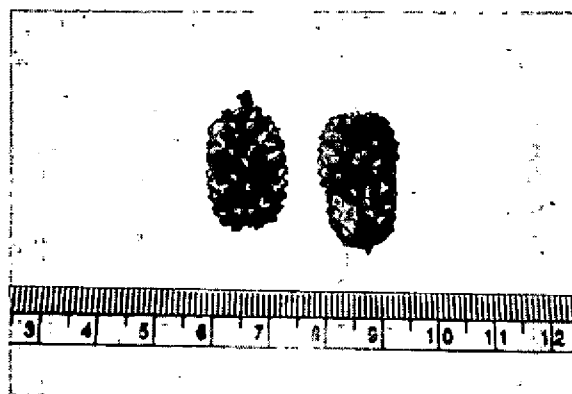
Description: A large to medium sized evergreen fast growing lofty tree with a straight stem and feathery foliage that appears to be leafless. It attains a height up to 50 m and a breast height diameter of 64 cm. It has a crown of green drooping branches resembling pine needles (NAS, 1980; Rai, 1999; Chacko et al., 2002).

Flowering season: February to April and September to October (Sahni, 2000).

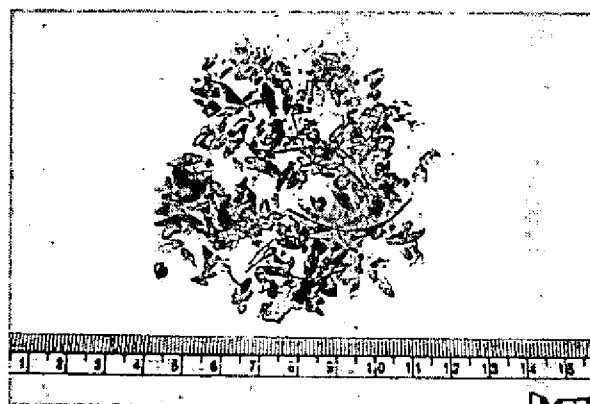
Fruiting season: June to December (Sahni, 2000).



Habit



Fruits



Seeds

Flowers: Unisexual, arranged in small spikes. The male growing in long spikes

and the female arranged in compact clusters about 1 cm across (Sahni, 2000). Flowers exhibit strong anemophilous adaptations such as very high pollen output, reduced flowers with large stigmatic area and light weighing winged fruits. Pollen is viable up to 99%, storable in 4°C up to three months with no loss in fertility (Nagarajan et al., 2006).

Fruits: Multiple, globose, woody cones, 1.87 cm diameter containing a number of winged achenes.

Fruit type: Samara or achene.

Seeds: Enclosed in an achene, which is light brown, terminating in a membranous wing. Larger seeds show better germination (60%) and seedling growth and vigour (Umarani et al., 1997a).

Seed dimension:

Seed length: 6 mm (Chacko et al., 2002).

Seed width:

Seed thickness:

Seed weight: 7,50,000 seeds/kg (Rai, 1999; Chacko et al., 2002).

Seed dispersal: Wind and insect dispersal.

Seed collection: Ripe cones are collected from the tree when dehiscence is seen in a few cones (Chacko et al., 2002). Cones collected from the top portion of the tree crown give higher seed recovery and better seed growth performance (Jerlin and Srimathi, 1997).

Transportation of seeds: Cones collected in cotton / plastic / gunny bags are transported to the processing centre as quickly as possible (Chacko et al., 2002).

Seed processing: Cones are spread out in shade and covered with gunny bags. After 3

or 4 days, the cones open up and the winged seeds come out. Healthy seeds are dark brown in colour with slightly yellowish wings. The seed yield from cones varies between 1.4 to 4.5 % by weight (Subramanian et al., 1992; Chacko et al., 2002).

Seed storage: Probably intermediate. Seeds can be stored for 2 months in earthen pots mixed with ash (Rai, 1999). Seeds can also be stored for 2 years at - 7°C (\pm 3°C) and 15% relative humidity (Luna, 1996; Chacko et al., 2002). Seeds are treated with leaf powders of arappu (*Albizia amara*), captan + carbaryl treatment, can be stored in polythene and paper bags for 7 months without much loss in viability (Umarani et al., 1997b). Oven drying is a superior method to other drying techniques for casuarina seeds in terms of seed recovery and quality (Umarani et al., 1997c). In addition, drying of cones in the sun between 08.00 and 12.00 and 14.00 and 15.00 h also give good seed recovery and seed growth performance (Jerlin and Srimathi, 1997). Seeds can be stored in metal tins or polythene containers (Aswathanarayana et al., 1997). Viability decreases with an increase in the storage period. The use of storage media help to increase the percentage of seed viability (Khomane and Bhosale, 2003).

Viability period: Seeds are viable only for a short period under ambient condition. Seeds give 5% germination after one year (Subbarao and Rodriguez-Barrueco, 1995; Chacko et al., 2002).

Seed emptiness: Low (Chacko et al., 2002).

Seed pre treatment: Treatment with 1.5% KNO₃ and 7.5% CaOCl₂ for 36 hrs (Subbarao and Rodriguez-Barrueco, 1995; Chacko et al., 2002). Soaking the seed in tap water for 24 hrs (Chacko et al., 2002). Soaking in 0.5% pyridoxine and ascorbic

acid increase germination to 60 and 58%, respectively (Umarani et al., 1998). Seed germination is increased by the 3 min hot water treatment (Aswathanarayana et al., 1997).

Germination type: Epigeous (Chacko et al., 2002).

Germination percentage: 50%. Viable seeds germinate in 14 days (Subramanian et al., 1992; Chacko et al., 2002). Water stress has intermediate inhibitory effect on germination (Saxena et al., 1998). Empty seeds and dormancy are the two factors that prohibit germination of live seeds. Seeds show only 40 to 45% germination even when they are freshly collected (Umarani and Vanangamudi, 2002).

Germination period: 10 to 30 days (Rai, 1999; Chacko et al., 2002).

Nursery technique: Seeds are sown in germination trays containing vermiculite or on moist foam sheet. When the seedlings attain 10 cm height, they are potted into polybags of size 20 x 10 cm filled with soil-based potting mixture and kept under shade (Chacko et al., 2002). Nursery soil in polybags after inoculating with 3 cultures of arbuscular mycorrhizas (AM) along with 3 levels of phosphorus fertilizer, produce fast growing and healthier seedlings than uninoculated. *Glomus fasciculatum* and P at 300 mg/polybag, are efficient and it produce robust seedlings with longer roots and shoots as well as higher dry matter and P uptake (Rajeswari et al., 2001; Valdes et al., 2004). Treatment of NPK also has a positive influence on seedling height, root length, seedling growth and biomass production. Higher doses of the inorganic fertilizers reduce seedling growth (Bhuiyan et al., 2000; Kang-Lihua et al., 2000). Inoculation of seedlings with Frankia or Azospirillum + phosphobacterium + VAM + Frankia increase root and shoot growth. Application

of DAP [diammonium phosphate] has positive influence on shoot and root growth, nodulation and nitrogenase activity (Ravichandran and Balasubramanian, 1997; Rajendran et al., 2003). Germination of *Casuarina* is significantly reduced by encapsulation in sodium alginate (Carvajal et al., 1994). Irrigation with 5000 ppm saline water increase plant height, stem diameter, and fresh and dry weight of stems, branchlets and roots, while 20000 ppm reduce all the vegetative growth parameters (El-Bagoury et al., 1999). However, water extract of *C. equisetifolia* root has allelopathic effect on seedlings (Lin-WuXing et al., 2005). Potting mixture consisting of sand, soil, compost, burnt rice husk and charcoal in the 30:10:50:5:5 ratio, sand, soil, compost in the ratio of 20:20:60 and sand/mushroom waste at 2:1 ratio produce seedlings with maximum height, collar diameter and dry biomass (Rathore et al., 2004; Savio et al., 1998).

Propagation:

Method of propagation: Seedlings.

Vegetative propagation:

Pests: Negligible. Ants sometimes take away the seeds (Chacko et al., 2002).

Diseases: Eleven fungi were recorded. *Epicoccum* sp., *Fusarium semitectum* were important spermoplane fungi (Mohan and Sharma, 1991; Chacko et al., 2002).

Medicinal properties: The plant is used to treat nervous disorders, diarrhoea and gonorrhoea. An infusion of bark is used as a remedy for cough, asthma and diabetes. The bark is astringent and used in diarrhoea and dysentery (Bose et al., 1998). Extracts from *Casuarina equisetifolia* have antioxidant activity (Zulaica-Villagomez et al., 2005). *Casuarina equisetifolia* has anticancer activity (Halos, 2004). Aqueous and

methanol extracts of *Casuarina equisetifolia* have antibacterial activity against 5 medically important bacterial strains (Jigna-Parekh et al., 2005). Ethanolic extracts of *Casuarina equisetifolia* has antimicrobial activity against drug-resistant bacteria and a yeast *Candida albicans* of clinical origin (Solomon, 1998). Reported to be astringent, diuretic, ecboic, emmenagogue, laxative, and tonic, beefwood is a remedy for beriberi, colic, cough, diarrhoea, dysentery, headache, nerves, pimples, sores, sorethroat, stomachache, swellings, and toothache (Duke and Wain, 1981). In Ternate, the seeds are used for passing blood in diarrhoea (Burkill, 1966). Asparagine and glutamine accounted for 92% of the total amino acid in the nodules. The bark contains 10% catchol tannin, the root 15%

Uses: Reared as a wind break in sports ground and land scapes. Widely planted on the coastline of the subcontinent and in Sri

Lanka to reclaim sand dunes and check erosion. It is one of the best fuelwoods of the world (Sahni, 2000). The bark is used for tanning and the tree yields a resin (Bose et al., 1998). Extracts from *Casuarina equisetifolia* has antioxidant activity (Zulaica-Villagomez et al., 2005). With plants spaced 2 m apart, on a 7-10 year rotation, the trees may yield 75-200 MT wood/ha, i.e., 10-20 MT/ha/yr. It fixes 58-229 kg/ha/yr nitrogen and 1,742 nmoles $C_2H_4/24$ hrs/g dry weight (Aspiras, 1981).

Wood properties: Wood reddish brown, very hard, much liable to split and crack (Gamble, 1922). Wood yields a good pulp with the neutral sulphite semichemical process. The wood is used for beams, boatbuilding, electric poles, fences, furniture, gates, house posts, mine props, oars, pavings, pilings, rafters, roofing shingles, tool handles, wagon wheels, and yokes (CSIR, 1948-1976).

References:

- Aspiras, R.B. 1981. Nitrogen fixation in nodulated non-legumes growing in the Philippines. *Canopy International* 7(7):3-5.
- Aswathanarayana, S.C., Mahadevappa, M., Ranganathaiah, K.G., Kalappa, V.P. and Reddy, Y.A.N. 1997. Seed viability and microflora of forest tree species. *Indian-Journal-of-Forestry*. 19(4): 326-329.
- Bhuiyan, M.Z.A., Hossain, M.K., and Osman, K.T. 2000. Effect of inorganic fertilizers on the initial growth performance of *Casuarina equisetifolia* seedlings in the nursery. *Indian-Journal-of-Forestry*. 23(3): 296-300.
- Bose, T.K., Das, P. and Maiti, G.G. 1998. *Trees of the world*, Vol. 1. Regional Plant Resource Centre, Orissa. India.
- Burkill, J.H. 1966. *A dictionary of economic products of the Malay peninsula*. Art Printing Works, Kuala Lumpur. 2 vols.
- CSIR (Council of Scientific and Industrial Research). 1948-1976. *The wealth of India*. 11 vols. New Delhi.

- Carvajal O.C., Peralta B.H., Santos B.R., and Hernandez T.M. 1994. Encapsulation of seeds of forest species. *Centro-Agricola*. 21(2): 14-20.
- Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C. and George Mathew. 2002. *Manual of Seeds of Forest Trees, Bamboos and Rattans*. Kerala Forest Research Institute, Peechi, Kerala.
- Duke, J.A. and Wain, K.K. 1981. *Medicinal plants of the world*. Computer index with more than 85,000 entries. 3 vols.
- El-Bagoury, H., Hossni, Y.A., El-Tantawy, A., Shehata, M. and Asmaael, R. 1999. Effect of saline water irrigation on growth and chemical composition of (Casuarina equisetifolia L.) seedlings. *Egyptian-Journal-of-Horticulture*. 26(1): 47-57.
- Gamble, J.S. 1922. *A manual of Indian timbers*. London Sampson Low, Marton and Company Ltd, Calcutta, India.
- Halos, S. 2004. Medicinal uses of selected fruit trees and woody perennials. *Journal-of-Tropical-Medicinal-Plants*. 5(2): 265-270.
- Jerlin, R. and Srimathi, P. 1997. Grading and storage potential of Casuarina equisetifolia seeds. *Annals-of-Forestry*. 5(1): 103-106.
- Jigna-Parekh, Darshana-Jadeja, and Sumitra-Chanda. 2005. Efficacy of aqueous and methanol extracts of some medicinal plants for potential antibacterial activity. *Turkish-Journal-of-Biology*. 29(4): 203-210 .
- Kang-LiHua, Li-SuCui, Peng-YaoQiang, Liu-YuLin, Cheng-HuaCheng, and Luo-ChengJiu .2000. Study on the effect of fertilizing on young trees of Casuarina inoculated with Frankia. *Forest-Research,-Beijing*. 13(3): 274-279
- Khomane, B.V. and Bhosale, L.J. 2003. Effect of storage medium on viability of seed in some fuelwood species. *International-Journal-of-Forest-Usufructs-Management*. 4(1): 55-58.
- Lin-WuXing, Hong-Wei, and Ye-GongFu. 2005. Effect of water extract of Casuarina equisetifolia root on nutrient absorption and growth of the seedlings. *Journal-of-Zhejiang-Forestry-College*. 22(2): 170-175.
- Luna, R.K. 1996. *Plantation Trees*. International Book Distributors, Dehra Dun, India.
- Nagarajan, B., Nicodemus, A., Sivakumar, V., Mandal, A.K., Kumaravelu, G., Jayaraj, R.S.C., Bai, V.N. and Kamalakannan, R. 2006. Phenology and control pollination studies in Casuarina equisetifolia Forst. *Silvae-Genetica*. 55(4/5): 149-155.

- Rai, S.N. 1999. Nursery and planting techniques of forest trees in Tropical South East Asia. Eastern Press, Bangalore, India.
- Rajendran, K., Sugavanam, V., and Devaraj, P. 2003. Effect of microbial inoculation on quality seedling production of Casuarina equisetifolia. SO: Journal-of-Tropical-Forest-Science. 15(1): 82-96.
- Rajeswari, E., Latha, T.K.S., Vanangamudi, K., Selvan, K.A., and Narayanan, R. 2001. Effect of arbuscular mycorrhizae and phosphorus on seedling growth of Casuarina equisetifolia. Indian-Phytopathology. 54(1): 85-87.
- Rathore, T.S., Annapurna, D., Joshi, G. and Srivastava, A . 2004. Studies on potting mixture and size of containers on the quality of seedling production in Casuarina equisetifolia Forst. Indian-Forester. 130(3): 323-332.
- Ravichandran, V.K. and Balasubramanian, A. 1997. Nodulation and growth response of Casuarina seedlings to various levels and sources of fertilizers. Madras-Agricultural-Journal. 84(9): 563-565.
- Sahni, K.C. 2000. The Book of Indian Trees. BNHS, Mumbai.
- Sasidharan, N. 2004. Forest Trees of Kerala. Kerala Forest Research Institute, Peechi, Kerala, India.
- Savio, M.M.D., Bachpai, V.K.W., Raman-Nautiyal, and Jayaraj, R.S.C. 1998. Potting mixture trials in Casuarina equisetifolia. Sylva-Plus. 6(1): 18-20.
- Saxena, A.K., Rao, O.P. and Singh, B.P. 1998. Germination responses in nine multipurpose tree species on moisture gradient. Range-Management-and-Agroforestry. 19(1): 69-73.
- Solomon, D. 1998. Viability of Casuarina equisetifolia and C. junghuhniana seed stored in three temperature regimes - an initial report. NFT-News 1(1): article 5
- Subbarao, N.S. and Rodriguez-Barrueco, C. 1995. Casuarinas: Trees of Multiple Utility. Indian Council of Forestry Research and Education, Dehra Dun, India.
- Subramanian, K.N., Bedell, P.E., Gurumurthi, K., George, M., Mandal, A.K., Madhavan Pillai, S.R., and Gurudev Singh, B. 1992. Casuarinas: Trees of Multiple Utility. Indian Council of Forestry Research and Education, Dehra Dun, India.
- Umarani, P., Bharathi, A., and Karivaratharaju, T.V . 1998. Effect of vitamin nutrients on germination and seedling growth of casuarina. Madras-Agricultural-Journal. 84(11/12). 698-699.

Umarani, R. and Vanangamudi, K. 2002. The effect of specific gravity separation on germination and biochemical potential of Casuarina equisetifolia seeds. *Journal-of-Tropical-Forest-Science*. 14(2): 207-212.

Umarani, R., Bharathi, A., and Karivaratharaju, T.V. 1997. Effect of seed treatments on storage life of Casuarina equisetifolia. *SO: Journal-of-Tropical-Forest-Science*. 10(1): 18-23 .

Umarani, R., Bharathi, A., and Raju, T.V.K. 1997. Effect of methods of cone drying on seed recovery and seed quality of Casuarina equisetifolia. *Madras-Agricultural-Journal*. 84(1): 31-32

Umarani, R., Bharathi, A., Karivaratharaju, T.V. 1997. Effect of seed size and depth of sowing on germination and seedling growth of Casuarina equisetifolia. *Journal-of-Tropical-Forest-Science*. 10(2): 275-276.

Valdes, M., Cayetano-Rodrigo, A., Leyva, M.A., and Camacho, A.D. 2004. Promotion of Casuarina equisetifolia (L.) growth in the nursery by symbiotic microorganisms. *Terra*. 22(2): 207-215.

Zulaica-Villagomez, H., Peterson, D.M., Herrin, L., Young, R.A . 2005. Antioxidant activity of different components of pine species. *Holzforschung*. 59(2): 156-162.

Ceiba pentandra

Nomenclature:

Scientific name: *Ceiba pentandra* (L.) Gaertn.

Vernacular name: Panji - ilavu, Panaya (Malayalam) (Gamble, 1922); Ilavam (Tamil)

Common name: White silk cotton, Truc kapok

Synonyms: *Eriodendron anfractuosum* DC. (Sasidharan, 2004); *Bombax pentandrum*, *E.orientala* (Gamble, 1922).

Family: Bombacaceae

Subfamily:

Origin: Tropical America (Sasidharan, 2004).

Distribution: Introduced in the Amazon, common in South India, Andamans, Sri Lanka and Myanmar (Sahni, 2000).

Description: A small to medium sized tree, young stems bear conical prickles, the branches arise in whorls and the adult trees are buttressed (Sahni, 2000).

Flowering season: In India, flowers appear in December to January, just before at the time as new leaves. They open at night, emit a powerful odour and secrete a copious amount of nectar (Sahni, 2000). January to March (Bose et al., 1998).

Fruiting season: March to April (Sahni, 2000); May to June (Bose et al., 1998).

Flowers: Dirty white with a milky smell, and much smaller than those of red silk cotton. Calyx bell-shaped, green with 5 obtuse teeth, persistent. Petals twice to 3 times the length of calyx, 5, oblong, connate

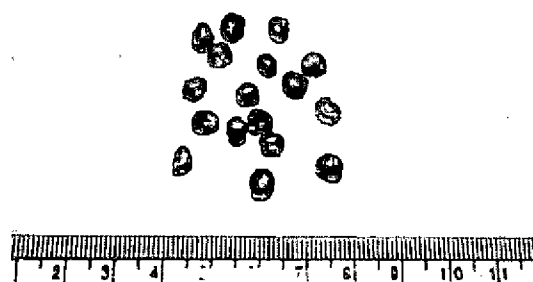
at the base, about 2.5 cm across; stamens 5, with 2 or three anthers (Sahni, 2000). Pollination is, largely effected by nectar feeding bats.



Habit



Branch with fruits



Seeds

Fruits: Fruit is a capsule, ovoid, oblong, 7 to 12 cm long, green, turning brown when ripe, containing long, white silky floss (Bose et al., 1998). 5-valved, many seeded (Sahni, 2000).

Fruit type: Capsule.

Seeds: Enclosed in separate woolly balls.

Seed dimension:

Seed length:

Seed width:

Seed thickness:

Seed weight: 15,860 seeds/kg

Seed dispersal: Bats.

Seed collection: Ripe fruits are collected from the trees during October to November and seeds are extracted, cleaned and stored (Vanangamudi and Natarajan, 2006).

Transportation of seeds:

Seed processing:

Seed storage: Orthodox type and medium in storage (Vanangamudi and Natarajan, 2006).

Viability period:

Seed emptiness:

Seed pre treatment: Not required.

Germination type:

Germination percentage: 90

Germination period:

Nursery technique: Seeds are sown in mother bed and pricked out to polythene bags at 4-leaf stage (Vanangamudi and Natarajan, 2006).

Propagation:

Method of propagation: By cuttings.

Vegetative propagation:

Pests:

Diseases:

Medicinal properties: The root extract of this tree is said to cure diabetes. The gum from trunk is used for the treatment of stomach ailments. The bark of the tree is febrifuge and the fruit is effective to cure migraine (Bose et al., 1998).

Uses: The tree is important owing to the excellent quality of the white floss from its fruits which is superior in quality to other vegetable floss and is the real 'kapok' of commerce. It is much used for stuffing cushions. Owing to its buoyancy and resistance to water it is in demand for making lifebuoys (Bose et al., 1998). It is used for plywood, packaging, lumber core stock, light construction, pulp and paper products and also locally for canoes and rafts.

Wood properties: The wood is greyish white without any distinct heartwood. It is extremely soft and light with straight grain and coarse texture. It is a diffuse porous wood with fairly distinct growth marks

delimited by bands of soft tissues. Pores very large, very scanty, often subdivided. Medullary rays fine, the distance between

them less than the diameter of the pores (Gamble, 1922).

References:

Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 135.

Gamble, J.S. 1922. A manual of Indian timbers. London Sampson Low, Marton and Company Ltd, Calcutta, India.

Sahni, K.C. 2000. The Book of Indian Trees. BNHS, Mumbai.

Sasidharan, N. 2004. Forest Trees of Kerala. Kerala Forest Research Institute, Peechi, Kerala, India.

Vanangamudi, K. and Natarajan. 2006. Advances in Seed science and technology (Vol I): recent trends in seed technology and management.

Chloroxylon swietenia

Nomenclature:

Scientific name: *Chloroxylon swietenia* DC.

Vernacular name: Mootanari, Varimaram, Purushu (Malayalam), Porasu (Tamil), Bhirra (Hindi) (Chacko et al., 2002).

Common name: Satin wood, Indian satin wood, (Gamble, 1922; Chacko et al., 2002); Bhirra.

Synonyms: *Swietenia chloroxylon* Roxb. (Gamble, 1922; Chacko et al., 2002).

Family: Flindersiaceae

Subfamily:

Origin:

Distribution: Common in the dry deciduous forests of the Western Peninsular India. It is also found in Sri Lanka (Luna, 1996; Chacko et al., 2002).

Description: Moderately fast growing, small to medium sized deciduous tree attaining a height of 20 m and a breast height diameter of 80 cm, young branches, petioles and inflorescence clothed with short, grey, pubescent (FRI, 1981; Chacko et al., 2002).

Flowering season: March to April (Bourdillon, 1908).

Fruiting season: May to August; Fruits ripen in June (Bourdillon 1908); March to August (Sen Gupta, 1937; Chacko et al., 2002).

Flowers: Flowers green coloured, bisexual, small, 5-merous, in terminal and axillary panicles; calyx deeply lobed; stamens 10,

inserted outside the disc; ovary 3-celled, ovules 8 in each cell (Bose et al., 1998).

Fruits: Capsules oblong (2.5-4.5 cm long), coriaceous, dark brown when ripe; coriaceous, 3-valved.

Fruit type: Capsule.

Seeds: Seeds brown, with a broad wing at one end; about 4 in each cell.

Seed dimension:

Seed length: 2 cm (Chacko et al., 2002).

Seed width: 1 cm (Chacko et al., 2002).

Seed thickness:

Seed weight: 1344 to 3111 seeds/kg (Kumar and Bhanja, 1992; Chacko et al., 2002).

Seed dispersal: Wind.

Seed collection: The mature capsules are collected from the tree before dehiscence (Kumar and Bhanja, 1992; Chacko et al., 2002).

Transportation of seeds: The capsules are collected in cotton bags. Care should be taken to see that the seeds are not blown away from the bags during transport (Chacko et al., 2002).

Seed processing: The capsules are sun dried, to release the seeds (Kumar and Bhanja, 1992; Chacko et al., 2002).

Seed storage: No information. Seed loses viability quickly. The seeds should be stored in a clean dry place in gunny bags (Kumar and Bhanja, 1992; Chacko et al., 2002).

Viability period: No information (Chacko et al., 2002).

Seed emptiness: Low (Chacko et al., 2002).

Seed pre treatment: Not required (Kumar and Bhanja, 1992; Chacko et al., 2002).

Germination type: Hypogeal (Chacko et al., 2002).

Germination percentage: 41 to 73 (Chacko et al., 2002).

Germination period: 10 to 17 days (Kumar and Bhanja, 1992; Chacko et al., 2002).

Nursery technique: Seeds are sown by broadcasting in open nursery beds and lightly covered with soil. Seedlings are delicate and require shade in first few months (Kumar and Bhanja, 1992; Chacko et al., 2002).

Propagation:

Method of propagation: Direct sowing and seedling transplantation. Also, it has a great power of regeneration often reproducing itself by root suckers.

Vegetative propagation: Pests:

No information (Chacko et al., 2002).

Diseases: Low (Chacko et al., 2002).

Medicinal properties: The bark is used as an astringent. The leaves are applied to wounds and also prescribed in rheumatism (Bose et al., 1998).

Uses: The tree yield reddish brown gum and a yellow dye. The wood yields an essential oil. It is also used as bridge, in house construction, for ploughs, oil mills, pestles, cart shafts, axels, naves, felloes and spokes (Chacko et al., 2002). The bark contains tannin. Bark has medicinal value.

Wood properties: The timber is durable and it is not liable to insect and fungus attack. The wood varies in colour from pale yellow to golden yellow with satin lustre. There is no distinct heartwood but the central portion of the logs is somewhat darker than the outer portion. The wood has faint sweet odour when fresh. Wood very hard, yellow or cream coloured. The inner wood darker, but without a distinct heartwood; having a fine satiny lustre. Annual rings distinct. Pores very small and rays very short (Bourdillon, 1908).

References:

Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 127.

Bourdillon, T.F. 1908. Forest trees of Travancore. International Book Distributors, Dehradun. pp. 93.

Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 102-103.

FRI. 1981. Troup's The Silviculture of Indian Trees. Vol. III. The Controller of Publications, Delhi.

Gamble, J.S. 1922. A manual of Indian timbers. London Sampson Low, Marton and Company Ltd, Calcutta, India.

Kumar, S.V. and Bhanja, M. 1992. Forestry Seed Manual of Andhra Pradesh. Andhra Pradesh Forest Department, Hyderabad, India.

Luna, R.K. 1996. Plantation Trees. International Book Distributors, Dehra Dun, India.

Sen Gupta, J.N. 1937. Seed weights, plant percents, etc. for forest plants in India. Indian Forest Records (New Series) Silviculture, 2:221 pp. Manager of Publications, Delhi.

Chukrasia tabularis

Nomenclature:

Scientific name: *Chukrasia tabularis*
A.Juss.

Vernacular name: Chuvannagil, Karadi,
Malavempu (Malayalam);
Madagirivembu, Vedivembu (Tamil);
Dalmara (Kannada); Chikrasi (Hindi)
(Chacko et al., 2002).

Common name: Chittagong wood, Indian
red wood (Chacko et al., 2002);
Chickrassy.

Synonyms: *Chukrasia velutina* Wight &
Arn., *Swietenia chikrassa* Roxb.
(Gamble, 1922; Chacko et al., 2002).

Family: Meliaceae

Subfamily:

Origin:

Distribution: Occurs in North East India
and Western Ghats. It is also in Bangladesh
and Myanmar. In Kerala, it occurs in the
Kannur and Palaghat districts; confined to
the highlands of northern Kerala (Chacko et
al., 2002).

Description: Fast growing very tall
handsome deciduous tree of 25 m height and
a breast height diameter of 133 cm (FRI,
1981; Chacko et al., 2002).

Flowering season: April to May
(Bourdillon, 1908).

Fruiting season: January to March (Chacko
et al., 2002). December to January
(Bourdillon, 1908).

Flowers: Yellowish in large, spreading
terminal panicles, shorter than the leaves.
Flowers in terminal panicles, yellowish or
pinkish white, 4-5-merous; petals erect, 1.2

cm long; staminal tube cylindrical, with short
teeth; ovary cylindrical, usually 3-celled (Bose
et al., 1998).

Fruits: Woody capsule, dark brown,
wrinkled and rough, splits into 3 valves
(Chacko et al., 2002; Bose et al., 1998).



Fruit



Seeds

Fruit type: Capsule.

Seeds: Seeds numerous, flat, closely packed
and winged.

Seed dimension:

Seed length: 3 cm (Chacko et al., 2002).

Seed width: 1 cm (Chacko et al., 2002).

Seed thickness:

Seed weight: 30,000 to 53,000 seeds/kg (Kindt et al., 1997; Chacko et al., 2002).

Seed dispersal: Wind dispersal.

Seed collection: Ripe capsules are collected from the tree (Chacko et al., 2002).

Transportation of seeds: Capsules collected in cotton / plastic bags are packed and transported (Chacko et al., 2002).

Seed processing: Capsules are spread out in the sun for 2 to 3 days to dehisce and the seeds are separated by gentle thrashing. Care should be taken to protect them from being blown away by wind (Chacko et al., 2002).

Seed storage: Intermediate / recalcitrant (CABI, 1998). Seeds can be stored in gunny bags for 3 months (Chacko et al., 2002).

Viability period: Seeds are viable for about 3 months (Chacko et al., 2002).

Seed emptiness: Low (Chacko et al., 2002).

Seed pre treatment: Not necessary (Chacko et al., 2002).

Germination type: Epigeal (Chacko et al., 2002).

Germination percentage: 23 to 90 (Chacko et al., 2002).

Germination period: 7 to 10 days (Luna, 1996; Chacko et al., 2002).

Nursery technique: Seeds are sown by broadcasting in open raised nursery beds of soil, sand and farmyard manure (2:1:1) and lightly covered with soil and river sand

(2:1). Beds are mulched with dry leaves and pine needles. Watering and weeding were done when required. When the seedlings are about 5 to 8 cm height, they are transplanted into polythene bags of 22.5 x 17.5 cm size filled with potting mixture (Chacko et al., 2002; Beniwal et al., 1989).

Propagation:

Method of propagation: By seeds.

Vegetative propagation:

Pests: Low to moderate (Chacko et al., 2002).

Diseases: *Fusarium moniliforme*, *Phoma* sp., *Macrophoma* sp. were recorded (Mohan and Sharma, 1991; Chacko et al., 2002).

Medicinal properties: Medicinally the bark is reported to be an astringent.

Uses: It is fairly strong and hard wood. The timber is suitable for high class furniture and bark yield a gum and tannin. Young leaves and bark contain 22% and 15% tannin respectively (Bose et al., 1998).

Wood properties: The sapwood is pale yellow with a pinkish tinge. It gradually merges into the hard wood which is yellowish brown to dark brown often with darker streaks. It is a moderately hard and moderately heavy wood with fine texture and interlocked grain. Medullary rays fine, uniform, mostly equidistant, slightly undulating; the distance between the rays generally equal to the transverse diameter of the pores (Gamble, 1922). Annual rings distinctly marked by a line (Bourdillon, 1908).

References:

- Beniwal, B.S., Dhawan, V.K. and Joshi, S.R. 1989. Effect of shade and mulch on germination of Chukrasia velutina, Roemer. *Indian Forester*. 115(12): 869-874.
- Bose, T.K., Das, P. and Maiti, G.G. 1998. *Trees of the world*, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 129.
- Bourdillon, T.F. 1908. *Forest trees of Travancore*. International Book Distributors, Dehradun. pp. 90-91.
- CABI. 1998. *The Forestry Compendium – A Silvicultural Reference*. Module 1. CABI Publishing, CAB International, Wallingford, Oxon, OX108DE, UK.
- Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. *Manual of Seeds of Forest Trees, Bamboos and Rattans*. Kerala Forest Research Institute, Peechi, Kerala. pp. 104-105.
- FRI. 1981. *Troup's The Silviculture of Indian Trees*. Vol. III. The Controller of Publications, Delhi.
- Gamble, J.S. 1922. *A manual of Indian timbers*. London Sampson Low, Marton and Company Ltd, Calcutta, India.
- Kindt, R., Mausya, S., Kimotho, J. and Waruhiu. 1997. *Tree seed suppliers Directory: Sources of Seeds and Microsymbionts*. International Centre for Research in Agro Forestry (ICRAF), Nairobi, Kenya.
- Luna, R.K. 1996. *Plantation Trees*. International Book Distributors, Dehra Dun, India.
- Mohanan, C. and Sharma, J.K. 1991. Seed pathology of forest tree species in India- Present status, practical problems and future prospects. *Commonwealth Forestry Review*, 70: 113-151.

Cinnamomum camphora

Nomenclature:

Scientific name: *Cinnamomum camphora* (Linn.) Nees

Vernacular name: Karpurammu (Tamil), Karpur (Hindi), Karppuram (Telugu) (Bose et al., 1998).

Common name: Japan or Formosa camphor tree (Troup, 1921).

Synonyms: *Camphora officinarum* Bauch. (Troup, 1921); *Laurus camphorifera* (Gamble, 1922).

Family: Lauraceae

Subfamily:

Origin: Malesia (Sasidharan, 2004).

Distribution: Natural habitat in East Asia i.e., between 10° - 34° N latitude. The tree is indigenous in China, Japan, and Taiwan but it is grown in many tropical and subtropical countries as ornamental tree.

Description: A large handsome evergreen tree 8-10 m high, trunk short, often branching near the ground (Troup, 1921).

Flowering season: March to April (Troup, 1921).

Fruiting season: Ripens at October (Troup, 1921).

Flowers: Pale green fragrant flowers (Troup, 1921). Flowers small yellow, sweet-scented, in short axillary panicles, shorter than the leaves; perianth membranous; yellow glands on inner stamens conspicuous (Bose et al., 1998).

Fruits: Sub globose drupe, 8 mm in diameter, black containing a single seed (Bose et al., 1998).

Fruit type: Drupe.

Seeds: Oily and retains vitality for few months, white inside, when cut (Troup, 1921).

Seed dimension:

Seed length:

Seed width:

Seed thickness:

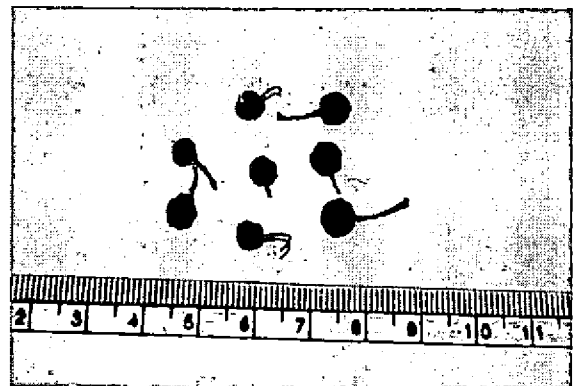
Seed weight: 2520 - 1440/ kg

Seed dispersal:

Seed collection:

Transportation of seeds:

Seed processing:



Fruits

Seed storage: Seeds show desiccation tolerance and freezing sensitivity. Fresh fruits have 100% seed viability when their moisture content is 46.3%. Seed viability can be maintained at the high value when they are exposed to open air for 1 month and when the moisture content of the fruits decreased to approximately 25%. However, seed viability falls to approximately 70%

when the fruits are exposed to open air for 2 months and the moisture content of the fruits will be decreased to approximately 18% (Chen-ZhangHe et al., 2004).

Viability period: Seeds are relatively short-lived under field conditions. A maximum of 1% of seeds remain viable at 12 months post sowing under field conditions (Panetta, 2001).

Seed emptiness:

Seed pre treatment: Soak the seeds in water for 24 hrs before sowing (Troup, 1921). Increase in germination and seedling growth is obtained with gibberellic acid, followed by kinetin and ethylene. IAA and ABA have little effect, and abscisic acid prevent germination (Bhandari, 1996). Removing whole seed coat give 100% germination after 10 days whereas untreated seeds sown in the nursery begin to germinate after 10 weeks, reaching 50% germination at 13 wk and culminating at 84% after 18 wk (Bahuguna et al., 1987). Soaking fresh seeds in 15% hydrogen peroxide for 25 min significantly increase germination (51-58%) over that of control (0-11%). A long crack to the hilum along the ridge of the seed coat was found after the 15% hydrogen peroxide treatment (Chien and Lin, 1994). Seeds removed from the seed coat have a higher germination percentage than intact seeds and show increased respiration indicating that permeability of the seed coat is poor. Seeds immersed in 19% H₂O₂ solution for 2 h show improved germination rates of 21 and 66% after 9 and 17 days, respectively. The combination of cold stratification for 4 months followed by 15% hydrogen peroxide for 25 min is effective for increasing germination percentage (Chien-ChingTe and Lin-TsanPiao, 1999).

Germination type:

Germination percentage:

Germination period: In the laboratory, germination begin after 55 and 69 days in the light and dark, respectively, and it last for more than 3 months. The percentage of germination is only 16% in the light condition. Less than 2% seeds germinate in the dark and they germinate 2 weeks later than the seeds in the light (Chen-ZhangHe et al., 2004).

Nursery technique: For raising plants from seed, fresh seeds should be sown in the nursery during late winter. At Dehra Dun sowing in boxes has proved more successful than sowing in seed-beds, but in either case a well worked porous soil is necessary, this consisting preferably of an equal mixture of loam, sifted leaf mould, and pure sand, well mixed and pulverized (Troup, 1921). Copper-treated containers eliminate root circling and deformation in the species, and seedlings in treated polybags and tubes exhibit similar growth results (Huang et al., 2002).

Propagation:

Method of propagation:

Seeds, layers, branch cutting or root cutting or by transplanting root suckers (Troup, 1921).

Vegetative propagation:

Pests:

Diseases:

Medicinal properties: It contains tannin, it has an astringent effect, increases constipation unless mixed with laxative. It is known to be antiseptic, circulatory stimulant and has a calming effect in cases of hysteria, neuralgia and general nervousness.

Uses: The camphor oil extracted from leaves, wood, and root is used in the preparation of expensive perfumes and soap manufacture. Camphor is used in puja by the Hindus. The essential oil, hydrodistilled from leaves of *C. camphora* has thirty-nine components of which camphor constitutes 71.2% (Pino and Fuentes, 1998; Pandey et al., 1997). Seed of the camphor tree (*C. camphora*) contains cinnamomin which is a special storage protein (novel type II ribosome-inactivating protein (RIP) (Liu-RenShui et al., 2002). Net height growth and net diameter growth of seedlings are enhanced in the early period of exposure to high CO₂ concentrations and high temperatures. However, when seedlings are exposed for a longer period of time to this high CO₂ concentration, net growth of

seedlings is inhibited. Seedlings grown in very small pots also probably experience restricted root growth. The photosynthetic capacities of seedlings are reduced during long term elevated CO₂ treatment. The carboxylation efficiency and light harvesting ability are also inhibited. The optimum temperature for the photosynthetic rate of seedlings grown at the higher temperature is higher, and seedlings grown in the elevated CO₂ concentration also show an increase in the optimum temperature for photosynthesis (Sheu-BorHung and Chang-AnnLi, 2001).

Wood properties: Moderately hard, strongly scented with camphor and used mainly for cabinet works. Wood greyish-white, moderately hard, scented strongly with camphor, rather rough (Gamble, 1922).

References:

- Bahuguna, V.K., Rawat, M.M.S. and Thapa, V.S. 1987. Preliminary investigation on dormancy and germination behaviour of Cinnamomum camphora Nees. seed. Van Vigyan. 25(1-2): 35-37.
- Bhandari, J. 1996. Effects of phytohormones on seeds and seedlings of Cinnamomum camphora. Indian Forester. 122(8): 767-769.
- Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 130.
- Chen-ZhangHe, Wu Bin, Li JingYi, Zhao JianGang, Zhou XianYe and Zhang YouKai. 2004. Germination of the seeds and growth of the seedlings of Cinnamomum camphora (L.) Presl. Plant Species Biology. 19(1): 55-58.
- Chien, C.T. and Lin, T.P. 1994. Mechanism of hydrogen peroxide in improving the germination of Cinnamomum camphora seed. Seed Science and Technology. 22(2): 231-236.
- Chien ChingTe and Lin TsanPiao. 1999. Effects of moisture content and temperature on the storage and germination of Cinnamomum camphora seeds. Seed Science and Technology. 27(1): 315-320.
- Gamble, J.S. 1922. A manual of Indian timbers. London Sampson Low, Marton and Company Ltd, Calcutta, India.

Huang, J., Kuo YauLun, Rose, R., Chien ChingTe, Huang, J., Kuo YauLun, Rose, R., and Chien ChingTe. 2002. Taiwan Journal of Forest Science. 17(4): 515-524.

Liu-RenShui, Wei GuoQing, Yang Qiang, He WenJun, and Liu WangYi. 2002. Cinnamomin, a type II ribosome-inactivating protein, is a storage protein in the seed of the camphor tree (Cinnamomum camphora). Biochemical Journal. 362(3): 659-663.

Pandey, A.K., Bora, H.R., Deka, S.C., Rastogi, R.C., and Baruah, A.K.S. 1997. Composition of the essential oil of the bark of Cinnamomum camphora. Journal of Medicinal and Aromatic Plant Sciences. 19(2): 408-409.

Panetta, F.D. 2001. Seedling emergence and seed longevity of the tree weeds Celtis sinensis and Cinnamomum camphora. Weed Research Oxford. 41(1): 83-95.

Pino, J.A. and Fuentes, V. 1998. Leaf oil of Cinnamomum camphora (L.) J. Presl. from Cuba. Journal of Essential Oil Research. 10(5): 531-532.

Sasidharan, N. 2004. Forest Trees of Kerala. Kerala Forest Research Institute, Peechi, Kerala, India.

Sheu-BorHung and Chang AnnLi. 2001. Effects of carbon dioxide and temperature on the growth and photosynthesis of Cinnamomum camphora seedlings. Taiwan Journal of Forest Science. 16(1): 11-23.

Troup, R. S. 1921. The Silviculture of Indian Trees. (Vol III) International Book Distributors, Dehra Dun.

Cleistanthus collinus

Nomenclature:

Scientific name: *Cleistanthus collinus* (Roxb.) Benth. ex Hk. f.

Vernacular name: Odugu (Malayalam) (Sasidharan, 2004); Oduvan, Wodan, Wodayu waddan (Tamil) (Gamble, 1922); Garari (Hindi) (Bose et al., 1998).

Common name:

Synonyms: *Chuytia collina* Roxb., *Lepidieropsis orbicularis* Muell. Arg. (Troup, 1921). *Chytia collina* Roxb. (Sasidharan, 2004).

Family: Euphorbiaceae

Subfamily:

Origin:

Distribution: In India from Simla to Bihar, Western Peninsula; Sri Lanka (Bose et al., 1998). Common in many parts as far as the Ganges river and Chota Nagpur, especially in the Singhbhum district. It is one of the commonest trees in some of the dry types of mixed forests, and thrives on dry rocky ground, where it often becomes more or less gregarious (Troup, 1921).

Description: A small tree, up to 8 m high (Gamble, 1922).

Flowering season: February to March.

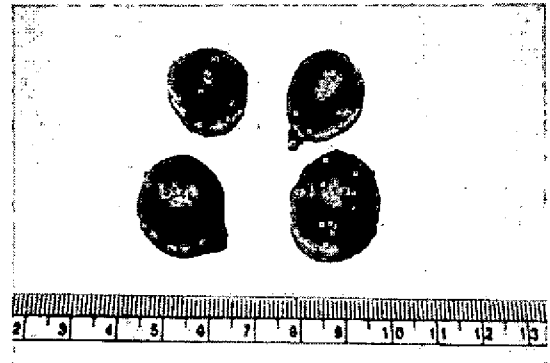
Fruiting season: October to November, March to April (Troup, 1921).

Flowers: Flowers yellowish green, in small axillary and shortly spicate clusters, silky villous; calyx 6 mm across; petals fleshy, narrow, incurved (Bose et al., 1998).

Fruits: Capsules globose, woody, 3-rarely 4-lobed, 1.5-1.8 cm in diameter, shining brown (Bose et al., 1998).

Fruit type: Capsule.

Seeds: Seeds 3-4 mm in diameter, globose, brown (Bose et al., 1998).



Fruits

Seed dimension:

Seed length:

Seed width:

Seed thickness:

Seed weight:

Seed dispersal:

Seed collection:

Transportation of seeds:

Seed processing:

Seed storage:

Viability period:

Seed emptiness:

Seed pre treatment: 24-h soaking of seeds in boiled water and 10 min soaking in concentrated sulfuric acid (Archana-Sharma *et al.*, 1999).

Germination type:

Germination percentage: Germination is 31.8% for lighter seeds and 83.8% in the mid-weight seeds (Quraishi *et al.*, 1996).

Germination period: Germination starts on day 10 and is complete by day 19 (Quraishi *et al.*, 1996).

Nursery technique:

Propagation:

Method of propagation:

Vegetative propagation:

Pests:

Diseases:

Medicinal properties: Fruits act as violent gastrointestinal irritant (Bose *et al.*, 1998).

Leaves of *C. collinus* contains diphyllin glycoside called cleistanthin A having anticancer potential (Pradheepkumar and Govindaswamy- Shanmugam, 1999).

Uses: *C. collinus* leaf extracts have antifeedant activity against *Spodoptera litura* (Arivudainambi and Baskaran, 2004), because of the presence of lactone glycosides (Arivudainambi *et al.*, 2006). Used for the purposes of suicide and homicide, as well as for medicinal use, also used to procure abortion (Amerjothy *et al.*, 2001; Shashiraj-Eswarappa *et al.*, 2003; Sarathchandra and Balakrishnamurthy, 1998).

Wood properties: Wood dark reddish-brown, tough hard, close-grained; heartwood small (Gamble, 1922). Wood blocks of heartwood of *C. collinus* are very resistant to decay fungi (both brown and white rots) with a mean weight loss of less than 6% (Remadevi *et al.*, 2006).

References:

- Amerjothy, S., Jayaraman, P. and Brindha, P. 2001. Pharmacognostic investigations of "Oduvan", a plant drug of forensic interest. *Journal of Medicinal and Aromatic Plant Sciences*. 22/23(4A/1A): 668-671.
- Archana-Sharma, Choubey, O.P., and Tiwari, K.P. 1999. Pre-treatment for hastening seed germination and seedling growth in Cleistanthus collinus (Benth). *Journal of Tropical Forestry*. 15(4): 247-252.
- Arivudainambi, S. and Baskaran, P. 2004. *Cleistanthus collinus* Benth - a potential source of pesticidal value. *Annals of Plant Protection Sciences*. 12(1): 202-203.
- Arivudainambi, S., Selvamuthukurnaran, T., and Baskaran, P. 2006. Lactone glycoside in *Cleistanthus collinus* (Euphorbiaceae), an effective insecticidal principle. *Indian Journal of Plant Protection*. 34(2): 256-257.

Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 139.

Gamble, J.S. 1922. A manual of Indian timbers. London Sampson Low, Marton and Company Ltd, Calcutta, India.

Pradheepkumar, C.P. and Govindaswamy-Shanmugam. 1999. Anticancer potential of cleistanthin A isolated from the tropical plant Cleistanthus collinus. *Oncology Research*. 11(5): 225-232.

Quraishi, A., Biswas, J. and Mishra, S.K. 1996. Seed weight related germination capacity in Cleistanthus collinus Benth. *Indian Journal of Forestry*. 19(1): 79-82.

Remadevi, O.K., Nagaveni, H.C., Raja Muthukrishnan, and Vijayalakshmi, G. 2006. Natural resistance of wood of Cleistanthus collinus (Roxb.) Benth and Hook against wood decay fungi and termites. *Journal of the Indian Academy of Wood Science*. 2(2): 45-50.

Sarathchandra, G. and Balakrishnamurthy, P. 1998. Acute toxicity of Cleistanthus collinus: an indigenous poisonous plant in Cavia procellus. *Journal of Environmental Biology*. 19(2): 145-148.

Sasidharan, N. 2004. Forest Trees of Kerala. Kerala Forest Research Institute, Peechi, Kerala, India.

Shashiraj-Eswarappa, Chakraborty, A.R., Palatty, B.U. and Vasnaik, M. 2003. Cleistanthus collinus poisoning: case reports and review of the literature. *Journal of Toxicology, Clinical Toxicology*. 41(4): 369-372.

Troup, R. S. 1921. The Silviculture of Indian Trees. (Vol III) International Book Distributors, Dehra Dun.

Cochlospermum religiosum

Nomenclature:

Scientific name: *Cochlospermum religiosum* (L.) Alston

Vernacular name: Apparutakka, Panyara, Parei-panji, Apakudukka (Malayalam), Kongillam, Kongu, Elluva (Tamil) (Gamble, 1922), Kondagogu (Telugu).

Common name: Buttercup tree, Torchwood tree, Yellow silk cotton tree (Bose et al., 1998).

Synonyms: *Cochlospermum gossypium* DC., *Bombax religiosum* Linn. (Sasidharan, 2004); *Bombax gossypium* Roxb.

Family: Cochlospermaceae

Subfamily:

Origin:

Distribution: It is found in India, Sri Lanka, Malaysia. Cultivated near temples in Sri Lanka and India. In India, Western Sub-Himalayan tract up to 900 m, plains of Uttar Pradesh, Bihar, West Bengal, Orissa, Madhya Pradesh, Maharashtra, Gujarat and in the Deccan east of the Western Ghats. In Kerala it is seen in Calicut and Palghat Districts; restricted to the highlands of northern Kerala (Sahni, 2000).

Description: A soft wooded deciduous tree, up to about 10 m height (Sahni, 2000).

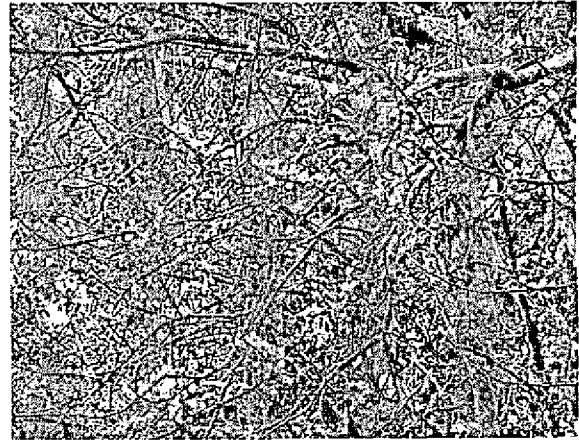
Flowering season: January to March, February to April (Sahni, 2000; Bourdillon, 1908).

Fruiting season: April to June, March to July (Sahni, 2000); April to May (Bourdillon, 1908).

Flowers: Large golden yellow, 7.5 to 13 cm across, short, in simple racemes or loosely branched terminal panicles. Sepals 5, unequal, downy, silky outside, petals 5 cm long, notched, broadly obovate (Sahni, 2000).

Fruits: Fruit is a capsule 5 to 10 cm long, obovate, 5-valved, furrowed, leathery brown, pendulous, pear-shaped (Sahni, 2000).

Fruit type: Capsule.



Branch with flowers and fruits

Seeds: Brownish, 0.4 cm long, reniform to cochleate, woolly-hairy. Seeds covered with silky hairs.

Seed dimension:

Seed length:

Seed width:

Seed thickness:

Seed weight: 13400 seeds/kg.

Seed dispersal: Wind.

Seed collection:

Transportation of seeds:

Seed processing:

Seed storage: Fruits are collected by lopping the branches or from the floor, kept in open for sometime and then the seeds are separated by trashing.

Viability period: Seed remains viable for 1 to 2 months.

Seed emptiness:

Seed pre treatment: Soaked in warm water for 12 to 24 hrs before sowing.

Germination type:

Germination percentage: 8

Germination period: 25 days

Nursery technique: Seeds are broadcasted in primary beds in June and seedlings are pricked out to polythene bags when six months old.

Propagation:

Method of propagation: By seed.

Vegetative propagation:**Pests:****Diseases:**

Medicinal properties: Medicinally, the gum is sweetish, cooling and sedative - is useful against cough. The dried leaves and flowers are also reported to be stimulants. Ethanol, acetone and chloroform extracts possess antibacterial and antifungal activities (Goud et al., 2002).

Uses: The brown seed oil is used in soap industry and the bark yields a fibre used in cordage. The tree yields a gum and it is used for binding books. The floss from the tree is used for stuffing pillows (Bose et al., 1998).

Wood properties: The wood is white, turning brown on exposure. It is extremely light, soft and spongy, and disintegrate into loose bundle of fibres on drying and is very coarse textured. Pores large, scanty, often subdivided into compartments. Medullary rays broad, visible on a radial section as long rough plates (Gamble, 1922).

References:

Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 141.

Bourdillon, T.F. 1908. Forest trees of Travancore. International Book Distributors, Dehradun. pp. 16.

Gamble, J.S. 1922. A manual of Indian timbers. London Sampson Low, Marton and Company Ltd, Calcutta, India.

Goud, P.S.P., Murthy, K.S.R., Pullaiah, T. and Babu, G.V.A.K. 2002. Screening for antibacterial and antifungal activities of some medicinal plants of Nallamalais, Andhra Pradesh, India. *Journal of Economic and Taxonomic Botany*. 26(3): 677-684.

Sahni, K.C. 2000. The Book of Indian Trees. BNHS, Mumbai.

Sasidharan, N. 2004. Forest Trees of Kerala. Kerala Forest Research Institute, Peechi, Kerala, India.

Cullenia exarillata Robyns

Nomenclature:

Scientific name: *Cullenia exarillata*
Robyns

Vernacular name: Vediplavu, Mullenpali, Kuranguplavu (Malayalam) (Sasidharan, 2004); Karayani (Malayalam), Vedipila (Tamil).

Common name: Vedi Pila

Synonyms: *Cullenia excelsa* Wt. (Sasidharan, 2004).

Family: Bombacaceae

Subfamily:

Origin:

Distribution: Western Ghats up to 1,200 m, from Coorg southwards through Kerala to Kanyakumari, Tamil Nadu, forming the top storey in moist regions from 600 to 1300 m.

Description: A very tall tree. Young shoots covered with shield shaped stalked scales.

Flowering season: Hot seasons.

Fruiting season: About June.

Flowers: Flowers rusty red, in large clusters borne on the old wood.

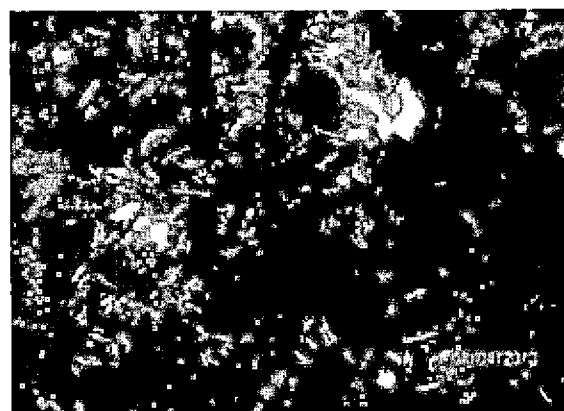
Fruits: Fruit is a capsule covered with long prickles, valves 3-5.

Fruit type: Capsule.

Seeds: Seeds few 3.3 cm long, hard, shining, nearly covered by a large fleshy white pulpy covering.



Tree



Fruits



Seeds

Seed dimension:

Seed length:

Seed width:	Germination percentage:
Seed thickness:	Germination period:
Seed weight:	Nursery technique:
Seed dispersal: Monkeys.	Propagation:
Seed collection:	Method of propagation:
Transportation of seeds:	Vegetative propagation:
Seed processing:	Pests:
Seed storage:	Diseases:
Viability period:	Medicinal properties:
Seed emptiness:	Uses:
Seed pre treatment:	Wood properties: Wood is moderately soft.
Germination type:	

References:

- Sahni, K.C. 2000. The Book of Indian Trees. BNHS, Mumbai.
- Sasidharan, N. 2004. Forest Trees of Kerala. Kerala Forest Research Institute, Peechi, Kerala, India.

Dalbergia latifolia

Nomenclature:

Scientific name: *Dalbergia latifolia* Roxb.

Vernacular name: Veeti, Eetti (Malayalam); Eetti, Iruppottu thodagathi (Tamil), Bilayata shisham (Hindi), Todagatti, Karimbeetti (Kannada) (Chacko et al., 2002).

Common name: Rosewood, Bombay black wood (Chacko et al., 2002), East Indian rosewood.

Synonyms: *Dalbergia emarginata* Roxb., *Amerimnon latifolium* (Roxb.) Kuntze (Chacko et al., 2002).

Family: Leguminosae

Subfamily: Faboideae.

Origin:

Distribution: It occurs in the Sub-Himalayan tract to Bihar, Sikkim, Orissa, Bengal, Chota Nagpur and Central, Western and Southern India in moist deciduous forests up to 1350 m. In Kerala, it occurs in semi-evergreen and moist deciduous forests up to 1200 m (Chacko et al., 2002).

Description: A large deciduous or nearly evergreen tree, up to 30 m high with cylindrical, fairly straight bole and full, rounded crown (Bose et al., 1998).

Flowering season: April (North and Central India) January-February (Kerala), April-May (drier parts of Maharashtra).

Fruiting season: Ripens in December to May (Chacko et al., 2002).

Flowers: Pure white in lax panicle, 8 mm long, on pedicels nearly as long as calyx tube, in short axillary much-branched

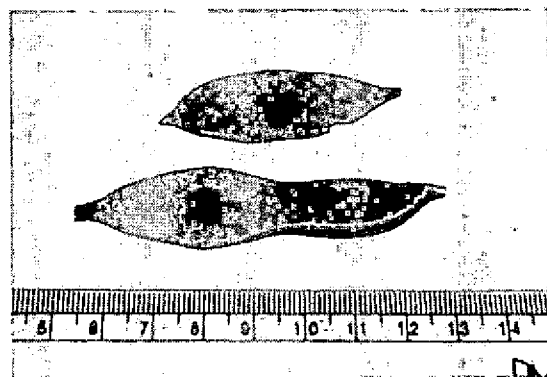
panicles. Stamens 9, monadelphous (Bose et al., 1998; Sahni, 2000).

Fruits: Fruit is a pod. Each pod contains 2 to 4 compressed, reniform, deep brown to black seeds (Chacko et al., 2002). Flat, indehiscent pods, firm and strap-shaped, oblong-lanceolate, 3-6 cm long (Bose et al., 1998).

Fruit type: Pod.



Twig with flowers



Fruits

Seeds: Reddish brown, hard smooth, shiny, testa coriaceous, deep brown to black seeds (Chacko et al., 2002).

Seed dimension:

Seed length: 5-7 mm (Chacko et al., 2002).

Seed width: 3-5 mm (Chacko et al., 2002).

Seed thickness: 1-2 mm (Chacko et al., 2002).

Seed weight: 21,000 to 40,000 seeds/kg (Chacko et al., 2002).

Seed dispersal:

Seed collection: Ripe dark brown coloured pods are collected from trees by lopping off the branches (Chacko et al., 2002).

Transportation of seeds: Pods collected in cotton bags are packed. The bags are loosely stacked during transport (Chacko et al., 2002).

Seed processing: The pods are dried in the sun and seeds extracted manually by crushing the pods, or pods are dried in oven at 50°C for 3.5 h and seeds extracted by crushing the pods. Winnowing to clean the seeds (Chacko et al., 2002).

Seed storage: Probably orthodox. The pods are stored in gunny bags and earthen pots for six months. Seeds imperfectly dried before storage usually loses viability in relatively short period (Chacko et al., 2002).

Viability period: Seed is viable up to six months (Chacko et al., 2002).

Seed emptiness: Moderate (Chacko et al., 2002).

Seed pre treatment: Soaking in cold water for 24 hrs before sowing will help germination (Chacko et al., 2002). IAA at lower concentrations (1-20 ppm) increase both germination and plant percentages by up to 10% (Tiwari et al., 1999).

Germination type: Epigeous (Chacko et al., 2002).

Germination percentage: 80 (Chacko et al., 2002).

Germination period: 7 to 21 days (Chacko et al., 2002).

Nursery technique: Seeds are sown in germination trays in vermiculite and watered. The seedlings are pricked out into polythene bags of size 22.5 x 17.5 cm filled with soil based potting mixture, when they are about 5 to 6 cm high. Seedling collar rot caused by *Rhizoctonia solani* occurs in nursery, which can be controlled by the application of fungicide, carboxin (1.0%) (Chacko et al., 2002). Seedlings grown in root trainers with potting media comprising 30% sand, 10% soil and 60% compost exhibit excellent growth (Srivastava et al., 2002).

Propagation:

Method of propagation: Tissue culture is successful.

Vegetative propagation:

Pests: High (Chacko et al., 2002).

Diseases: High (44-98%). Eight fungi and a bacterium were recorded. Apart from storage moulds, *Fusarium moniliforme* and bacteria were causing damage to seeds (Mohan and Geetha Varma, 2001; Chacko et al., 2002).

Medicinal properties: Parts of the tree are reported to be useful as stimulant and appetiser and also used for the treatment of dyspepsia, diarrhoea, leprosy, obesity etc. (Bose et al., 1998).

Uses: The wood is used for furniture, cabinet work, carving, ornamental ply-boards and veneers. The wood is too

expensive for general constructional work but also used for posts, rafters, doors and window frames (Chacko et al., 2002). Leaves are used as a fodder and bark contains tannin. It is grown in coffee plantation as a shade tree (Bose et al., 1998). *Dalbergia latifolia* can tolerate salts up to 6.5 dS/m at germination stage (Ashutosh-Sharma and Kukadia, 2003).

Wood properties: The sapwood is yellowish white with a pinkish cast. The

heartwood which is sharply differentiated from the sapwood, varies in colour from light purplish brown to dark purple with darker streaks giving rise to an attractive figure. No distinct annual rings. Pores moderate sized to large, often subdivided, irregular, scanty, in patches of light tissue, which patches are generally joined by narrow, white, wavy interrupted concentric lines. Medullary rays fine, numerous, uniform, equidistant and very short (Gamble, 1922).

References:

- Ashutosh-Sharma and Kukadia, M.U. 2003. Effects of salinity levels on germination, number of leaves and shoot and root length of different tree species. *Indian Journal of Forestry*. 26(2): 135-142.
- Bose, T.K., Das, P. and Maiti, G.G. 1998. *Trees of the world*, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 163.
- Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. *Manual of Seeds of Forest Trees, Bamboos and Rattans*. Kerala Forest Research Institute, Peechi, Kerala. pp. 106-107.
- Mohanan, C. and Geetha Varma. 2001. Microorganisms associated with seeds of *Dalbergia*, *Acacia* and *Albizia* species and their management for optimum seed germination and seedling health. *Journal of Tropical Forestry* (in press).
- Sahni, K.C. 2000. *The Book of Indian Trees*. BNHS, Mumbai.
- Srivastava, A., Rathore, T.S., Joshi, G., and Reddy, K.S. 2002. Modern nursery practices in the production of quality seedlings of important forestry species using root trainer technology. *Myforest*. 38(3): 257-263.
- Tiwari, P.K., Ravi Agrawal, and Savita Kiran. 1999. Studies on the effect of growth regulators on germination percent and plant percent of some leguminous forest tree species. *Journal of Tropical Forestry*. 15(3): 196-201.

Dalbergia paniculata

Nomenclature:

Scientific name: *Dalbergia paniculata* Roxb.

Vernacular name: Pinekanni, Pachilamaram, Vettutholi (Malayalam), Poraputchalia, Adukkuvagia Painganni (Tamil), Dhobein, Passi, Satpuria Pachari (Hindi) (Chacko et al., 2002).

Common name:

Synonyms: *D. nigrescens* Kurz (Bose et al., 1998).

Family: Leguminosae

Subfamily: Faboideae

Origin:

Distribution: Distributed in the forests of Uttar Pradesh, Central India, Western Peninsula and Myanmar (Bose et al., 1998). In Kerala, it is found in the dry deciduous forests (FRI, 1983; Chacko et al., 2002).

Description: Moderately fast growing, medium sized to large deciduous tree, with irregularly fluted trunk attaining a height of 25-30 m and a breast height diameter of 51 cm (FRI, 1983; Bose et al., 1998; Chacko et al., 2002).

Flowering season: March to September; April-June (Bose et al., 1998)

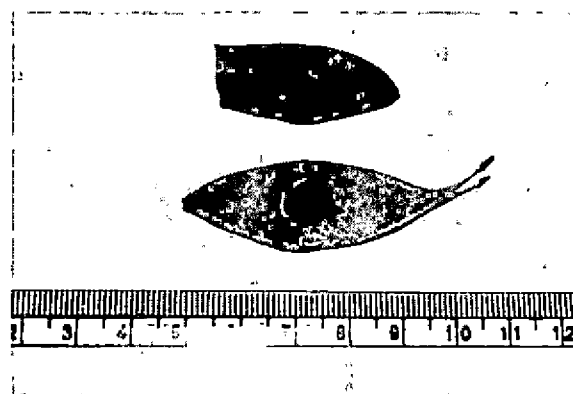
Fruiting season: September to October and continue till March throughout the year (FRI, 1983; Chacko et al., 2002).

Flowers: Flowers in copious axillary and terminal panicles with racemose-corymbose branchlets. Bluish white, nearly sessile, crowded at short, densely brown, silky racemes, arranged in compact terminal panicles; calyx 3 mm long, densely silky;

corolla twice the length of calyx (Bose et al., 1998).

Fruits: Fruit is a pod narrowed at both ends (Bose et al., 1998).

Fruit type: Pod.



Fruits

Seeds: Seed ellipsoid but sub-reniform at base, brown coloured and smooth (FRI, 1983; Chacko et al., 2002).

Seed dimension:

Seed length: No information (Chacko et al., 2002).

Seed width: No information (Chacko et al., 2002).

Seed thickness: No information (Chacko et al., 2002).

Seed weight: 7,700 seeds/kg (FRI, 1983; Chacko et al., 2002).

Seed dispersal:

Seed collection: Pods are beaten off the trees using a long stick (Chacko et al., 2002).

Transportation of seeds: Pods are gathered in cotton / jute bags and transported. No special care is needed.

Seed processing: Pods are dried in sun for 3 to 4 days and stored after removing dead leaves, portion of twigs and other foreign matter. No effort need be made to extract seeds from the indehiscent pods (Chacko et al., 2002).

Seed storage: Probably orthodox. Pods can be stored in sealed tins, gunny bags or baskets after drying. Careful drying is essential as viability is rapidly reduced if pods not dried before storing. Seeds to be used in the same season may even be heaped on floor (Chacko et al., 2002).

Viability period: Seed is viable up to six months (Chacko et al., 2002).

Seed emptiness: Moderate (Chacko et al., 2002).

Seed pre treatment: Not necessary (Chacko et al., 2002).

Germination type: Epigeal (Chacko et al., 2002).

Germination percentage: Up to 90 (FRI, 1983; Chacko et al., 2002).

Germination period: 7 to 25 days (Chacko et al., 2002).

Nursery technique: Seedlings raised in germination trays are pricked out into polythene bags of size 20 x 10 cm, when they are about 5 to 6 cm height (Chacko et al., 2002).

Propagation:

Method of propagation: By seeds.

Vegetative propagation:

Pests: Low (Chacko et al., 2002).

Diseases: No information (Chacko et al., 2002).

Medicinal properties:

Uses: Leaves are used as fodder. The bark is chewed with betel in Assam. The wood is used for building purposes and for musical instruments (Bose et al., 1998).

Wood properties: The wood is greyish or yellowish white without any distinct heartwood. It is a soft and light wood with straight grain and coarse texture. It is a diffuse porous wood with 1-2 mm thick concentric layers of darker phloem tissues. Pores moderate sized scanty often subdivided. Medullary rays fine, fairly numerous (Gamble, 1922).

References:

Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 164.

Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 108-109.

FRI. 1983. Troup's The Silviculture of Indian Trees. Vol. IV. The Controller of Publications, Delhi.

Gamble, J.S. 1922. A manual of Indian timbers. London Sampson Low, Marton and Company Ltd, Calcutta, India.

Dalbergia sissooides

Nomenclature:

Scientific name: *Dalbergia sissooides*
Grah. ex Wight & Arn.

Vernacular name: Eetti, Veetti, Karitti (Malayalam), Thothagatti (Tamil), Chelabetti (Kannada) (Chacko et al., 2002).

Common name: Rose wood (Chacko et al., 2002).

Synonyms: *Dalbergia latifolia* Roxb. var. *sissooides* (Grah. ex Wight & Arn.) Baker (Chacko et al., 2002; Sasidharan, 2004).

Family: Leguminosae

Subfamily: Faboideae

Origin:

Distribution: Occurs in the south west part of Peninsular India. In Kerala, it is fairly common in moist deciduous and semi-evergreen forests up to 1,500 m (Chacko et al., 2002).

Description: Slow growing large deciduous tree resembling *Dalbergia latifolia*, attaining a height of 30 m and a breast height diameter of 103 cm (Chacko et al., 2002).

Flowering season: January to March.

Fruiting season: October to January; Available in India during February (Thothathri, 1987; Chacko et al., 2002).

Flowers: Flowers white, in small terminal panicles of about 12 together. Stamens 9, united in a sheath.

Fruits: Pod, tapering at both ends.

Fruit type: Pod.

Seeds: Reniform and deep brown to black seeds (Chacko et al., 2002).

Seed dimension:

Seed length: 5-7 mm (Chacko et al., 2002).

Seed width: 3-5 mm (Chacko et al., 2002).

Seed thickness: 1-2 mm (Chacko et al., 2002).

Seed weight: 26,000 to 46,000 seeds/kg (Chacko et al., 2002).

Seed dispersal:

Seed collection: Pods are collected from trees by lopping the branches (Chacko et al., 2002).

Transportation of seeds: Pods can be packed in jute / cloth / polythene bags and transported (Chacko et al., 2002).

Seed processing: The pods are dried in the sun and seeds extracted manually by crushing the pods, or pods are dried in oven at 50°C for 3.5 h and seeds extracted by crushing the pods. Winnowing to clean the seeds (Chacko et al., 2002).

Seed storage: Probably orthodox (Chacko et al., 2002). Seeds can be stored in gunny bags or sealed containers for 6 months (Chacko et al., 2002).

Viability period: The seeds keep well in gunny bags for 6 months, thereafter the seeds rapidly deteriorate (Dent, 1948; Chacko et al., 2002).

Seed emptiness: 26 to 38% (Chacko et al., 2002).

Seed pre treatment: Not necessary (Chacko et al., 2002).

Germination type: Epigeal (Chacko et al., 2002).

Germination percentage: Up to 89 (Chacko et al., 2002).

Germination period: 2 to 11 days (Chacko et al., 2002).

Nursery technique: Seeds are sown in germination trays in vermiculite and watered. The seedlings are pricked out into polythene bags of size 22.5 x 17.5 cm, when they are about 5 to 6 cm height. Seedling collar rot caused by *Rhizoctonia solani* occurs in nursery, which can be controlled by application of fungicide, carboxin (0.1%) (Chacko et al., 2002).

Propagation:

Method of propagation: By seeds and vegetative method.

Vegetative propagation:

Pests: The bruchids *Bruchus pisorum* L., *B. maculatithorax* Pic., and *Bruchidius uberatus* Fb. are reported to cause damage to stored seeds (Sen-sarma and Thakur, 1994; Chacko et al., 2002).

Diseases: More than 24 fungi are recorded. Species of *Aspergillus*, *Chaetomium*, *Cladosporium*, etc. are the important storage moulds. *Alternaria* sp., *Drechslera* sp., *Bipolaris* sp., *Fusarium* sp. are the important field pathogens associated with the seeds (Mohan and Geetha Varma 2001; Chacko et al., 2002).

Medicinal properties:

Uses: The wood is used for constructions, furniture, veneer, etc. (Chacko et al., 2002).

Wood properties: Sapwood yellowish white, heartwood purple or dark purplish brown, with darker streaks, extremely hard, close grained, with very numerous, irregular, wavy, interrupted concentric lines.

References:

Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 112-113.

Dent, T.V. 1948. Seed storage with particular reference to the storage of seed of Indian forest plants. Indian Forest Records (New Series) Silviculture, 7: 134 pp. Manager of Publications, Delhi.

Mohan, C. and Geetha Varma. 2001. Microorganisms associated with seeds of *Dalbergia*, *Acacia* and *Albizia* species and their management for optimum seed germination and seedling health. *Journal of Tropical Forestry* (in press).

Sasidharan, N. 2004. Forest Trees of Kerala. Kerala Forest Research Institute, Peechi, Kerala, India.

Sen-Sarma, P.K. and Thakur, M.L. 1994. Pests of Dipterocarpaceae and their management. In: L.K. Jha and P.K. Sen Sarma (eds.). Forest Entomology. Ashish Publishing House, New Delhi, pp. 165-186.

Thothathri, K. 1987. Taxonomic revision of the tribe Dalbergieae in the Indian subcontinent. Botanical Survey of India, Calcutta.

Dalbergia sissoo

Nomenclature:

Scientific name: *Dalbergia sissoo* Roxb. ex DC.

Vernacular name: Sisham, Irupul (Malayalam), Sissu itti, Mukko-gette (Tamil), Shisham, Sissoo Sissu, Sissai (Hindi) (Chacko et al., 2002).

Common name: Sissoo, Sisham (Chacko et al., 2002).

Synonyms: *Amerimnon sissoo* (Roxb. ex DC.) Kuntze (Chacko et al., 2002).

Family: Leguminosae

Subfamily: Faboideae

Origin:

Distribution: Throughout the Sub-Himalayan tracts up to 900 m. It is widely used for afforestation except the coldest, wettest and driest parts (FRI, 1983; Chacko et al., 2002). It is planted in Kerala, as an avenue tree (Chacko et al., 2002).

Description: Fast growing large deciduous trees, of over 30 m height and a breast height diameter of 86 cm (FRI, 1983; Chacko et al., 2002).

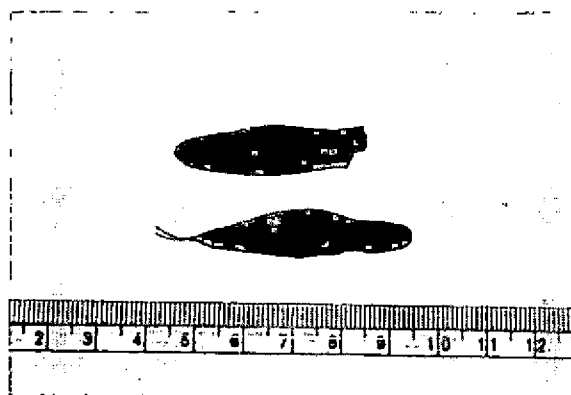
Flowering season: March / April (Sahni, 2000).

Fruiting season: Ripens during November to January; November to March (Sen Gupta, 1937; Chacko et al., 2002). October to November (Bose et al., 1998).

Flowers: Yellow flowers in axillary panicle of short racemes, fragrant, about 8 mm long; stamens 9, monadelphous (Bose et al., 1998).

Fruits: Long pods 5 to 7.5 cm long, linear-lanceolate, flat, strap-shaped, pale-brown, glabrous, indehiscent, 1 to 4 seeded (Sahni, 2000).

Fruit type: Pod.



Fruits

Seeds: Seeds 1 to 4, reniform, thin, flat and light-brown coloured with a delicate papery testa (Chacko et al., 2002). Medium seeds perform better in terms of producing larger seedlings (Khera et al., 2004). High quality seeds are those with large size and low electrical conductivity (Yadav et al., 1998).

Seed dimension:

Seed length: 6-8 mm (Chacko et al., 2002).

Seed width: 4-5 mm (Chacko et al., 2002).

Seed thickness:

Seed weight: 50,000 to 53,000 seeds/kg (Kumar and Bhanja, 1992; Chacko et al., 2002); 35,000 to 55,000 seeds/kg (Kindt et al., 1997; Chacko et al., 2002).

Seed dispersal: Wind.

Seed collection: Ripe pods are collected from the trees in bags or baskets. The pods may be also beaten off from the trees with sticks to the ground (Kumar and Bhanja, 1992; Chacko et al., 2002).

Transportation of seeds: No special care is suggested (Chacko et al., 2002).

Seed processing: Pods are dried in the sun for 3 to 4 days and stored after removing dead leaves, portion of twigs and other foreign matter (Kumar and Bhanja 1992; Chacko et al., 2002).

Seed storage: Orthodox (Kindt et al., 1997; CABI, 1998). Pods are stored in sealed tins, gunny bags or baskets after drying. Viability is rapidly reduced if seed is not dried before storing (FRI, 1983; Chacko et al., 2002). Germination decrease steadily with storage, from 96% at collection time, to 58-68% after 12 months' storage (Dod et al., 1997).

Viability period: Seed is viable for about one year in sealed tins under ambient room temperatures (Luna, 1996; Chacko et al., 2002).

Seed emptiness: High (Chacko et al., 2002).

Seed pre treatment: Soaking the seeds in cold water for 24 hrs improves germination (Kumar and Bhanja, 1992; Chacko et al., 2002). A seed pretreatment with 5% CMC (carboxy methyl cellulose) medium enhance germination and increase root and shoot growth (Harsh and Ojha, 2000).

Germination type: Epigeous.

Germination percentage: 40 (after one year). 90 to 100 (Kumar and Bhanja, 1992; Chacko et al., 2002). Germination of *D. sissoo* is less dependent, on light quality (Khera and Singh, 2005). Salinity reduces germination period and germinative energy (Rashid et al., 2004). Water stress has an

inhibitory effect in germination of *Dalbergia sissoo* (Saxena et al., 1998).

Germination period: 5 to 77 days (Sen Gupta, 1937; Chacko et al., 2002).

Nursery technique: Broken pieces of pods containing seeds are sown in germination trays containing vermiculite in February-March. Too much watering is avoided. Germinated seeds are potted into polythene bags of 20 x 10 cm size filled with soil-based potting mixture (Chacko et al., 2002). Soil, sand and FYM in 1:2:2 and 1:2:1 ratios give growth, dry weight and quality index of seedlings (Pankaj-Tiwari and Saxena, 2003). Seedlings of higher quality can be raised in polyethylene bags kept on MAI beds as compared to those on nursery beds (Mohit-Gera et al., 2005; Singh et al., 2000). *D. sissoo* seedlings perform well in 20% sand and 80% compost combination also in sand, soil and compost in the ratio 1:1:3, 1:0:4, and pure compost alone. Combinations of charcoal, compost, and rice husk in the ratio 1:3:1 and 1:4:0 also show good growth (Ginwal et al., 2002). Irrespective of the pre-treatment, the seeds sown in sand+clay+FYM (1:1:2) medium show good germination and establishment (Atul, 2002). Sawdust and white quartz media under normal watering at nursery condition are better for germination of *D. sissoo* seeds (Sagta and Nautiyal, 2001). PK at the rate of 160 kg/ha fertilizer with soil and cowdung mixture (soil:cowdung=3:1) is recommended for optimum growth and nodule formation of *D. sissoo* in degraded soils at a nursery level (Huda et al., 2007). Presence of nitrogen in soil discourage the formation of nodules (Naugraiya, 2007).

Propagation:

Method of propagation: Seed and grafting (Sinha, 1968).

Vegetative propagation:

Pests: *Plaeoptera reflexa* is the defoliator (Ram parkash and Drake Hocking, 1986).

Diseases: Six fungi and a bacteria are recorded. *Fusarium* sp. and *Colletotrichum* sp. are seed-borne (Mohanan and Anil Chandran, 2001; Chacko et al., 2002). Root rot is caused by *Ganoderma lucidum*, root rot and wilt caused by *Polyporus gilvus* and *Fusarium oxysporum*, respectively (Khan and Khan, 2000).

Medicinal properties: The oil from seed is applied to cure skin diseases and powered wood is used as a remedy for leprosy and skin eruption. The bark and heartwood are used for the treatment of skin diseases, vomiting, leprosy, scabies, ulcers, dysentery, inflammations and fevers (Prajapati *et al.*, 2003).

Uses: Excellent fuel and best furniture timber, used as shade tree and fertilizer for tea, heartwood is excellent for high class furniture, panelling and general

constructional work (Chacko et al., 2002). *D. sissoo* has isoflavone glycosides (Niwa, 2001). Seed's polyphenol and hydrocarbon content are 7.1% and 1.9%, respectively (Augustus and Seiler, 2001). The wood is used for high class furniture and cabinets, plywood, aircraft and marine plywood, blackboards, construction, doors and ship building.

Wood properties: The sapwood is pale yellow or greyish white sharply demarcated from the heartwood, which is golden brown to deep brown with darker streaks. Annual rings are not distinctly marked. Pores large and moderate sized, scanty, in light coloured irregular patches which are joined by fine, wavy, more or less concentric streaks, which are frequently interrupted often very oblique; well defined on a longitudinal section, often filled with resin. Medullary rays pale, very fine uniform, equidistant, and numerous (Gamble, 1922).

References:

- Atul, Shivesh Sharma, and Punam. 2002. Germination potential and establishment studies on important leguminous tree species of north-west Himalayas in different soil media. *Crop Research Hisar*. 24(1): 126-130.
- Augustus, G.D.P.S. and Seiler, G.J. 2001. Promising oil producing seed species of Western Ghats (Tamil Nadu, India). *Industrial Crops and Products*. 13(2): 93-100.
- Bose, T.K., Das, P. and Maiti, G.G. 1998. *Trees of the world*, Vol. 1. Regional Plant Resource Centre, Orissa, India. pp. 164.
- CABI. 1998. *The Forestry Compendium – A Silvicultural Reference*. Module 1. CABI Publishing, CAB International, Wallingford, Oxon, OX108DE, UK.
- Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. *Manual of Seeds of Forest Trees, Bamboos and Rattans*. Kerala Forest Research Institute, Peechi, Kerala. pp. 110-111.

- Dod, V.N., Gabhane, V.V., Pagar, P.G. and Patil, B.N. 1997. Effect of storage conditions on germination of shisam (Dalbergia sissoo) seed. PKV Research Journal. 21(2): 171-172.
- FRI. 1983. Troup's The Silviculture of Indian Trees. Vol. IV. The Controller of Publications, Delhi.
- Gamble, J.S. 1922. A manual of Indian timbers. London Sampson Low, Marton and Company Ltd, Calcutta, India.
- Ginwal, H.S., Rawat, P.S., Bhandari, A.S., Krishnan, C., and Shukla, P.K. 2002. Evaluation of potting mixtures for raising Dalbergia sissoo seedlings under root trainer system. Indian Forester. 128(5): 523-532.
- Harsh, N.S.K. and Ojha, B.M. 2000. A possible pretreatment for seeds of tropical tree species. Seed Science and Technology. 28(2): 513-516.
- Huda, S.M.S., Sujauddin, M., Shafinat, S., and Uddin, M.S. 2007. Effects of phosphorus and potassium addition on growth and nodulation of Dalbergia sissoo in the nursery. Journal of Forestry Research. 18(4): 279-282.
- Khan, M.M. and Khan, M.H. 2000. Die-back of Dalbergia sissoo in Pakistan. Field Document FORSPA. (18): 51-56.
- Khera, N., Saxena, A.K. and Singh, R.P. 2004. Seed size variability and its influence on germination and seedling growth of five multipurpose tree species. Seed Science and Technology. 32(2): 319-330.
- Kindt, R., Mausya, S., Kimotho, J. and Waruhiu. 1997. Tree seed suppliers Directory: Sources of Seeds and Microsymbionts. International Centre for Research in Agro Forestry (ICRAF), Nairobi, Kenya.
- Kumar, S.V. and Bhanja, M. 1992. Forestry Seed Manual of Andhra Pradesh. Andhra Pradesh Forest Department, Hyderabad, India.
- Luna, R.K. 1996. Plantation Trees. International Book Distributors, Dehra Dun, India.
- Mohan and Anil Chandran. 2001. Microorganisms associated with seeds of tropical forest species and their management for improving the storability and seedling production. Seed Science and Technology (in press).
- Mohit-Gera, Sanjeev Srivastava, and Neelu Gera. 2005. Production of quality seedlings using improved polythene bag seedling production system. Indian Forester. 131(2): 170-182.
- Prajapati, N.D., Purohit, S.S., Arun K. Sharma and Tarun Kumar. 2003. A Hand Book of medicinal plants. A complete source book. Agrobios. Jodhpur, India.

- Naugraiya, M.N. 2007. Effect of soil types and fertilizers on nursery crop of *Dalbergia sissoo* Roxb. *Indian Journal of Agroforestry*. 9(2): 97-101.
- Khera, N and Singh, R.P. 2005. Germination of some multipurpose tree species in five provenances in response to variation in light, temperature, substrate and water stress. *Tropical Ecology*. 46(2): 203-217.
- Niwa, M. 2001. Isoflavonoid glycosides from *Dalbergia sissoo*. *Phytochemistry*. 57(8): 1263-1268.
- Pankaj-Tiwari and Saxena, A.K. 2003. Effect of different soil mixtures and fertilizers on the growth of *Dalbergia sissoo* Roxb. seedlings. *Indian Journal of Forestry*. 6(3): 254-259.
- Ram Parkash and Drake Hocking. 1986. Some favourite trees for fuel and fodder. Society for promotion of waste lands development, New Delhi. pp.12-16.
- Rashid, M.M., Hoque, A.K.F. and Iftexhar, M.S. 2004. Salt tolerances of some multipurpose tree species as determined by seed germination. *Journal of Biological Sciences*. 4(3): 288-292.
- Sagta, H.C. and Nautiyal, S. 2001. Variation in germination of *Dalbergia sissoo* Roxb. seeds under different media and osmoconditions. *Indian Forester*. 127(12): 1371-1376.
- Sahni, K.C. 2000. *The Book of Indian Trees*. BNHS, Mumbai.
- Saxena, A.K., Rao, O.P., and Singh, B.P. 1998. Germination responses in nine multipurpose tree species on moisture gradient. *Range Management and Agroforestry*. 19(1): 69-73.
- Sen Gupta, J.N. 1937. Seed weights, plant percents, etc. for forest plants in India. *Indian Forest Records (New Series) Silviculture*, 2:221 pp. Manager of Publications, Delhi.
- Singh, R.R., Kaushik, J.C., and Jagir Singh. 2000. Effect of soil media on germination, shoot and root length and number of nodules of three nitrogen fixing tree species seedlings. *Indian Journal of Forestry*. 23(2): 157-159.
- Sinha, R.P.N. 1968. *Our trees*. Publications division, Ministry of environment and broad casting, New Delhi. pp. 14-15.
- Yadav, S.S., Hooda, M.S. and Bangarwa, K.S. 1998. Effect of seed size on physiological seed quality in shisham (*Dalbergia sissoo*). *Indian Journal of Forestry*. 21(1): 13-15.

Delonix regia

Nomenclature:

Scientific name: *Delonix regia* (Boj.) Rafin.

Vernacular name: Alasippu, Poomaram (Malayalam), Thanga mohar, Mayir konnai (Tamil), Gulmohar (Hindi), (Chacko *et al.*, 2002). Fire tree, flame tree, gold mohar, royal peacock (English).

Common name: Royal poinciana, Peacock flower, Flamboyant, Gulmohar, Gold Mohar, flame tree (Chacko *et al.*, 2002; Bose *et al.*, 1998).

Synonyms: *Poinciana regia* Bojer. ex Hook. (Chacko *et al.*, 2002).

Family: Leguminosae

Subfamily: Caesalpinioideae

Origin: Madagascar (Sasidharan, 2004).

Distribution: Native of Madagascar and widely planted in both dry and moist regions of India as an avenue and garden tree (Luna, 1996). In Kerala, it is planted along roadsides and gardens (Chacko *et al.*, 2002). Introduced to India in 1800s. Seen both in dry and moist regions of tropical India up to Himalayan subtracts.

Description: Large deciduous ornamental tree with broad spreading umbrella shaped crown of light feathery foliage (Bose *et al.*, 1998).

Flowering season: At the end of the hot season, May or early June.

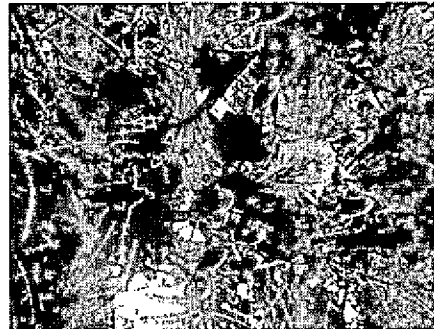
Fruiting season: January to October (Chacko *et al.*, 2002).

Flowers: Large, 7-10 cm across, deep crimson, flaming red, with spreading petals,

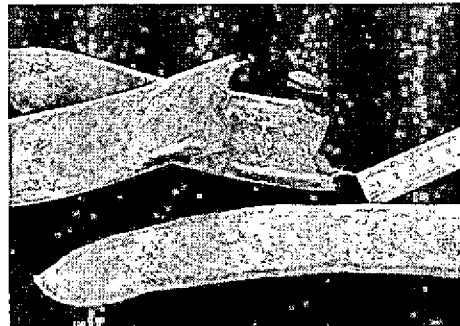
in large corymbs; stamens 10, red (Bose *et al.*, 1998).



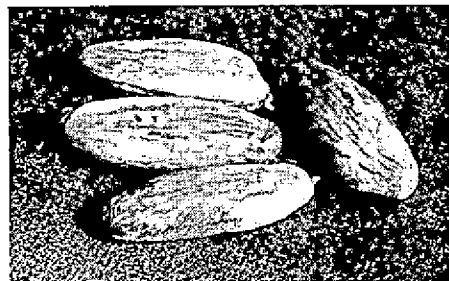
Habit



Flowers



Fruits



Seeds

Fruits: Pods 30-60 cm x 3.8-7.6 cm, broad, ending in a short beak (Chacko *et al.*, 2002), thick and firm, dark brown or nearly black.

Fruit type: Pod.

Seeds: Arranged at right angle to the length of the pod; oblong, transversely mottled, with bony testa (Luna, 1996; Chacko *et al.*, 2002).

Seed dimension:

Seed length: 1.72 cm (Chacko *et al.*, 2002).

Seed width: 0.59 cm (Chacko *et al.*, 2002).

Seed thickness:

Seed weight: 1,600 to 2,100 seeds/kg (Kindt *et al.*, 1997; Chacko *et al.*, 2002); 2,190 to 3,245 (Kumar and Bhanja, 1992; Chacko *et al.*, 2002).

Seed dispersal:

Seed collection: Pods are collected from the trees by lopping the branches (Kumar and Bhanja, 1992; Chacko *et al.*, 2002).

Transportation of seeds: Pods are collected in cotton / plastic / polythene / gunny bags and transported without special care (Chacko *et al.*, 2002).

Seed processing: The pods are dried for 2 to 3 days in sun and beaten up to separate the seeds (Chacko *et al.*, 2002).

Seed storage: Orthodox (Kindt *et al.*, 1997; CABI, 1998). Seeds retain viability for more than 5 years (Luna, 1996) and can be stored in sealed plastic containers (Chacko *et al.*, 2002).

Viability period: Seeds remain viable for more than one year (Chacko *et al.*, 2002).

Seed emptiness: Low (Chacko *et al.*, 2002).

Seed pre treatment: Seeds are soaked in boiled water for 5 days or in cold water for 10 days (Kumar and Bhanja, 1992; Chacko *et al.*, 2002). Seeds are acid scarified for 100 min and soaked in 500 ppm gibberellic acid (Tagad and Mate, 2005).

Germination type: Epigeal (Chacko *et al.*, 2002). Greater initial reserves within seeds perform a greater role in early germination (Singh and Arunachalam, 2002).

Germination percentage: 25 to 68 (Luna, 1996; Chacko *et al.*, 2002).

Germination period: 12 to 349 days (Luna, 1996; Chacko *et al.*, 2002).

Nursery technique: Pre-treated seeds are sown in germination trays filled with the vermiculite and watered regularly. The seedlings are pricked out into polythene bags of size 22.5 x 17.5 cm filled with soil and kept under shade (Chacko *et al.*, 2002).

Propagation:

Method of propagation:

Vegetative propagation:

Pests: Low (Chacko *et al.*, 2002).

Diseases: Moderate (32 to 50.5%); 12 fungi and a bacterium are recorded. *Chaetomium* sp., *Aspergillus restrictus*, *Fusarium* sp., *Chlamydomyces palmarum* are the important fungi (Mohanan and Anil Chandran, 2001; Chacko *et al.*, 2002).

Medicinal properties:

Uses: Ornamental tree. The seeds contain a gum which may find use in food and textile industries. The flowers and buds are used for flavouring food. The wood takes a fine finish and used for making combs and

matches. Natural dyes extracted from flower parts (Purohit *et al.*, 2007). Seed germination and early seedling development is better under 100% light intensity (Aref, 2002).

Wood properties: The wood is white, soft and light. It is a diffuse porous wood with growth rings delimited by fine lines of soft tissue. The pores are moderately large to small, moderately few.

References:

- Aref, I.M. 2002. The effect of light intensity on seed germination and seedling growth of Cassia fistula (Linn.), Enterolobium saman (Jacq.) Prain ex King. and Delonix regia (Boj) Raf. Alexandria Journal of Agricultural Research. 47(2): 73-80.
- Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 165-166.
- Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 114-115.
- Kindt, R., Mausya, S., Kimotho, J. and Waruhiu. 1997. Tree seed suppliers Directory: Sources of Seeds and Microsymbionts. International Centre for Research in Agro Forestry (ICRAF), Nairobi, Kenya.
- Kumar, S.V. and Bhanja, M. 1992. Forestry Seed Manual of Andhra Pradesh. Andhra Pradesh Forest Department, Hyderabad, India.
- Luna, R.K. 1996. Plantation Trees. International Book Distributors, Dehra Dun, India.
- Mohanan and Anil Chandran. 2001. Microorganisms associated with seeds of tropical forest species and their management for improving the storability and seedling production. Seed Science and Technology (in press).
- Purohit, A., Mallick, S., Nayak, A., Das, N.B., Nanda, B., and Sahoo. 2007. Developing multiple natural dyes from flower parts of Gulmohur. Current Science.; 92(12): 1681-1682.
- Singh, N.D. and Arunachalam, A. 2002. Effect of pre-sowing treatments and seed size on germination in five leguminous tree species. Range Management and Agroforestry. 23(2): 139-143.
- Tagad, L.N. and Mate, S.N. 2005. Pretreatment of Poinciana vegia seeds for improvement in germination. New Botanist. 32(1/4): 121-125.

Dendrocalamus strictus

Nomenclature:

Scientific name: *Dendrocalamus strictus* (Roxb.) Nees

Vernacular name: Kallanmula (Malayalam), Kalmungil (Tamil), Lathi bans, Bans (Hindi), Sannabiduru, Kib (Kannada) (Chacko et al., 2002).

Common name: Male bamboo, Solid bamboo (Chacko et al., 2002).

Synonyms: *Bambusa pubescence* Lodd.; *B. tanaea*; *B. stricta* Roxb. (Chacko et al., 2002).

Family: Poaceae (Graminae)

Subfamily:

Origin:

Distribution: Widely distributed in semi-arid and arid zones. It occurs in deciduous forests throughout the country except in higher Himalayas or the north-east upto an altitude of 1200 m. In Kerala it occurs in the dry deciduous forests (Chacko et al., 2002).

Description: A densely tufted deciduous, bamboo, with culms reaching 8 to 16 m high and 2.5 to 8 cm diameter (Seethalakshmi and Muktesh Kumar, 1998; Chacko et al., 2002) with strong thick walled or solid culms varying much in size according to locality (Bose et al., 1998).

Flowering season: November to April (Ravindra Sharma, 2003).

Fruiting season: April to June; April to May (Chacko et al., 2002).

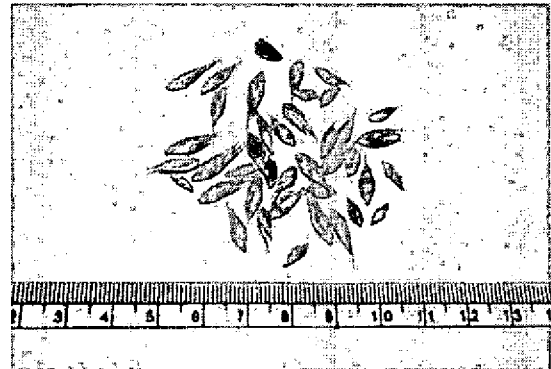
Flowers: Inflorescence is a large panicle of large dense globular heads, 4-5 cm apart; rachis rounded, smooth; spikelets

spinescent, usually hairy; the fertile intermixed with many sterile smaller ones, 7.5-12 mm, with 2-3 fertile flowers; empty glumes 2 or more, ovate, spinescent, many-nerved; flowering glumes ovate; stamens long exserted; filaments fine; anthers yellow, shortly apiculate; ovary turbinate, stalked (Bose et al., 1998).

Fruits: Fruit is a caryopsis and fusiform with obtuse or aristate rostrum at the apex covered with white pubescence (Chacko et al., 2002).

Fruit type: Caryopsis.

Seeds: Caryopsis is a brown, ovoid to sub-globose and fusiform (Chacko et al., 2002).



Seeds

Seed dimension:

Seed length: 7-7.3 mm (Seethalakshmi and Muktesh Kumar, 1998; Chacko et al., 2002).

Seed width: 2.98-3.33 mm (Seethalakshmi and Muktesh Kumar, 1998; Chacko et al., 2002).

Seed thickness:

Seed weight: 20,000 to 33,000/kg (Kindt et al., 1997; Chacko et al., 2002).

Seed dispersal:

Seed collection: Seeds are collected by sweeping the ground under the flowered clumps (Seethalakshmi and Muktesh Kumar, 1998). Seeds may also be collected by spreading a cloth or tarpaulin sheet below the flowered clumps (Chacko *et al.*, 2002).

Transportation of seeds: Seeds are collected in plastic bags or gunny bags and transported to the processing centre without delay (Chacko *et al.*, 2002).

Seed processing: Mature fruits and chaff are separated by winnowing and seeds are dried in shade for about 3 days (Seethalakshmi and Muktesh kumar, 1998; Chacko *et al.*, 2002).

Seed storage: Orthodox. The seeds should be dried before storage and stored in sealed tins. The seeds can be stored up to 3 years by keeping silica gel or up to 5 years with anhydrous calcium chloride in a desiccator or under cold storage in deep freezer at -18°C, reducing the moisture content to 8% (Chacko *et al.*, 2002).

Viability period: Seeds retain viability up to one year if stored in sealed tins (Chacko *et al.*, 2002).

Seed emptiness: No information (Chacko *et al.*, 2002).

Seed pre treatment: Cold water soaking for 24 to 48 hrs (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002). Soak in cold water for 2 to 3 hrs (Edwards and Naithani, 1999).

Germination type: Epigeal (Chacko *et al.*, 2002).

Germination percentage: 21 to 61 (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Germination period: 7 to 17 days (Seethalakshmi and Muktesh kumar, 1998; Chacko *et al.*, 2002).

Nursery technique: Seeds are sown directly in nursery beds during March to May in patches and covered with soil. Partial shade is necessary for initial establishment of the seedlings. Seedlings are pricked out when they attain 5 to 6 cm of height, potted in polythene bags of 22.5 x 17.5 cm size filled with a potting media containing 3 parts forest top soil one part sand and one part powdered farm yard manure. One-year-old polypotted seedlings are transplanted in the field (Chacko *et al.*, 2002).

Propagation:

Method of propagation: Direct sowing. Rooted culm cuttings and micropropagation (Troup, 1921).

Vegetative propagation:

Pests: A sap sucking insect *Udonga montana*(Dist.) Heteroptera: Pentatomidae attacks the inflorescence of *D.strictus*. Adult bugs and nymphs suck the sap from the seed and affects its developments. Stored seeds are affected by the grain moth *Sitotroga cerealella* oliv. (Lepidoptera:Gelachidae) (Chacko *et al.*, 2002).

Diseases: *Bipolaris* sp., *Fusarium* sp., *Exserohilum* sp., *Phomopsis* sp., are the important seed-borne fungi (Mohanan, 1997; Chacko *et al.*, 2002).

Medicinal properties: The clumps are used as tonic and astringent. The silicacious matter at the nodal joints of this bamboo is medicinal as a cooling, tonic and astringent (Ravindra Sharma, 2003).

Uses: The bamboos are strong, elastic and in use for all purposes, for building and mat work. It acts as soil binder and thus helps in checking the soil erosion. Wood is used for

paper, construction and agricultural implements (Troup, 1921).

Wood properties:

References:

Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa, India. pp. 166, 171.

Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 116-117.

Edwards, D.G. and Naithani, S.C. 1999. Seed and Nursery Technology of forest trees. New Age, New Delhi.

Kindt, R., Mausya, S., Kimotho, J. and Waruhiu. 1997. Tree seed suppliers Directory: Sources of Seeds and Microsymbionts. International Centre for Research in Agro Forestry (ICRAF), Nairobi, Kenya.

Mohanan, C. 1997. Diseases of Bamboo in Asia: An Illustrated Manual. International network for Bamboo and Rattan. Beijing, Eindhoven.

Ravindra Sharma. 2003. Medicinal plants of India. An encyclopaedia. Daya Publishing House, New Delhi.

Seethalakshmi, K.K. and Muktesh Kumar, M.S. 1998. Bamboos of India - a Compendium. Bamboo Information Centre - India, Kerala Forest Research Institute, Peechi and International Network for Bamboo and Rattan, Beijing, Eindhoven, New Delhi.

Troup, R. S. 1921. The Silviculture of Indian Trees. (Vol III) International Book Distributors, Dehra Dun.

Dillenia pentagyna

Nomenclature:

Scientific name: *Dillenia pentagyna* Roxb.

Vernacular name: Vazhapunna, Kodapunna, Pattipunna, Malampunna (Malayalam) (Sasidharan, 2004); Naytekku, Pinnai (Tamil) (Gamble, 1922); Aggai (Hindi) (Bose et al., 1998).

Common name: Naitheku, Toothed dillenia.

Synonyms: *Colberatia coromandeliana* DC.; *Dillenia floribunda* Hook.f. & Thoms.; *Dillenia pilosa* Roxb., *Dillenia angusta* (Troup, 1921).

Family: Dilleniaceae

Subfamily:

Origin: The tree is native of deciduous forests all over India.

Distribution: It is a very common tree in certain types of lower mixed deciduous forests on alluvial ground. It is also grown in China (Bose et al., 1998).

Description: A medium-sized to large evergreen tree, attaining a height up to 16 m, with a rounded crown (Bose et al., 1998).

Flowering season: March to April (Troup, 1921; Bose et al., 1998).

Fruiting season: May to June (Troup, 1921); June to August (Bose et al., 1998).

Flowers: Flowers numerous, fragrant, yellow, sweet scented, about 2.5 cm across, borne on the branches, sepals broadly

elliptic; petals 2 cm long; stamens numerous; carpels 5 (Bourdillon, 1908; Bose et al., 1998).

Fruits: Fruit is berry like, orange yellow in colour, succulent, edible, about 1.5-2 cm in diameter (Purkayastha, 1996).

Fruit type:

Seeds: Seeds about 0.5 x 0.25 cm, rounded or angular, dark brown, smooth shining, testa hard, but not difficult to break (Troup, 1921).

Seed dimension:

Seed length:

Seed width:

Seed thickness:

Seed weight: 37400-51200 seeds/kg (Troup, 1921).

Seed dispersal: Animals, Birds (Troup, 1921). Elephants (Vinod and Cheeran, 2000).

Seed collection:

Transportation of seeds:

Seed processing:

Seed storage:

Viability period:

Seed emptiness:

Seed pre treatment:

Germination type: Epigeal

Germination percentage:10 to 15.

Germination period:

Nursery technique:

Propagation:

Method of propagation:By seeds.

Vegetative propagation:

Pests:

Diseases:

Medicinal properties:

Uses: Bark contains tannin and yield a fibre used for cordage. The buds and fruits are eaten raw or cooked. The dry leaves are used for polishing ivory and horns. Fatty oil

from seeds has been found to contain medium chain fatty acids which are in great demand now (Mamta Negi et al., 2002). The leaves are sometimes used for plates. The wood is occasionally used only in construction, ship building and for rice mills and house posts (Gamble, 1922).

Wood properties: The wood is reddish grey, sapwood is yellowish brown. It is moderately hard and heavy wood and is used for house posts, rafters, planking and panelling. Annual rings are marked by a narrow belt in the outer edge without pores. Pores small and moderate sized, many of them filled with a white substance, which is visible both on the horizontal and vertical section, and is one of the characteristics of the wood (Gamble, 1922).

References:

Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 172.

Bourdillon, T.F. 1908. Forest trees of Travancore. International Book Distributors, Dehradun. pp. 1.

Gamble, J.S. 1922. A manual of Indian timbers. London Sampson Low, Marton and Company Ltd, Calcutta, India.

Mamta Negi, Ravindra Singh, and Jain, P.P. 2002. Studies on non-traditional oilseeds. MFP News. 12(3): 8-9.

Purkayastha, S.K. 1996. A manual of Indian timbers. Sri Bhumi Publishing Company, Calcutta.

Sasidharan, N. 2004. Forest Trees of Kerala. Kerala Forest Research Institute, Peechi, Kerala, India.

Troup, R. S. 1921. The Silviculture of Indian Trees. (Vol I) International Book Distributors, Dehra Dun.

Vinod, T.R. and Cheeran, J.V. 2000. Seed dispersal by Asian elephants (Elephas maximus L.) in Idukki Wildlife Sanctuary, Kerala, South India. Tigerpaper. 27(4): 30-32.

Diospyros ebenum

Nomenclature:

Scientific name: *Diospyros ebenum* J. Koenig

Vernacular name: Karimaram, Karingali (Malayalam), Abnus, Ebans (Hindi), Balemara, Karemara (Kannada), Karingali, (Chacko et al., 2002). Acha, Tumbi (Tamil).

Common name: Ebony persimmon (Chacko et al., 2002).

Synonyms: *D. sapota* Roxb. (Bose et al., 1998).

Family: Ebenaceae

Subfamily:

Origin:

Distribution: Occurs in the dry evergreen forests of the Deccan. In Kerala, it occurs in the dry deciduous forests (Purkayastha, 1996).

Description: Slow growing, small to moderate sized evergreen tree attaining a height of 15 m and a breast height diameter of 25 cm (FRI, 1985; Chacko et al., 2002).

Flowering season: February to April. In Sri Lanka, flowers about March, but the flowering season is irregular (Sahni, 2000).

Fruiting season: February to April, September to October (Sen Gupta, 1937; Chacko et al., 2002).

Flowers: Pale greenish yellow, 1 cm long before expansion, lobes 4 (Sahni, 2000). Male flowers: 3-12 together or less and very often 3, sessile or in shortly pedunculate cyme; calyx about 4 mm long, infundibuliform; corolla tubular, about 9 mm long; lobes ovate, greenish yellow;

stamens 16 or more, very unequal; female flower: solitary; calyx longer than male; lobes 4, ovate, acute; staminodes 8; ovary 8-celled (Bose et al., 1998).

Fruits: Fruit is a berry, sub-globose, greenish black (Chacko et al., 2002).

Fruit type: Berry.

Seeds: Seeds 4 to 6, brownish black, smooth and shiny (Chacko et al., 2002).

Seed dimension:

Seed length: 1 cm (Chacko et al., 2002).

Seed width:

Seed thickness:

Seed weight: 9,170 seeds/kg (Chacko et al., 2002).

Seed dispersal:

Seed collection: Fruits are collected from the tree by shaking the branches manually. Seeds can also be collected from the ground (Chacko et al., 2002).

Transportation of seeds: Fruits or seeds collected in the polythene bags are transported to the processing centre at the earliest (Chacko et al., 2002).

Seed processing: Fruits are de-pulped and the seeds are dried before storage (Chacko et al., 2002).

Seed storage: Dried seeds can be stored for two months (Chacko et al., 2002).

Viability period: 2 months (Chacko et al., 2002).

Seed emptiness: No information (Chacko et al., 2002).

Seed pre treatment: Cold water soaking for 24 hrs (Chacko et al., 2002).

Germination type: Epigeal (Chacko et al., 2002).

Germination percentage: Up to 81 (FRI, 1985; Chacko et al., 2002).

Germination period: 226 days (FRI, 1985; Chacko et al., 2002).

Nursery technique: The tree is rarely raised artificially (FRI, 1985). Fresh seeds are sown in germination trays and the seedlings are pricked out to polythene containers (Chacko et al., 2002).

Propagation:

Method of propagation:

Vegetative propagation:

Pests: No information (Chacko et al., 2002).

Diseases: No information (Chacko et al., 2002).

Medicinal properties:

Uses: Wood is commonly known as Royal timber of Travancore; used for carving, turnery for making walking sticks, cabinet work and also sports good (Purkayastha, 1996). The timber is valuable in the fancy wood market. It is mostly used for ornamental carving and turnery for making walking sticks and also veneers, sports goods, cabinetwork, keys of pianos, and musical and mathematical instruments. The fruit is edible (FRI, 1985; Chacko et al., 2002).

Wood properties: The wood is usually black or grey or greyish brown, rarely yellowish or red. It is a very hard and very heavy wood with straight to somewhat irregularly wavy grain and fine texture (Purkayastha, 1996).

References:

- Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 173.
- Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 118-119.
- FRI. 1985. Troup's The Silviculture of Indian Trees. Vol. VI. The Controller of Publications, Delhi.
- Purkayastha, S.K. 1996. A manual of Indian timbers. Sri Bhumi Publishing Company, Calcutta.
- Sahni, K.C. 2000. The Book of Indian Trees. BNHS, Mumbai.
- Sen Gupta, J.N. 1937. Seed weights, plant percents, etc. for forest plants in India. Indian Forest Records (New Series) Silviculture, 2:221 pp. Manager of Publications, Delhi.

Dysoxylum malabaricum

Nomenclature:

Scientific name: *Dysoxylum malabaricum* Bedd. ex Hiern

Vernacular name: Vella akil (Malayalam), Vellayagil (Tamil), Bilibudlige (Kannada) (Chacko et al., 2002).

Common name: Purple cone flower, White cedar (Gamble, 1922; Chacko et al., 2002).

Synonyms: *Dysoxylum glandulosum* Talbot (Chacko et al., 2002).

Family: Meliaceae

Subfamily:

Origin:

Distribution: Distributed in evergreen and semi-evergreen forests. In Kerala it occurs in Wayanad, Palghat, Ernakulam, Idukki, Pathanamthitta and Quilon districts; almost throughout the state, mainly in the highlands.

Description: Large trees, reaching 35 m tall and around 3 m girth (Bourdillon, 1908).

Flowering season: March to April (Bourdillon, 1908).

Fruiting season: June to July (Bourdillon, 1908). May to July (Chacko et al., 2002; Nair et al., 2002).

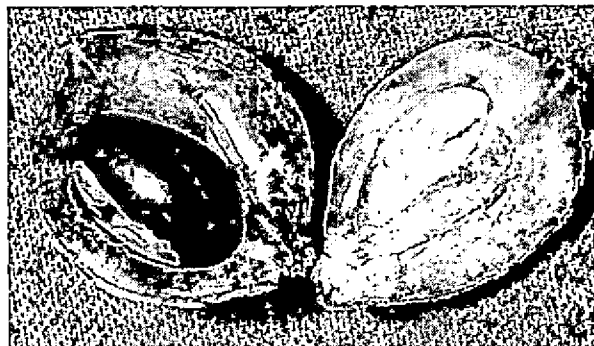
Flowers: Fragrant white to greenish yellow, distinctly stalked. Flowers numerous in axillary panicles about 27 cm long, very fragrant, greenish yellow, 0.6 cm across (Bourdillon 1908).

Fruits: Capsule, pear-shaped, greenish yellow, 5 to 7.5 cm long, and vertically

ridged (Chacko et al., 2002); 5-7 cm long, bright yellow when ripe.

Fruit type: Capsule.

Seeds: Seeds 3-4, sub-globose and brown coloured (Chacko et al., 2002) bluntly 3 angled, dark brown.



Fruit with seed

Seed dimension:

Seed length: 1.5 cm (Chacko et al., 2002).

Seed width: 1.2 cm (Chacko et al., 2002).

Seed thickness:

Seed weight: 121 seeds / kg with seed coat, 190 seeds/kg without seed coat at 58% moisture content (Chacko et al., 2002).

Seed dispersal: Wild animals.

Seed collection: Ripe fruits at a bright yellow colour (Nair et al., 2002). They can be collected from standing trees or from ground (Troup, 1921) before eaten by animals (Chacko et al., 2002).

Transportation of seeds: Fruits are collected in ventilated containers and transported to the processing centre (Chacko et al., 2002).

Seed processing: Mature fruits are stored under shade for two or three days where they dehisce open. Seeds can be separated by hand. If these fruits fail to dehisce open, they can be split open longitudinally using a sharp seed cutter (or knife) without injuring the seeds (Chacko et al.,2002).

Seed storage: Most probably recalcitrant. The seeds are liable to loss their viability if stored for long and should be sown as soon as possible after collection (Troup 1921). Seeds can be stored in wet gunny bags for 6 weeks (Dent, 1948; Chacko et al., 2002).

Viability period: No information (Chacko et al.,2002).

Seed emptiness: Low (Chacko et al.,2002).

Seed pre treatment: The seed coat may be peeled off by hand (Chacko et al.,2002).

Germination type: Epigeal (Chacko et al.,2002).

Germination percentage: 45; above 80% for fresh seeds (Chacko et al., 2002).

Germination period: 24 to 40 days (Chacko et al.,2002).

Nursery technique: Seeds germinated in vermiculite medium may be potted in large polythene containers of 40 x 18 cm one week after germination. The seedling attain a height of 15 cm at about 6 week after germination (Chacko et al.,2002).

Propagation:

Method of propagation:By seeds and vegetative method.

Vegetative propagation:

Pests: Heavy infestation by a tephritid fly *Daccus* sp. (Diptera) is noticed in the field. Stored seeds are also heavily infested by coleopteran and lepidopteran borers (Chacko et al., 2002).

Diseases: Heavy when stored. Storage fungi like *Trichoderma* sp. *Arpergillus* sp., and *Penicillium* sp., were recorded on seeds. *Alternaria* sp., *Fusarium* sp., *Curvularia* sp., *Verticillium* sp. were recorded as a seed-borne fungi. Seed treatment with Hexathir or Captan @ 4 g/kg of seeds reduce the seed rot (Chacko et al., 2002; Nair et al., 2002;).

Medicinal properties: The wood is used to cure rheumatism, wood oil is used to treat ear and eye diseases (Chacko et al., 2002).

Uses: A very lofty tree, wood sweet scented, used for oil casks. Wood is a valuable timber.

Wood properties: Sapwood is white, usually narrow. The heartwood which is not sharply demarcated from the sapwood, is white with yellowish cast or pale yellow, lustrous, with a faint cedary odour. It is a moderately hard and moderately heavy timber (Air dry weight about 720 kg/m³). Wood light red, hard, close-grained and elastic. Pores moderate sized, numerous, evenly distributed, sometimes in fine concentric white lines, sometimes alone. Medullary rays fine, numerous (Gamble, 1922).

References:

Bourdillon, T.F. 1908. Forest trees of Travancore. International Book Distributors, Dehradun. pp. 81-82.

Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 120-121.

Dent, T.V. 1948. Seed storage with particular reference to the storage of seed of Indian forest plants. Indian Forest Records (New Series) Silviculture, 7: 134 pp. Manager of Publications, Delhi.

Gamble, J.S. 1922. A manual of Indian timbers. London Sampson Low, Marton and Company Ltd, Calcutta, India.

Nair, K.K.N., Mohanan, C. and George Mathew, 2002. Plantation technology for nine selected indigenous tree species of Kerala State. KFRI Research Report No. 231. Kerala Forest Research Institute, Peechi, Kerala, India. pp. 110.

Troup, R.S. 1921. The Silviculture of Indian Trees. Vol. I. Clarendon Press, Oxford.

Elaeocarpus serratus

Nomenclature:

Scientific name: *Elaeocarpus serratus* Linn.

Vernacular name: Kaaramavu, Kara, Bhadraksham, Valiya kaara (Malayalam), Ulang karei, Utraccham (Tamil) (Gamble, 1922).

Common name: The wild olive tree.

Synonyms: *E. cuneatus* Wt.

Family: Elaeocarpaceae

Subfamily:

Origin:

Distribution: Eastern Himalayas (up to 900 m) and in the evergreen forests of the Western Ghats, Sri Lanka and Malaysia.

Description: A medium sized to a fairly large tree.

Flowering season: January to March and again July to September (Bourdillon, 1908); November to December (Bose et al., 1998).

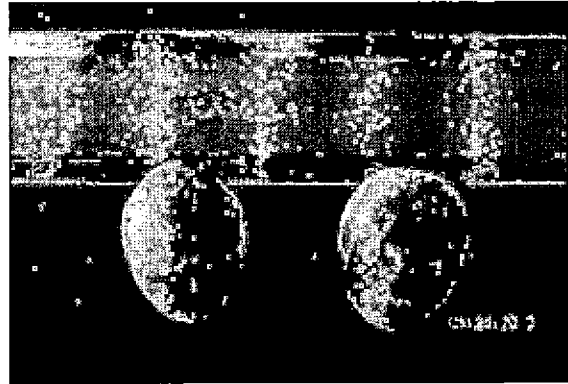
Fruiting season: February to April.

Flowers: Flowers white, racemes always axillary, sepals 0.6 cm, stamens 25 to 30, filaments much shorter than glands, the longer anther valve ciliate; sepals about 6 mm long; petals 3-fid to the middle, segments lacinate; disc of 5 distinct tomentose glands (Bose et al., 1998).

Fruits: Drupe ovoid, more or less acuminate at both ends, stone strongly tubercled in a copious pulp.

Fruit type: Drupe.

Seeds: 1 seeded.



Seeds

Seed dimension:

Seed length:

Seed width:

Seed thickness:

Seed weight:

Seed dispersal:

Seed collection:

Transportation of seeds:

Seed processing:

Seed storage:

Viability period:

Seed emptiness:

Seed pre treatment:

Germination type:

Germination percentage:

Germination period:

Nursery technique:

Propagation:

Method of propagation:

Vegetative propagation:

Pests:

Diseases:

Medicinal properties: Paste of leaves applied to cure ulcers. The fruits are used in dysentery and diarrhoea (Bose et al., 1998).

Uses: The acetone extract shows antibacterial activity against organisms like

Salmonella typhimurium and *Morganella morganii* (Singh and Gopal Nath, 1999). Shows allelopathic activity on lettuce (Fujii et al., 2003). The fruit is known as " wild olives " and eaten. Fleshy outer portion of fruit is edible. Wood is used for small packing cases, match boxes and splints. The fleshy portion of the drupe surrounding the stone is subacid and edible, eaten in curries and pickled (Bose et al., 1998).

Wood properties: Wood greyish white, soft, annual rings prominent, marked by darker wood. Pores large, often subdivided, scanty, prominent on a radial section. Medullary rays very numerous, fine to moderately broad (Gamble, 1922)

References:

Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 189.

Bourdillon, T.F. 1908. Forest trees of Travancore. International Book Distributors, Dehradun. pp. 58-59.

Fujii, Y., Parvez, S.S., Parvez, M.M., Ohmae, Y. and Iida, O. 2003. Screening of 239 medicinal plant species for allelopathic activity using the sandwich method. *Weed Biology and Management*. 3(4): 233-241.

Gamble, J.S. 1922. A manual of Indian timbers. London Sampson Low, Marton and Company Ltd, Calcutta, India.

Singh, R.K. and Gopal Nath. 1999. Antimicrobial activity of *Elaeocarpus sphaericus*. *Phytotherapy Research*. 13(5): 448-450.

Erythrina indica

Nomenclature:

Scientific name: *Erythrina indica* Lam.

Vernacular name: Mullumurikku, Kalyana murrikku (Malayalam), Pangra (Hindi & Marathi).

Common name: Indian Coral tree, Mullumurikku (Sasidharan, 2004).

Synonyms: *E.variegata* Linn., *E. corallodendron*, *E. cuneata* Grah.

Family: Leguminosae

Subfamily: Faboideae

Origin: India (East coast) (Sasidharan, 2004).

Distribution: Indigenous to the coast forests in the W. ghats, Sunderbans and Andamans. The tree is native of India and Malaysia but it is grown in many tropical countries of the world, more frequently in Africa and Asia.

Description: A moderate sized tree of rapid growth with small black prickles.

Flowering season: April to May.

Fruiting season: Ripen about June; June - August (Vanangamudi *et al.*, 2006).

Flowers: Flowers are pea shaped, red in colour, borne in dense racemes, and arranged in clusters of 1-3 on a tomentose rachis.

Fruits: Pods torulose, 15 to 30 cm long, stalked, green at first but turned to deep brown.

Fruit type: Pod.

Seeds: Seeds 1 to 18, brown, oblong and smooth. Medium and large seeds with light purple coat colour produce healthy seedlings

with well-developed shoot:root system (Krishna *et al.*, 2005; Bal Krishan and Singh, 1995).

Seed dimension:

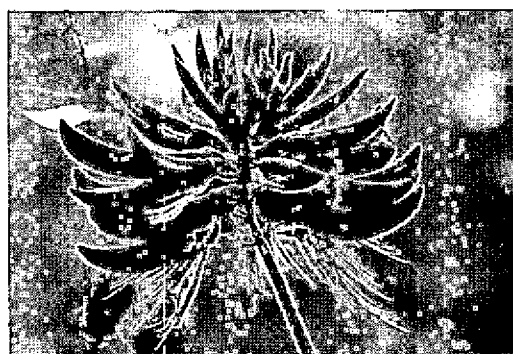
Seed length:

Seed width:

Seed thickness:

Seed weight: 1,500-2,200 seeds/kg.

Seed dispersal: By birds.



Inflorescence



Seeds

Seed collection: Ripe pods are collected from the trees during August to September and seeds are extracted, cleaned, graded and stored (Vanangamudi *et al.*, 2006). The seeds are obtained from the ripe fruits collected from the ground under the mother tree, during the month of June.

Transportation of seeds:**Seed processing:****Seed storage:**

Viability period: 2 years (Vanangamudi *et al.*, 2006).

Seed emptiness:

Seed pre treatment: 2 min immersion in water at 80°C is suitable for seed germination in *Erythrina indica* (Toral and Gonzalez, 1999).

Germination type: Epigeal.

Germination percentage: 60 to 80

Germination period: 1-2 year (Vanangamudi *et al.*, 2006).

Nursery technique: Pre treated seeds are sown in mother beds. Germinated seeds are pricked out in polybags after 4-leaf stage (Vanangamudi *et al.*, 2006).

Propagation:

Method of propagation: Stem cutting and by seeds. The natural regeneration of this tree is satisfactory. The seeds fall to the ground and germinate at the commencement of the rains.

References:

- Bal Krishan and Singh, V. 1995. Effects of seed size and colour on germination and seedling growth in five tree species. *Advances in Horticulture and Forestry*. 4: 199-204.
- Krishna, A., Ganiger, B.S. and Ramesh Rathod. 2005. Effect of seed weight and seed coat colour on germination and vigour of forest tree *Erythrina indica* (Lam). *Karnataka Journal of Agricultural Sciences*. 18(1): 208-209.
- Nkengfack, A.E., Azebaze, A.G.B., Waffo, A.K., Fomum, Z.T., Meyer, M. and Heerden, F.R van. 2001. Cytotoxic isoflavones from *Erythrina indica*. *Phytochemistry*. 58(7): 1113-1120.

Vegetative propagation:**Pests:****Diseases:**

Medicinal properties: Coral tree is used for some pharmaceutical preparations. The leaves have diuretic and laxative properties. Crushed leaves are used as an antidote for snake bite.

Uses: The bark yields a fibre used for cordage. The leaves and tender shoots are eaten as pot herbs and are also used as fodder. The trees are used as hedge plants as wind break in horticulture gardens. Bark of *Erythrina indica* contains six isoflavones (genistein, wighteone, alpinumisoflavone, dimethylalpinumisoflavone, 8-prenyl erythrinin C and crysenegalensein E), one cinnamate (erythrinassinate B), two pentacyclic triterpenes (oleanolic acid and erythrodiol), and two phytosterols (stigmasterol and its 3-O- beta -D-glucopyranoside) (Nkengfack *et al.*, 2001). Seeds of *Erythrina indica* contains a novel prenylated flavone glycoside (Yadava and Reddy, 1999).

Wood properties: The wood is white, light, spongy, fibrous and soft. It is fairly tough and coarse textured. Air dry weight about 370 kg/m³.

Sasidharan, N. 2004. Forest Trees of Kerala. Kerala Forest Research Institute, Peechi, Kerala, India.

Toral, O. and Gonzalez, Y. 1999. Effect of hot water upon seed germination of ten tree species. *Pastos y Forrajes*. 22(2): 111-114.

Vanangamudi, K., Natarajan, K., Saravanan, T., Natarajan, N., Umarani, R., Bharathi, A. and Srimathi, P. 2006. *Advances in Seed Science and Technology*, Vol. 3 : Forest Tree Seed Technology and Management. Agrobios, India.

Yadava, R.N. and Reddy, K.I.S. 1999. A novel prenylated flavone glycoside from the seeds of Erythrina indica [E. variegata]. *Fitoterapia*. 70(4): 357-360.

Eucalyptus camaldulensis

Nomenclature:

Scientific name: *Eucalyptus camaldulensis* Dehnh.

Vernacular name: Eucaly (Malayalam) (Chacko *et al.*, 2002).

Common name: River red gum (Chacko *et al.*, 2002).

Synonyms: *Eucalyptus rostrata* Schlecht; *E. longirostris* F. Muell. ex Miq. (Chacko *et al.*, 2002).

Family: Myrtaceae

Subfamily:

Origin: Australia.

Distribution: Native of Australia and is widely planted in many parts of India (Luna, 1996). In Kerala, it is raised in plantations on a small scale (Chacko *et al.*, 2002).

Description: Fast growing, tall evergreen tree attaining a height of 50 m and a breast height diameter up to 200 cm (Chacko *et al.*, 2002).

Flowering season: June to July.

Fruiting season: December to January; November to January (Chacko *et al.*, 2002).

Flowers: Flowers are white, globose, heads 1 cm in diameter, solitary or in small bunches.

Fruits: Fruit is a loculicidal capsule. Fruit pedicellate, 6 to 8 mm x 4 to 6 mm, hemispherical to globular, valves incurved, usually 4, exerted, disc wide and convex (Luna, 1996; Chacko *et al.*, 2002).

Fruit type: Capsule.

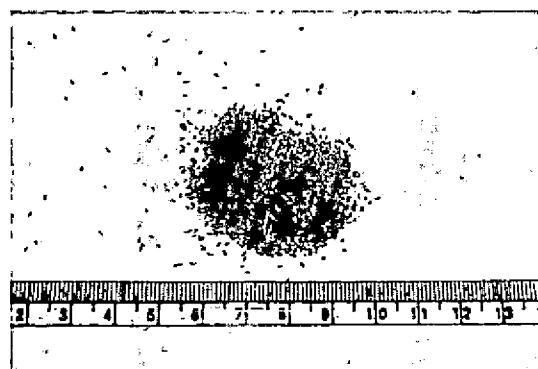
Seeds: Seeds small, many, angulars.

Seed dimension:

Seed length: No information (Chacko *et al.*, 2002).

Seed width:

Seed thickness:



Seeds

Seed weight: 2,60,000 to 4,00,000 seeds/kg (Kindt *et al.*, 1997; Chacko *et al.*, 2002).

Seed dispersal:

Seed collection: The twigs bearing capsules. The capsules are lopped off and the capsules are collected on a tarpaulin (FRI, 1984; Kumar and Bhanja, 1992; Chacko *et al.*, 2002).

Transportation of seeds: The capsules with branches are transported in cloth bags (Chacko *et al.*, 2002).

Seed processing: Capsules are dried in shade for a day or two. Seeds are separated from the capsules by shaking the dehised capsules, dried and stored in a cool dry place (FRI, 1984; Chacko *et al.*, 2002).

Seed storage: Orthodox (Kindt *et al.*, 1997; CABI, 1998). Seeds are viable for 2 to 3 years if kept in airtight containers stored in a

cool dry place (Dutta, 1986; Chacko *et al.*, 2002).

Viability period: Seeds are viable for 2 to 3 years (Chacko *et al.*, 2002).

Seed emptiness: Low (Chacko *et al.*, 2002).

Seed pre treatment: Soaking the seeds in hot water for a minute followed by soaking in cold water for 24 hrs (Kindt *et al.*, 1997; Chacko *et al.*, 2002). 100 ppm GA₃ treatment positively influence both germination and seedling vigour indices (Bhattacharya *et al.*, 1991).

Germination type: Epigeal (Chacko *et al.*, 2002).

Germination percentage: 55 to 90 (Carlowitz, 1991; Chacko *et al.*, 2002).

Germination period: 7 to 20 days (Chacko *et al.*, 2002).

Nursery technique: Seeds are sown in germination trays containing perlite medium, or on 12 mm thick polyurethane foam sheets maintained moist in an aluminium tray of 35 x 45 cm (Chacko and

Muhammad, 1986). Germination takes place within 5 to 15 days. When the seedlings attain 5 cm of height, they are pricked out into polybags of 20 x 10 cm size filled with potting mixture (Chacko *et al.*, 2002).

Propagation:

Method of propagation: Seedlings.

Vegetative propagation:

Pests: Nil (Chacko *et al.*, 2002).

Diseases: Low. *Fusarium semitectum* was the important seed pathogen (Mohan and Sharma, 1991; Chacko *et al.*, 2002).

Medicinal properties: The gum is occasionally used in diarrhoea, relaxed throats and astringent in dentistry, cuts etc.

Uses: The plant is valued as bee posturage. The leaves contain volatile oil. Wood is used for fuel, charcoal, posts, poles, hardboard, saw-timber and pulp (Chacko *et al.*, 2002).

Wood properties: Wood is hard and strong. Heartwood a dark reddish brown and sapwood is pale greyish brown.

References:

- Bhattacharya, A.K., Lahiri, A.K. and Basu, R.N. 1991. Improvement of germinability of Eucalyptus species by pregermination treatments. *Indian Forester*. 117(8): 661-663.
- CABI. 1998. The Forestry Compendium – A Silvicultural Reference. Module 1. CABI Publishing, CAB International, Wallingford, Oxon, OX108DE, UK.
- Carlowitz, P.G.V. 1991. Multipurpose Trees and Shrubs: Source of seeds and Inoculants. International council for research in Agroforestry, Nairobi, Kenya.
- Chacko, K.C. and Muhammad, E. 1986. Polyurethane foam nursery technique for raising healthy seedlings of Eucalyptus. In: J.K. Sharma, C.T.S. Nair, S. Kedarnath and S. Kondas(eds.) Eucalyptus in India: Past, Present and Future. Proceedings of the National Seminar on

Eucalyptus in Indian Forestry-Past, Present and Future, Kerala Forest Research Institute, Peechi, Kerala, India, January 30-31, 1984. pp. 177-180.

Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 122-123.

Dutta, J.J. 1986. Eucalyptus in Madhya Pradesh. In: J.K. Sharma, C.T.S. Nair, S. Kedarnath and S. Kondas(eds.) Eucalyptus in India: Past, Present and Future. Proceedings of the National Seminar on Eucalyptus in Indian Forestry-Past, Present and Future, Kerala Forest Research Institute, Peechi, Kerala, India, January 30-31, 1984. pp. 77-93.

FRI. 1984. Troup's The Silviculture of Indian Trees. Vol. V. The Controller of Publications, Delhi.

Kindt, R., Mausya, S., Kimotho, J. and Waruhiu. 1997. Tree seed suppliers Directory: Sources of Seeds and Microsymbionts. International Centre for Research in Agro Forestry (ICRAF), Nairobi, Kenya.

Kumar, S.V. and Bhanja, M. 1992. Forestry Seed Manual of Andhra Pradesh. Andhra Pradesh Forest Department, Hyderabad, India.

Luna, R.K. 1996. Plantation Trees. International Book Distributors, Dehra Dun, India.

Mohanan, C. and Sharma, J.K. 1991. Seed pathology of forest tree species in India - Present status, practical problems and future prospects. Commonwealth Forestry Review, 70: 113-151.

Eucalyptus globulus

Nomenclature:

Scientific name: *Eucalyptus globulus* Labill.

Vernacular name: Karpura maraum (Bose *et al.*, 1998); Eucaly (Malayalam), Thailamaram (Tamil) (Chacko *et al.*, 2002); Mattu kankuli (Tamil) (Bose *et al.*, 1998).

Common name: Blue gum, Tasmanian blue gum (Chacko *et al.*, 2002); Southern Blue gum.

Synonyms:

Family: Myrtaceae

Subfamily:

Origin: Native of Australia.

Distribution: Native of Australia and planted in the tropical and subtropical regions of Asia, Africa and America. In India, it has been extensively planted in Nilgiris, Anamalais and Palni hills (Luna, 1996; Chacko *et al.*, 2002). Indigenous in Tasmania, Victoria and New South Wales, extensively planted in subtropical regions throughout the world; in India grown in the hills above 1000 m (First introduction in India in 1843) (Bose *et al.*, 1998).

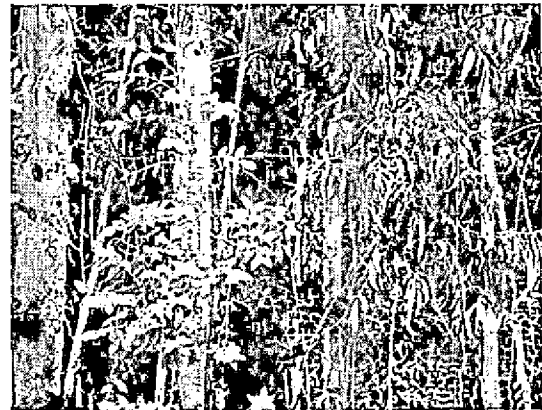
Description: Fast growing, large evergreen tree of 75 m height and a breast height diameter of 56 cm (Chacko *et al.*, 2002).

Flowering season: February to March; August to January (Bose *et al.*, 1998).

Fruiting season: Ripens from March to April collected in May; December to April (Bose *et al.*, 1998).

Flowers: Umbel, flowers are bluish white in colour, either solitary or 2 or 3 in number.

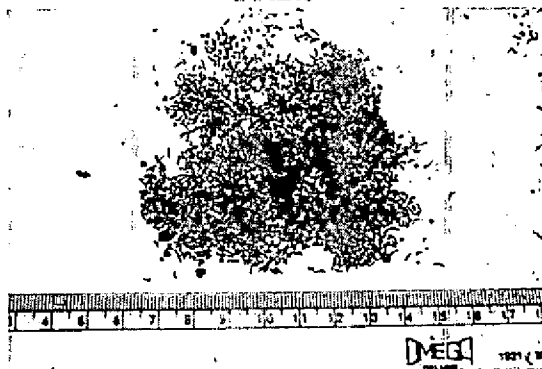
Flowers large, axillary, solitary, rarely 2-3-flowered, on a rudimentary peduncle over 4 cm across; operculum flattened, hemispherical, thick and warty, much shorter than the broadly conical, angled calyx tube (Bose *et al.*, 1998).



Habit



Fruits



Seeds

Fruits: Capsule, disc large, convex, rather thick, moderately smooth and flat. Fruits

globular to conical, 4-ribbed, 2-2.5 cm in diameter, warty, valves 3-5 (Bose *et al.*, 1998).

Fruit type: Capsule.

Seeds: Seeds very small, compressed, sterile seeds much narrower than fertile seeds (Bose *et al.*, 1998).

Seed dimension:

Seed length: No information (Chacko *et al.*, 2002).

Seed width:

Seed thickness:

Seed weight: 1,80,000 seeds/kg (Kindt *et al.*, 1997; Chacko *et al.*, 2002).

Seed dispersal:

Seed collection: The twigs bearing capsules are lopped off the trees and collected on tarpaulin sheet (Chacko *et al.*, 2002).

Transportation of seeds: The capsules are separated from the twigs and transported in gunny bags (Chacko *et al.*, 2002).

Seed processing: Capsules are dried in shade for a day or two in cloth bags. Seeds released from the capsules are winnowed to remove chaff. The seeds are dried well before storage (Chacko *et al.*, 2002).

Seed storage: Orthodox (Kindt *et al.*, 1997, CABI, 1998). Fresh seeds give high germination percentage, those kept for two years gave very poor germination percentage (Luna, 1996; Chacko *et al.*, 2002).

Viability period: Seeds are viable for about one year in sealed tins (Chacko *et al.*, 2002).

Seed emptiness: No information (Chacko *et al.*, 2002).

Seed pre treatment: Not required (Carlowitz, 1991; Chacko *et al.*, 2002).

Germination type: Epigeal (Chacko *et al.*, 2002).

Germination percentage: 30 to 80 (Luna, 1996; Chacko *et al.*, 2002).

Germination period: 10 to 30 days (Luna 1996; Chacko *et al.*, 2002).

Nursery technique: Seeds are sown in germination trays containing perlite medium or on 12 mm thick polyurethane foam sheets (Chacko and Muhammad, 1986), placed in trays. Germination takes place within 5 to 15 days. The seedlings are pricked out into polythene bags of 20x10 cm size filled with potting mixture within three weeks after germination (Chacko *et al.*, 2002).

Propagation:

Method of propagation: By seeds or cuttings.

Vegetative propagation:

Pests: Nil (Chacko *et al.*, 2002).

Diseases: Moderate. Eleven fungi and a bacterium are recorded on seeds. *Aspergillus* sp., *Cephalosporium* sp., *Curvularia* sp., *Paecilomyces* were the important storage moulds (Sharma and mohan, 1980; Chacko *et al.*, 2002). Leaf spot caused by *Phaeoseptoria eucalypti* (Sharma *et al.*, 1990). 'Pink disease' (of cambium), caused by *Corticium salmonicolor* (Seth *et al.*, 1978).

Medicinal properties: The oils of *E. globulus* are potential sources of 1,8-cineole [eucalyptol] (Dethier *et al.*, 1994). The oil extracted from the leaves is used in pharmaceutical preparations, flavouring of cough lozenges, vaporisers, toothpastes, soaps, repellents against mosquitoes,

germicides etc. Essential oil derived from the leaves is antiseptic, expectorant, febrifuge, diaphoretic and largely used in the diseases of the respiratory tract (Bose *et al.*, 1998).

Uses: Wood is used for fuel and pulp wood, and it is also suitable for ship building,

agricultural implements, wood pulps (Bose *et al.*, 1998).

Wood properties: The wood is brown, hard, tough and durable. The sapwood is grey which gradually merges into light brown heartwood. The wood varies greatly in hardness and weight depending upon the age of the tree.

References:

- Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 200-201.
- CABI. 1998. The Forestry Compendium – A Silvicultural Reference. Module 1. CABI Publishing, CAB International, Wallingford, Oxon, OX108DE, UK.
- Carlowitz, P.G.V. 1991. Multipurpose Trees and Shrubs: Source of seeds and Inoculants. International council for research in Agroforestry, Nairobi, Kenya.
- Chacko, K.C. and Muhammad, E. 1986. Polyurethane foam nursery technique for raising healthy seedlings of Eucalyptus. In: J.K. Sharma, C.T.S. Nair, S. Kedarnath and S. Kondas(eds.) Eucalyptus in India: Past, Present and Future. Proceedings of the National Seminar on Eucalyptus in Indian Forestry-Past, Present and Future, Kerala Forest Research Institute, Peechi, Kerala, India, January 30-31, 1984. pp. 177-180.
- Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 124-125.
- Dethier, M., Nduwimana, A., Cordier, Y., Menut, C. and Lamaty, G. 1994. Aromatic plants of tropical central Africa. XVI. Studies on essential oils of five Eucalyptus species grown in Burundi. Journal of Essential Oil Research. 6(5): 469-473.
- Kindt, R., Mausya, S., Kimotho, J. and Waruhiu. 1997. Tree seed suppliers Directory: Sources of Seeds and Microsymbionts. International Centre for Research in Agro Forestry (ICRAF), Nairobi, Kenya.
- Luna, R.K. 1996. Plantation Trees. International Book Distributors, Dehra Dun, India.
- Seth, S.K., Bakshi, B.K., Reddy, M.A.R. and Sujjan Singh. 1978. Pink disease of Eucalyptus in India. European Journal of Forest Pathology. 8: 200-216.
- Sharma, J.K. and Mohanan, C. 1980. Spermoplane microflora of stored seeds of *Tectona grandis*, *Bombax ceiba*, and Eucalyptus spp. in relation to germinability. In: B.S.P. Wang and

J.A. Pitel(eds.). Proceedings of International Symposium on Forest Tree Seed Storage. CanadianForest Service. pp. 107-125.

Sharma, J.K., Mohanan, C. and Florence, E.J.M. 1990. Diseases of forest trees in Kerala. 6. Leaf diseases of eucalypts in plantations. Evergreen Trichur. (25): 12-15.

Eucalyptus grandis

Nomenclature:

Scientific name: *Eucalyptus grandis* W. Hill ex Maid.

Vernacular name: Grandis (Malayalam), Thayila maram (Tamil) (Chacko *et al.*, 2002).

Common name: Red gum, Flooded gum (Chacko *et al.*, 2002); Rose gum (Bose *et al.*, 1998).

Synonyms:

Family: Myrtaceae

Subfamily:

Origin: Native of New South Wales and Queensland, Australia (Chacko *et al.*, 2002).

Distribution: Native of Australia, Queensland and extensively in South Africa, Zambia, Sri Lanka and India.

Description: Fast growing, tall ornamental evergreen tree of 65 m high (Chacko *et al.*, 2002).

Flowering season: Duringsummer.

Fruiting season: December to February (Chacko *et al.*, 2002).

Flowers: Inflorescence is a 7-11 flowered umbel, peduncle flattened, to 2 cm long, pedicels angular. Flower buds ovoid or broadly fusiform; operculum conical or rostrate, 3-4 mm long, 4-5 mm wide; hypanthium obconical or campanulate (Bose *et al.*, 1998).

Fruits: Fruit is a capsule, pear shaped with very gradual taper. Fruits subpyriform, to 1 cm long and 0.5 cm broad; disc narrow; valves 4-5, exserted, incurved (Bose *et al.*, 1998).

Fruit type: Capsule.

Seeds:

Seed dimension:

Seed length: No information (Chacko *et al.*, 2002).

Seed width:

Seed thickness:



Habit



Fruits

Seed weight: 2,00,000 to 2,50,000 seeds/kg (Kindt *et al.*, 1997; Chacko *et al.*, 2002).

Seed dispersal:

Seed collection: The twigs bearing capsules are lopped off the trees and collected on a tarpaulin sheet (Chacko *et al.*, 2002).

Transportation of seeds: The capsules are separated from the twigs and transported in gunny bags (Chacko *et al.*, 2002).

Seed processing: Capsules are dried in shade for a day or two in cloth bags. Seeds released from the capsules are winnowed to remove chaff. The seeds are dried well before storage (Chacko *et al.*, 2002).

Seed storage: Orthodox (Kindt *et al.*, 1997; CABI, 1998). Air dried seeds stored in air tight container retains viability to a fair extent for one to two years (Chacko *et al.*, 2002).

Viability period: Seeds are viable for about 2 years in sealed tins (Chacko *et al.*, 2002).

Seed emptiness: No information (Chacko *et al.*, 2002).

Seed pre treatment: Not required (Carlowitz, 1991; Chacko *et al.*, 2002). Hot water treatments (50°C), surface treatments (10% sodium hypochlorite or 33.3% hydrogen peroxide) and fungicidal application (captan) (Donald and Lundquist, 1988). Covering seeds with rice husks and dried grasses increase germination percentage (Pereira *et al.*, 1981).

Germination type: Epigeal (Chacko *et al.*, 2002).

Germination percentage: 35 to 65 (Carlowitz, 1991; Chacko *et al.*, 2002).

Germination period: 3 to 8 days (Chacko *et al.*, 2002).

Nursery technique: Seeds are sown in germination trays containing perlite medium

or on 12 mm thick polyurethane foam sheets (Chacko and Muhammad, 1986), placed in trays. Germination takes place within 5 to 15 days. The seedlings are pricked out into polythene bags of 20 x 10 cm size filled with potting mixture within three weeks after germination. Seedlings can be raised in root trainers and other types of containers by direct sowing also (Chacko *et al.*, 2002).

Propagation:

Method of propagation:

Vegetative propagation:

Pests: Nil (Chacko *et al.*, 2002).

Diseases: Low (Sharma and Mohanan, 1980; Chacko *et al.*, 2002). Pink disease caused by *Corticium salmonicolor*; stem canker caused by *Cytospora eucalypticola* and *C. eucalypti* (Sharma *et al.*, 1990) and *Cryphonectria* canker disease. Outbreaks are localised up to 30% of the trees in a stand. Infection usually occurs on the main stem 1-1.5 m above ground and occasionally near ground level (Sharma *et al.*, 1985). Web blight is caused by *Rhizoctonia solani*, damping-off by *Pythium myriotylum* and *P. deliense*, seedling blight by *Cylindrocladium camelliae*, leaf and shoot blights by *C. clavatum* and seedling wilt and root rot by *Sclerotium rolfsii* (Sharma *et al.*, 1984; Mohanan and Sharma, 1985).

Medicinal properties:

Uses: An important timber tree, the wood being resistant to borers, used for boat building, flooring, plywood, panelling and construction works (Bose *et al.*, 1998). Wood is used as a raw material for manufacturing writing, printing, wrapping papers and newsprint. The poles can be used as fencing posts, in construction work, for transmission in electric and telephone lines etc. (FRI, 1984; Chacko *et al.*, 2002).

Wood properties: The wood is very similar to *E. globulus* in colour and weight and is indistinguishable from it in anatomical characteristics and properties.

References:

- Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 201.
- CABI. 1998. The Forestry Compendium – A Silvicultural Reference. Module 1. CABI Publishing, CAB International, Wallingford, Oxon, OX108DE, UK.
- Carlowitz, P.G.V. 1991. Multipurpose Trees and Shrubs: Source of seeds and Inoculants. International council for research in Agroforestry, Nairobi, Kenya.
- Chacko, K.C. and Muhammad, E. 1986. Polyurethane foam nursery technique for raising healthy seedlings of Eucalyptus. In: J.K. Sharma, C.T.S. Nair, S. Kedarnath and S. Kondas(eds.) Eucalyptus in India: Past, Present and Future. Proceedings of the National Seminar on Eucalyptus in Indian Forestry-Past, Present and Future, Kerala Forest Research Institute, Peechi, Kerala, India, January 30-31, 1984. pp. 177-180.
- Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 126-127.
- Donald, D.G.M. and Lundquist, J.E. 1988. Treatment of Eucalyptus seed to maximise germination. South African Forestry Journal. (147): 9-15.
- FRI. 1984. Troup's The Silviculture of Indian Trees. Vol. V. The Controller of Publications, Delhi.
- Kindt, R., Mausya, S., Kimotho, J. and Waruhiu. 1997. Tree seed suppliers Directory: Sources of Seeds and Microsymbionts. International Centre for Research in Agro Forestry (ICRAF), Nairobi, Kenya.
- Mohanan, C. and Sharma, J.K. 1985. *Cylindrocladium* causing seedling diseases of Eucalyptus. Transactions of the British Mycological Society. 84: 538-539.
- Pereira, A.R., Oliveira, A.C de. and Morais, E.J de. 1981. Studies of types of cover in the production of Eucalyptus grandis seedlings. Floresta. 12: 49-52.
- Sharma, J.K. and Mohanan, C. 1980. Spermoplane microflora of stored seeds of *Tectona grandis*, *Bombax ceiba*, and Eucalyptus spp. in relation to germinability. In: B.S.P. Wang and J.A. Pitel(eds.). Proceedings of International Symposium on Forest Tree Seed Storage. Canadian Forest Service. pp. 107-125.

Sharma, J.K., Mohanan, C. and Florence, E.J.M. 1984. Nursery diseases of Eucalyptus in Kerala. *European Journal of Forest Pathology*. 14: 77-89.

Sharma, J.K., Mohanan, C. and Florence, E.J.M. 1985. Occurrence of *Cryphonectria* canker disease of Eucalyptus in Kerala, India. *Annals of Applied Biology*. 106: 265-276.

Sharma, J.K., Mohanan, C. and Florence, E.J.M. 1990. Diseases of forest trees in Kerala. 5. Diseases of eucalypts in plantations. *Evergreen Trichur*. (24): 8-10.

Eucalyptus tereticornis

Nomenclature:

Scientific name: *Eucalyptus tereticornis* Sm.

Vernacular name: Hybrid (Malayalam), Thayila maram (Tamil), Safeda (Hindi) (Chacko *et al.*, 2002).

Common name: Mysore gums (Trade name), Grey gum, Forest red gum (Chacko *et al.*, 2002); Bastard box, Flooded gum (Bose *et al.*, 1998).

Synonyms: *Eucalyptus umbellata* auct. non (Gaertn.) Domin, *Eucalyptus subulata* A. Cunn. ex Schauer (Chacko *et al.*, 2002).

Family: Myrtaceae

Subfamily:

Origin: Native of Australia.

Distribution: Exotic from Australia, hybridised and naturalized in Karnataka. Indigenous in South Australia and New Guinea; cultivated in many parts of the world, including India in Meghalaya, Uttar Pradesh and in the Nilgiris and Palnis in South India (Bose *et al.*, 1998). In Kerala, it has been planted extensively in the low altitude places (Nair, 1986; Chacko *et al.*, 2002).

Description: A robust tree up to 40 m high, with open crown; branchlets apically angular (Bose *et al.*, 1998). Fast growing, tall, evergreen tree reaching a height of 50 m and a breast height diameter of 200 cm (Chacko *et al.*, 2002).

Flowering season: One month before fruiting, April to May (Bose *et al.*, 1998).

Fruiting season: In autumn - October to November; Summer - May to June.

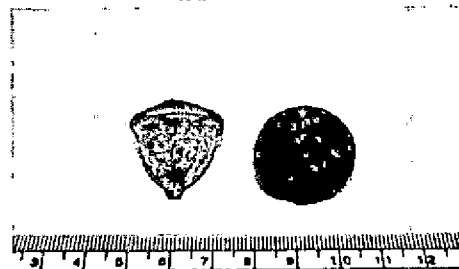
February to March or October to November (Luna 1996 ; Chacko *et al.*, 2002).



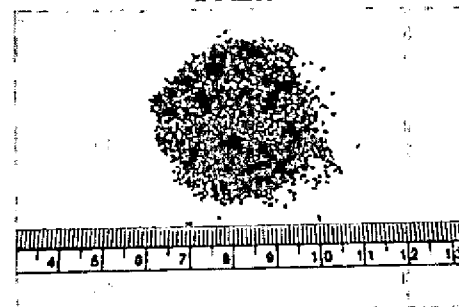
Habit



Flowers



Fruits



Seeds

Flowers: Flowers axillary, ovoid or conical in buds, 1-1.5 cm long, white, in 4-9-flowered umbels; operculum twice as long as calyx tube, conical, horn-shaped, acute apex (Bose *et al.*, 1998).

Fruits: Fruit is a capsule, hemispherical, on a short and thick pedicel, nearly globose, 6-8 cm in diameter, truncate above; disc ascending; valves 4 or 5, exserted (Bose *et al.*, 1998).

Fruit type: Capsule.

Seeds: Capsule, disc wide and convex.

Seed dimension:

Seed length:

Seed width:

Seed thickness:

Seed weight: 3,67,400 (Luna, 1996) to 8,00,000 seeds/kg (Kindt *et al.*, 1997; Chacko *et al.*, 2002).

Seed dispersal:

Seed collection: The twigs bearing capsules are lopped off the trees and collected on a tarpaulin sheet (Chacko *et al.*, 2002).

Transportation of seeds: The capsules are separated from the twigs and transported in gunny bags (Chacko *et al.*, 2002).

Seed processing: Capsules are dried in shade for a day or two in cloth bags. Seeds released from the capsules are winnowed to remove chaff. The seeds are dried well before storage (Chacko *et al.*, 2002).

Seed storage: Orthodox (Kindt *et al.*, 1997; CABI, 1998). Air-dried seeds stored in airtight container retain viability up to two years (Kumar and Bhanja, 1992; Chacko *et al.*, 2002).

Viability period: Seeds are viable for about two years in sealed tins (Chacko *et al.*, 2002).

Seed emptiness: Low (Chacko *et al.*, 2002).

Seed pre treatment: Not required (Chacko *et al.*, 2002).

Germination type: Epigeal (Chacko *et al.*, 2002).

Germination percentage: Up to 90 (Kumar and Bhanja, 1992; Chacko *et al.*, 2002).

Germination period: 3 to 15 days (FRI, 1984; Kumar and Bhanja, 1992; Chacko *et al.*, 2002).

Nursery technique: Seeds are sown in germination trays containing perlite medium or on 12 mm thick polyurethane foam sheets (Chacko and Muhammad, 1986), placed in trays. Germination takes place within 5 to 15 days. The seedlings are pricked out into polythene bags of 20 x 10 cm size filled with potting mixture within the three weeks after germination. Seedlings can be raised in root trainers and other types of containers by direct sowing also (Chacko *et al.*, 2002).

Propagation:

Method of propagation: Cuttings obtained from coppice shoots treated with 4,000 ppm IBA in talcum, root in partially controlled environment conditions in a mist chamber (Chaturvedi *et al.*, 1992). Natural regeneration is rarely observed where *E. tereticornis* is planted as an exotic. Natural seedfall germinates in suitable conditions, where soil is moist alluvium.

Vegetative propagation:

Pests: Nil (Chacko *et al.*, 2002). *Trinervitermes biformis*, *Odontotermes*

redemanni and *O. bellahunisensis* (Roonwal, and Rathore, 1984).

Diseases: Moderate. Twenty three spermatophyte fungi and a bacterium were recorded on seeds. *Cylindrocladium clavatum*, *Drechslera rostrata*, *D. australiensis*, *Fusarium equiseti*, *F. moniliforme*, *Macropromina* sp. were the important field fungi on seeds (Sharma and Mohanan, 1980; Chacko *et al.*, 2002). Leaf blight caused by *Alternaria padwickii* (Thankamma and Nair, 1989). Stem canker caused by *Botryodiplodia theobromae* in 1-2 yr old plantations of *E. tereticornis*; root rot caused by *Cylindrocladium floridanum* (Sharma *et al.*, 1989).

Medicinal properties:

Uses: Wood is used for making pulp, newsprint, wrapping, writing and printing papers. Also used for rayon manufacturing, as small timber, posts, pole, fuel etc. (Chacko *et al.*, 2002). Leaves are important source of essential oil.

Wood properties: Wood is heavy, moderately strong, moderately tough and hard. The sapwood is pale greyish brown which gradually merges into pale reddish brown heartwood. The weight and hardness of the wood varies widely with the age and locality of growth.

References:

- Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa, India. pp. 202.
- CABI. 1998. The Forestry Compendium – A Silvicultural Reference. Module 1. CABI Publishing, CAB International, Wallingford, Oxon, OX108DE, UK.
- Chacko, K.C. and Muhammad, E. 1986. Polyurethane foam nursery technique for raising healthy seedlings of Eucalyptus. In: J.K. Sharma, C.T.S. Nair, S. Kedarnath and S. Kondas(eds.) Eucalyptus in India: Past, Present and Future. Proceedings of the National Seminar on Eucalyptus in Indian Forestry-Past, Present and Future, Kerala Forest Research Institute, Peechi, Kerala, India, January 30-31, 1984. pp. 177-180.
- Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 128-129.
- Chaturvedi, A.N., Koul, V.K., Adhikari, B.S. and Kapri, K.D. 1992. Cloning of Eucalyptus hybrid. Journal of Tropical Forestry. 8(1): 26-30.
- FRI. 1984. Troup's The Silviculture of Indian Trees. Vol. V. The Controller of Publications, Delhi.
- Kindt, R., Mausya, S., Kimotho, J. and Waruhiu. 1997. Tree seed suppliers Directory: Sources of Seeds and Microsymbionts. International Centre for Research in Agro Forestry (ICRAF), Nairobi, Kenya.

Kumar, S.V. and Bhanja, M. 1992. Forestry Seed Manual of Andhra Pradesh. Andhra Pradesh Forest Department, Hyderabad, India.

Luna, R.K. 1996. Plantation Trees. International Book Distributors, Dehra Dun, India.

Nair, P.N. 1986. Eucalyptus in Kerala. In: J.K. Sharma, C.T.S. Nair, S. Kedarnath and S. Kondas(eds.) Eucalyptus in India: Past, Present and Future. Proceedings of the National Seminar on Eucalyptus in Indian Forestry-Past, Present and Future, Kerala Forest Research Institute, Peechi, Kerala, India, January 30-31, 1984. pp. 68-70.

Roonwal, M.L. and Rathore, N.S. 1984. New termite pests of eucalyptus in India and their control. Zeitschrift fur Angewandte Entomologie. 98: 225-230.

Sharma, J.K. and Mohanan, C. 1980. Spermoplane microflora of stored seeds of *Tectona grandis*, *Bombax ceiba*, and Eucalyptus spp. in relation to germinability. In: B.S.P. Wang and J.A. Pitel(eds.). Proceedings of International Symposium on Forest Tree Seed Storage. Canadian Forest Service. pp. 107-125.

Sharma, J.K., Mohanan, C. and Florence, E.J.M. 1989. Diseases of forest trees in Kerala. 4. Diseases of eucalypts in plantations. Evergreen Trichur. (23): 4-6.

Thankamma, L. and Nair, J.M. 1989. Leaf blight disease of Eucalyptus tereticornis caused by *Alternaria padwickii*. Indian Forester. 115(4): 274-275.

Ficus religiosa

Nomenclature:

Scientific name: *Ficus religiosa* L.

Vernacular name: Arayal (Malayalam), Arasu (Tamil), Pipal (Hindi) (Chacko *et al.*,2002).

Common name: Peepal tree, Sacred fig, Bodhi (Chacko *et al.*,2002); Arayal.

Synonyms: *Urostigma religiosum* (L.) Gasp.; *Ficus affinior* Griff.; *Urostigma affine* Miq.; *Ficus rhynchophylla* Steud.; *Ficus superstiosa* Link (Chacko *et al.*,2002).

Family: Moraceae

Subfamily:

Origin: E. Himalayas; S. E. Asia (Sasidharan, 2004).

Distribution: Occurs in the sub-Himalayan region, Bangladesh, and Nepal. Introduced and planted elsewhere. In Kerala, it is mostly planted in the temple premises (Rai, 1999; Chacko *et al.*, 2002).

Description: Fast growing, large glabrous spreading deciduous tree attaining a height of more than 25 m and a breast height diameter of 300 cm (Bose *et al.*, 1998).

Flowering season:

Fruiting season: April, also October to November, October to June (Chacko *et al.*,2002).

Flowers:

Fruits: Fruit is a hypanthodium, ripe fruits are dark brown in colour.

Fruit type: Hypanthodium.

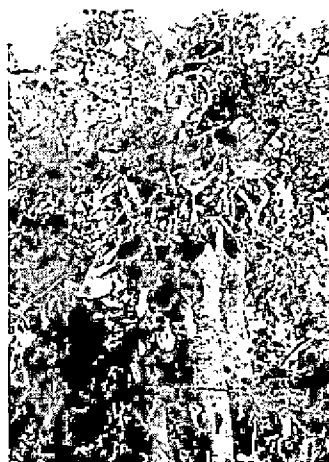
Seeds: Minute seeds (Chacko *et al.*, 2002).

Seed dimension:

Seed length: No information (Chacko *et al.*,2002).

Seed width:

Seed thickness:



Habit



Fruits

Seed weight: 2,10,000 to 2,20,000 seeds/kg (Rai, 1999; Chacko *et al.*,2002).

Seed dispersal: Birds and Monkeys, particularly green pigeons.

Seed collection: Ripe fruits, which are dark purple in colour are collected from the ground (Chacko *et al.*,2002).

Transportation of seeds: Fruits collected in plastic / cotton bags are transported to the processing centre as quickly as possible (Chacko *et al.*,2002).

Seed processing: Ripe fruits are crushed in water and washed to get clean seeds. The seeds then dried (Chacko *et al.*,2002).

Seed storage: No information. Seeds are stored in airtight containers (Hocking, 1993; Chacko *et al.*,2002).

Viability period: Seed retain viability for about 2 months (Chacko *et al.*,2002).

Seed emptiness: Low (Chacko *et al.*,2002).

Seed pre treatment: Not necessary (Chacko *et al.*,2002).

Germination type: Epigeal (Chacko *et al.*, 2002).

Germination percentage: Up to 90 (Chacko *et al.*,2002).

Germination period: 10 to 15 days (Chacko *et al.*,2002).

Nursery technique: Seeds are sown in germination trays containing perlite and watered. Seeds can also be sown directly in 22.5 x 17.5 cm bags. Results are poor when sown in nursery beds and hence this should always be discouraged. If germination is delayed by more than twenty days resowing should be done without further delay.

References:

- Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 221-222.
- Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 130-131.

Seedlings will be ready in two months for pricking out. The container seedlings should be well irrigated (Chacko *et al.*,2002).

Propagation:

Method of propagation:It is propagated by cuttings, by seeds and vegetative method.

Vegetative propagation:

Pests: Low. Dry fruits are attacked by the fig moth *Ephestia cautella* Wlk. (Lepidoptera: Phycitidae) (Chacko *et al.*, 2002).

Diseases: No information (Chacko *et al.*,2002).

Medicinal properties: Every part of the tree can be used as medicine. Leaves and tender shoots used as purgative and in skin diseases. It is used for ulcers. Bark is used in the treatment of gonorrhoea, diarrhoea and dysentery.

Uses: The tree yield latex. The tree is one of the recorded hosts of the Indian lac insect and the leaves are used to feed camels and elephants. Wood is less used and is suitable for match boxes, packing cases. This is a sacred tree to the Hindus and Buddhists and therefore, often planted near temples (Bose *et al.*, 1998).

Wood properties: Wood greyish white, moderately hard (Gamble, 1922).

Gamble, J.S. 1922. A manual of Indian timbers. London Sampson Low, Marton and Company Ltd, Calcutta, India.

Hocking, D. 1993. Trees for Drylands. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.

Rai, S.N. 1999. Nursery and Planting Techniques of Forest Trees in Tropical South Asia. Eastern Press, Bangalore, India.

Sasidharan, N. 2004. Forest Trees of Kerala. Kerala Forest Research Institute, Peechi, Kerala, India.

Gliricidia sepium

Nomenclature:

Scientific name: *Gliricidia sepium* (Jacq.)
Kunth ex Walp.

Vernacular name: Seema konna
(Malayalam); Pachai uram (Tamil)
(Chacko *et al.*, 2002).

Common name: Mother of cocoa,
Mexican lilac (Chacko *et al.*, 2002);
Madre tree, Madura shade tree (Bose *et al.*, 1998).

Synonyms: *Gliricidia maculata* var.
multijuga Micheli; *Lonchocarpus*
sepium (Jacq.) DC.; *Robinia sepium*
Jacq. (Chacko *et al.*, 2002).

Family: Leguminosae

Subfamily: Faboideae

Origin: Tropical America (Sasidharan,
2004).

Distribution: Native of Mexico, Central
America and North South America. In India
it is grown as live fence or wind-break and
also as an ornamental tree for its dense white
or pink flowers (NAS, 1980; Chacko *et al.*,
2002).

Description: Fast growing small deciduous
tree, with arching branches and feathery
foliage attaining a height of 10 m. It has an
open crown and contorted trunk that attains
30 cm in diameter (NAS, 1980; Chacko *et al.*,
2002). Usually a small tree; trunk short,
branches straight, long, almost vertical,
axillary branches (Bose *et al.*, 1998).

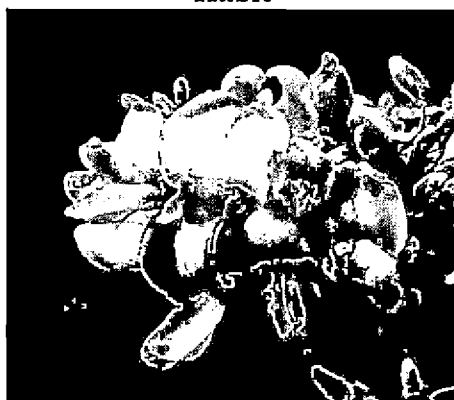
Flowering season: January to February.

Fruiting season: March to April (Chacko *et al.*,
2002).

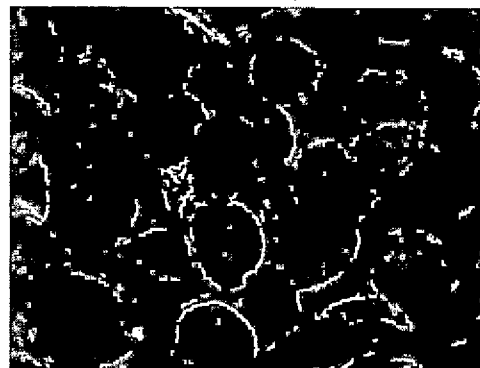
Flowers: Flowers pea-shaped, white, pink
or pale mauve, 12-15 mm long, in axillary
clusters, covering the greater part of the
branches; the standard with a pale yellow
spot near the base; stamens diadelphous
(Bose *et al.*, 1998).



Habit



Flowers



Seeds

Fruits: Pod flat, oblong, linear and
compressed. The ripe pods are yellowish
brown.

Fruit type: Pod.

Seeds: Each pod contain ten or more seeds. The seeds are light brown and oval in shape.

Seed dimension:

Seed length: 1 cm (Chacko *et al.*, 2002).

Seed width: 0.90 cm (Chacko *et al.*, 2002).

Seed thickness:

Seed weight: 7,000 (Kindt *et al.*, 1997) to 8,500 seeds/kg (Chacko *et al.*, 2002).

Seed dispersal: Wind dispersal.

Seed collection: The pods are collected from the tree by shaking the branches using a long pole and hook. They may also be collected from the ground soon after fall (Chacko *et al.*, 2002).

Transportation of seeds: No special care is suggested (Chacko *et al.*, 2002).

Seed processing: The pods are sun-dried until they open and seeds are separated manually (Chacko *et al.*, 2002).

Seed storage: Orthodox (Kindt *et al.*, 1997; CABI, 1998). Seeds can be stored for about a year (Chacko *et al.*, 2002).

Viability period: No information (Chacko *et al.*, 2002).

Seed emptiness: No information (Chacko *et al.*, 2002).

Seed pre treatment: Soak the seeds in hot water and cool off during the night, and sow the next morning (NAS, 1980; Chacko *et al.*, 2002).

Germination type: Epigeal.

Germination percentage: Up to 90 (Chacko *et al.*, 2002).

Germination period: No information (Chacko *et al.*, 2002).

Nursery technique: Pre-treated seeds are sown in germination trays filled with vermiculite and watered regularly. When the seedlings emerge, they are pricked out into polybags of size 22.5 cm x 17.5 cm filled with potting mixture and kept under shade for about a week (Chacko *et al.*, 2002).

Propagation:

Method of propagation: Propagated seeds or cuttings.

Vegetative propagation: Vegetatively, it can be easily propagated by stem and branch cuttings (Mac Dicken, 1994) without any special treatment (Chacko *et al.*, 2002).

Pests: No information (Chacko *et al.*, 2002).

Diseases: No information (Chacko *et al.*, 2002).

Medicinal properties: In Mexico, the plant is used as antihistamanic, antipyretic, and diuretic.

Uses: It is valued as a source of green manure for paddy and it has been recommended for cultivation on bunds and fields. The branches are used as a fire wood. Wood is used for light works like fences, stakes as well as posts. A very useful tree for providing shade to plantation crops; planted along road-sides, in gardens and other places for the beautiful flowers (Bose *et al.*, 1998).

Wood properties: The wood is heavy and hard (Chacko *et al.*, 2002).

References:

- Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 235.
- CABI. 1998. The Forestry Compendium – A Silvicultural Reference. Module 1. CABI Publishing, CAB International, Wallingford, Oxon, OX108DE, UK.
- Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 132-133.
- Kindt, R., Mausya, S., Kimotho, J. and Waruhiu. 1997. Tree seed suppliers Directory: Sources of Seeds and Microsymbionts. International Centre for Research in Agro Forestry (ICRAF), Nairobi, Kenya.
- Mac Dicken, K.G. 1994. Selection and Management of Nitrogen Fixing Trees. Winrock International, Bangkok, FAO.
- NAS. 1980. Firewood Crops: Shrub and Tree Species for Energy Production. National Academy of Science, Washington, D.C.
- Sasidharan, N. 2004. Forest Trees of Kerala. Kerala Forest Research Institute, Peechi, Kerala, India.

Gmelina arborea

Nomenclature:

Scientific name: *Gmelina arborea* Roxb.

Vernacular name: Gumhar, Sewan (Hindi), Gumadi (Tamil), Kumizhu, Kumbil, Kumala (Malayalam) (Chacko *et al.*, 2002).

Common name: White teak (Chacko *et al.*, 2002); Gamari, Candahar tree (Bose *et al.*, 1998).

Synonyms: *G. rheedii* Hook.; *Premna arborea* Roth; *Premna tomentosa* Miq.

Family: Verbenaceae

Subfamily:

Origin: It is a native of Pakistan, Butan, and India.

Distribution: It is a native of Pakistan, Butan, and India. In India it is found in the Sub-Himalayan tract, Uttar Pradesh, Punjab, Orissa, West Bengal, Karnataka, Tamil Nadu and Kerala. Occurs throughout the greater parts of India, Myanmar and Sri Lanka, but usually scattered in the mixed deciduous forests, but occasionally in evergreen forests (Troup, 1921; Chacko *et al.*, 2002).

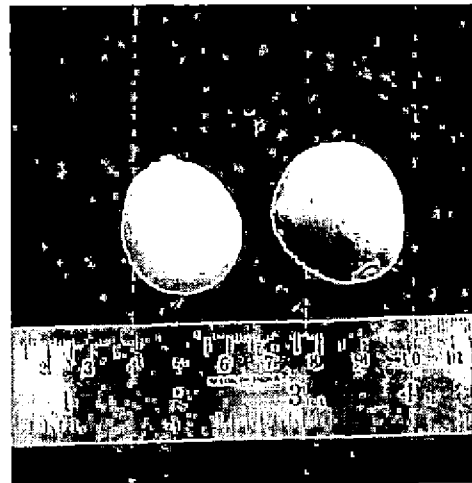
Description: A moderate sized or large deciduous tree 10 to 15 m high sometimes 30 m high. Straight trunk and spreading branches, pubescent (Bose *et al.*, 1998).

Flowering season: February to April; March to April (Bose *et al.*, 1998).

Fruiting season: Ripen during April to July (Sen Gupta 1937; Chacko *et al.*, 2002).

Flowers: Dull chestnut with yellow lip, axillary panicles of 1 to 3 flowered cymes. Flowers brownish yellow, 3-4 cm long, in

terminal paniculate cymes; corolla 3.5 cm across, two lipped; lower lip 3 lobed and the upper 2-lobed; stamens 4, projecting beyond the mouth of the tube (Bose *et al.*, 1998). Large, brownish-yellow, bisexual and zygomorphic nectariferous flowers. The breeding system involves both self- and cross-pollination, but most of the self-pollinated flowers abort after two weeks of growth. The floral characteristics suggest bee-floral syndrome, but bees, especially *Xylocopa* bees and passerine birds, pollinate the flowers (Raju and Rao, 2006).



Fruits



Seeds

Fruits: Succulent ovoid or oblong drupe, 2.25-3 cm long, yellow when ripe, with leathery shining pericarp, sweetish pulp and a hard bony stone. Mature fruits are yellow or yellow greenish (Mindawati and Rohayat,

1994). Yellow, fleshy fruits are single-seeded (Raju and Rao, 2006).

Fruit type: Drupe.

Seeds: 1.5-2.25 cm long, ovoid, pointed at one end, usually 2-celled or 2 seeded. Large sized stones give better, rapid and uniform germination (Galan Larrea et al., 2000; Samidha Pandey et al., 2002a).

Seed dimension:

Seed length: 1.5-1.8 cm (Kumar and Bhanja, 1992; Chacko et al., 2002).

Seed width:

Seed thickness:

Seed weight: 980 (Nair et al., 2002) to 2,500 depulped seeds/kg (Sen Gupta 1937; Kumar and Bhanja, 1992; Chacko et al., 2002).

Seed dispersal: Animals. Monkeys ingest and excrete the seeds unaffected helping in seed dispersal (Raju and Rao, 2006).

Seed collection: Ripe brown fruits are collected by plucking from the trees or from the ground (Kumar and Bhanja, 1992; Chacko et al., 2002). It is better to collect greenish yellow fruits for seed extraction to produce quality seedlings (Samidha Pandey et al., 2002b).

Transportation of seeds: No special care is suggested (Chacko et al., 2002).

Seed processing: Fruits are either heaped in a room or buried in a pit for 4-5 days and then washed to remove the pulp (Kumar and Bhanja 1992). A modified coffee depulper can be used to extract stones (Amata Archachai and Wasuwanich, 1986). Depulping improves the germination of green and fresh seeds (Wasuwanich, 1984; Ogunnika and Kadeba, 1993). The seeds are sun-dried for 2-3 days (Rai 1999;

Chacko et al., 2002). Seeds are also depulped by hand, cleaned of all loose fleshy materials and oven dried at 30°C to 10% moisture content (Kinako and Ogbonnaya, 1990).

Seed storage: Probably intermediate. Storage of seeds is not advisable as viability goes down in storage especially after one year (Kumar and Bhanja 1992; Chacko et al., 2002). Drying the seeds over silica gel reveals desiccation tolerance in *G. arborea*. Desiccation-tolerant seeds of *G. arborea* are tolerant of low temperature (-20 and 0°C) storage, retaining their initial viability over 60 to 150 days. Germinability will be gradually lost with further storage (~280 days). Rapid drying of *G. arborea* seeds improve their storage, maintaining higher viability over longer periods (Naithani et al., 2005). The fresh seed of *Gmelina* can be stored in bags in a cool dry place for about three months without losing much viability.

Viability period: Seeds retain 50% of initial germination capacity after one year and 25% after two years when stored in gunny bags (Dent 1948; Chacko et al., 2002).

Seed emptiness: No information (Chacko et al., 2002).

Seed pre treatment: Not necessary (Kumar and Bhanja, 1992). However, weathering of seeds (alternate wetting and drying) improve germination (Rai, 1999; Chacko et al., 2002). Immersion in water at room temperature (27°C) for 1 or 2 days promote respectively 62.2 and 51.06% germination beginning 7 days after sowing (Charomaini, 1989). Seed inoculation with saprophytic fungus *Chaetomium bostrychodes* increase the germination percentage (32 and 95% after 5 weeks for uninoculated and inoculated seeds, respectively); this is

because the fungus contributes to digestion of the hard testa of the seeds (Osonubi *et al.*, 1990). Dormancy in the seeds is of the physical type caused by its hard seed coat. Chemical scarification for 10 min with conc. H₂SO₄ (Archana Sharma *et al.*, 2000) is very effective in breaking seed dormancy. 1 mM and 10 mM KNO₃ and KNO₂ are also used to terminate dormancy (Mensah and Agbagwa, 2004). Stones soaked in 100 ppm GA3 for 40 hrs give 95% germination (Samidha Pandey *et al.*, 2002c). Treating seeds with 3% H₂O₂ accelerate seed germination and vigour (Galan Larrea *et al.*, 2000).

Germination type: Epigeal (Troup 1921; Chacko *et al.*, 2002).

Germination percentage: Up to 85 (Sen Gupta, 1937; Chacko *et al.*, 2002). Troup (1921), reported germination of 90% for fresh seed, but after one year of storage, germination dropped to 30%.

Germination period: 10 to 35 days (Sen Gupta 1937; Chacko *et al.*, 2002).

Nursery technique: Seeds are sown in germination trays filled with vermiculite and watered. The seedlings germinate in 2 to 3 weeks. They are potted in polybags of 22.5 x 17.5 cm. Seedlings grow fairly fast under proper nursery conditions, reaching a height up to 1 m in 3-4 months (Chacko *et al.*, 2002). Incorporation of slow release fertilizers into the nursery medium improve the growth of establishing seedlings (Reddell *et al.*, 1999). Application of higher levels of inorganic fertilizers in addition to FYM promote better growth, development and seeding quality (Raman *et al.*, 2008).

Propagation:

Method of propagation: By seeds, cuttings, and stumps. Vegetatively using branch cuttings.

Vegetative propagation:

Pests: No attack (Chacko *et al.*, 2002). Ring barking of young saplings caused by termites (Sailesh Chattopadhyay, 2005).

Diseases: Moderate (10-49%). Spermoplane microbes recorded include 11 fungi and actinomycetes. *Trichoderma viride* occurred in high frequency. *Cylindrocladium parvum* and *Colletotrichum gloeosporioides* are the important field fungi recorded on seeds (Chacko *et al.*, 2002). Leaf spot diseases caused by *Phoma tropica*, *Deptoshaeria gmelinae*, *Macrophomina phaseolina* and *Alternaria alternata*; top dying caused by *Phomopsis* sp.; and foot rot, in which seedlings were attacked at ground level and *Fusarium oxysporum* (Jamaluddin *et al.*, 1988).

Medicinal properties: Roots which form an ingredient in the ayurvedic drug combination. Dasamoola is the major product of medicinal use. Component of 'Bruhat-panchmula' (Ghate, 1999). Decoction of root bark cures rheumatism, weakness, piles, and improves digestion. The juice extract of the leaves is used as a remedy for wounds and ulcers and flowers cure leprosy and blood diseases. The fruits are effective in the treatment of anaemia, leprosy and ulcer (Bose *et al.*, 1998). It is used in treating various diseases like gonorrhoea, ayurvedic preparation 'Dasamukh'. The fruit is sweetish bitter and cooling, and is also an ingredient in many decoctions prescribed for fever, headache

and burning heat of body called dastar (Tewari, 1995).

Uses: It is a fast growing tree, and therefore popular in the tropics for its valuable timber. It is also an ornamental tree. The fruits are eaten by tribal people (Bose *et al.*, 1998). Extracts of *Gmelina arborea* is suitable in controlling the legume pod borer *Maruca vitrata* and the pod sucking bug *Clavigralla tomentosicollis* on cowpea (Oparaeke, 2005). Gmelinol isolated from heartwood of *G. arborea* is an important antifungal constituent (Kawamura *et al.*, 2004). The extracts of *Gmelina arborea* cause a considerable reduction in the number of weevils (*Callosobruchus maculatus*) (Kayode and Adanlawo, 2002). *Gmelina arborea* withstands salinity only up to 2.5 ds/m (Sharma *et al.*, 1998). Good species for phyto-remediation of crude oil contaminated habitats (Agbogidi *et al.*, 2007). The wood of this tree is an excellent source for pulp and paper industries as vessels and fiber configurations are most suitable for pulping, and pulp uniformity is also better than many commercially used eucalyptus. *G. arborea* has a distinguished acceptability as fodder (Tewari, 1995). The

References:

- Agbogidi, O.M., Dolor, E.D. and Okechukwu, E.M. 2007. Evaluation of *Tectona grandis* (Linn.) and *Gmelina arborea* (Roxb.) for phyto-remediation in crude oil contaminated soils. *Agriculturae Conspectus Scientificus Poljoprivredna Znanstvena Smotra*. 72(2): 149-152.
- Amata Archachai, P. and Wasuwanich, P. 1986. Mechanical extraction and cleaning of nuts of some tropical species. *Embryon*. 2(1): 1-8.
- Archana Sharma, Tiwari, K.P., Tiwari, H.C. and Mohan Koshare. 2000. Pre-treatment of *Gmelina arborea* Roxb. seeds to obtain better germination and seedling vigour. *Vaniki Sandesh*. 24(2): 1-4.
- Bose, T.K., Das, P. and Maiti, G.G. 1998. *Trees of the world*, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 238.

species has been extensively used in reforestation activities and attracted plantation growers due to its high economic importance. It is a highly valuable source of timbers in the tropics, its wood is used for particleboard, plywood core stock, pit props, matches, and saw timber for light construction, furniture, general carpentry, and packing; it is also used to make musical instruments and ornaments.

Wood properties: Wood yellowish, greyish, or reddish white, with a glossy lustre, even grained soft, light, strong, and durable. It is a diffuse porous wood with a tendency for semi ring porosity. Weight about 497 kg/m³. It provides a source of suitable raw material for the manufacture of medium density UF particleboards (Chew *et al.*, 1988). Sliced and peeled veneers of *Gmelina arborea* used to make plywood and to face medium density fibreboard and particleboard (Huong, 1989). Wood is also suitable for match industry. The timber is classified as a light hardwood and does not have good strength properties, but has various potential non-structural uses - for pulping and papermaking, as veneer, for panels, etc. (Martawijaya and Barly, 1995).

Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 134-135.

Charomaini, Z.M. 1989. Pre-sowing treatment of Gmelina arborea seed in assisting germination. Buletin Penelitian Hutan. (515): 29-39.

Chew, L.T., Ong, C.L. and Suhaimi Muhammad. 1988. Urea-formaldehyde particleboard from yemane (Gmelina arborea). Journal of Tropical Forest Science. 1(1): 26-34.

Dent, T.V. 1948. Seed storage with particular reference to the storage of seed of Indian forest plants. Indian Forest Records (New Series) Silviculture, 7: 134 pp. Manager of Publications, Delhi.

Galan Larrea, R., Vargas Hernandez, J. and Rodriguez Laguna, R. 2000. Treatments to stimulate and homogenize germination in seeds of Gmelina arborea Roxb. Revista Chapingo Serie Ciencias Forestales y del Ambiente. 6(1): 21-28.

Ghate, V.S. 1999. Bruhat-panchamula in ethno-medico-botany and Ayurved. Journal of Medicinal and Aromatic Plant Sciences. 21(4): 1099-1110.

Huong, Z.H. 1989. Study on making veneer and plywood with Gmelina arborea and Mytilaria laosensis. Wood Industry Beijing. 3(2): 14-20.

Jamaluddin, Dadwal, V.S. and Soni, K.K. 1988. Some new and noteworthy diseases of Gmelina arborea Roxb. from Madhya Pradesh. Journal of Tropical Forestry. 4(3): 297-299.

Kawamura, F., Ohara, S. and Nishida, A. 2004. Antifungal activity of constituents from the heartwood of Gmelina arborea: Part 1. Sensitive antifungal assay against basidiomycetes. *Holzforschung*. 58(2): 189-192.

Kayode, J. and Adanlawo, I.G. 2002. Pesticidal potentials of Azadirachta indica and Gmelina arborea on cowpea weevil (Callosobruchus maculatus). Journal of Tropical Forest Products. 8(2): 130-134.

Kinako, P.D.S. and Ogbonnaya, C.I. 1990. Propagule size and seedling growth relationships in Gmelina arborea Roxb. *Discovery and Innovation*. 2(3): 89-92.

Kumar, S.V. and Bhanja, M. 1992. Forestry Seed Manual of Andhra Pradesh. Andhra Pradesh Forest Department, Hyderabad, India.

Martawijaya, A. and Barly. 1995. Wood properties of Gmelina arborea Roxb. *Duta Rimba*. 20(185/186): 35-40.

Mensah, S.I. and Agbagwa, I.O. 2004. Breaking dormancy in Gmelina arborea Roxb. through treatment of seeds with chemical substances and alternating temperature : Bio research. 2(1): 59-66.

Mindawati, N. and Rohayat, N. 1994. Effect of fruit colour of Gmelina arborea L. on germination and seedling growth. Buletin Penelitian Hutan. (560): 43-54.

Nair, K.K.N., Mohanan, C. and George Mathew, 2002. Plantation technology for nine selected indigenous tree species of Kerala State. KFRI Research Report No. 231. Kerala Forest Research Institute, Peechi, Kerala, India P. 110.

Naithani, S.C., Ranjana Naithani, Varghese, B., Godheja, J.K. and Sahu, K.K. 2005. Conservation of four tropical forest tree seeds from India. Comparative storage biology of tropical tree seeds. 174-191.

Ogunnika, C.B. and Kadeba, O. 1993. Effects of various methods of extraction on germination of Gmelina arborea seeds/fruits. Journal of Tropical Forest Science. 5(4): 473-478.

Oparaeke, A.M. 2005. Studies on insecticidal potential of extracts of Gmelina arborea products for control of field pests of cowpea, Vigna unguiculata (L.) Walp: the pod borer, Maruca vitrata and the coreid bug, Clavigralla tomentosicollis. Journal of Plant Protection Research. 45(1): 1-7.

Osonubi, O., Okon, I.E. and Bamiduro, T.A. 1990. Effect of different fungal inoculation periods on performance of Gmelina seedlings under dry soil conditions. Forest Ecology and Management. 37(4): 223-232.

Rai, S.N. 1999. Nursery and Planting Techniques of Forest Trees in Tropical South-Asia. Eastern Press, Bangalore, India.

Raju, A.J.S. and Rao, S.P. 2006. Pollination by bees and passerine birds and seed dispersal by monkeys in the white teak Gmelina arborea Roxb., a commercially important timber tree species in the Eastern Ghats. Current Science. 90(2): 232-236.

Raman, K.R., Sharma, M.S., Mahato, G.P. and Sivaji, V. 2008. Response of seedlings of Gmelina arborea to FYM and its combination with NPK fertilizers. Range Management and Agroforestry. 29(1): 25-28.

Reddell, P., Webb, M.J., Poa, D. Aihuna, D. 1999. Incorporation of slow-release fertilisers into nursery media. New Forests. 18(3): 277-287.

Sailesh Chattopadhyay. 2005. Sapling mortality of gamhar. Journal of Interacademicia. 9(4): 633-634.

Samidha Pandey, Smita Bisht and Krishnan, C. 2002a. Pre-sowing treatment of stones of Gmelina arborea with growth regulators. Indian Journal of Tropical Biodiversity. 10(1/4): 73-76.

Samidha Pandey, Jamaluddin, Smita Bisht and Pant, N.C. 2002b. Germination behaviour of Gmelina arborea Roxb. influenced by stone size. *Seed Research*. 30(2): 279-283.

Samidha Pandey, Smita Bisht and Jamaluddin. 2002c. Pericarp colour - an indicator for seed quality in *Gmelina arborea* Roxb. *Indian Forester*. 128(4): 473-476.

Sharma, A., Kukkadia, M.U., Jadeja, D.B. and Vashi, B.G. 1998. Effect of different salinity levels on germination and initial growth parameters of different agroforestry tree species in nursery stage. *Indian Journal of Forestry*. 21(2): 156-159.

Sen Gupta, J.N. 1937. Seed weights, plant percents, etc. for forest plants in India. *Indian Forest Records (New Series) Silviculture*, 2:221pp. Manager of Publications, Delhi.

TEWARI, D.N. 1995. A monograph on GAMARI (*Gmelina arborea*, Roxb.). Milton Book Company, Dehra Dun, India: 41 pp.

Troup, R.S. 1921. *The Silviculture of Indian Trees* Vol. II. Clarendon Press, Oxford.

Wasuwanich, P. 1984. Collection and handling of *Gmelina arborea* Roxb. stone [seeds] in Thailand. *Embryon*. 1(1): 14-20.

Grevillea robusta

Nomenclature:

Scientific name: *Grevillea robusta* A. Cunn. ex R.Br.

Vernacular name: Silver oak (Malayalam); Savakumaram (Tamil); Silver oak (Kannada) (Chacko *et al.*, 2002).

Common name: Silver oak (Chacko *et al.*, 2002); Silk oak (Gamble, 1922).

Synonyms:

Family: Proteaceae

Subfamily:

Origin: Australia.

Distribution: Native of Australia. In Kerala, it is grown as shade tree in tea and coffee plantations. It is very popular in tropical and subtropical climate and extensively grown in gardens, parks, and on road-sides for showy appearance (Bose *et al.*, 1998).

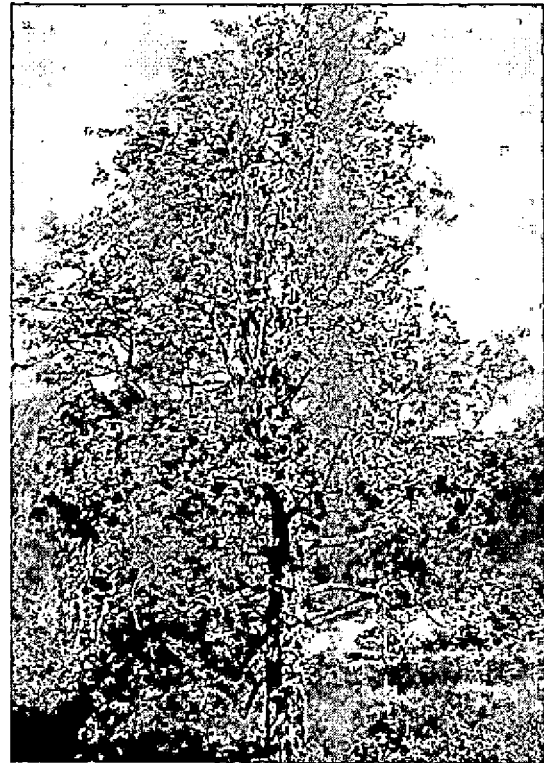
Description: Fast growing, medium sized evergreen tree attaining a height of 30 to 35 m and a breast height diameter of 50 to 60 cm (Luna, 1996; Chacko *et al.*, 2002).

Flowering season: March to April.

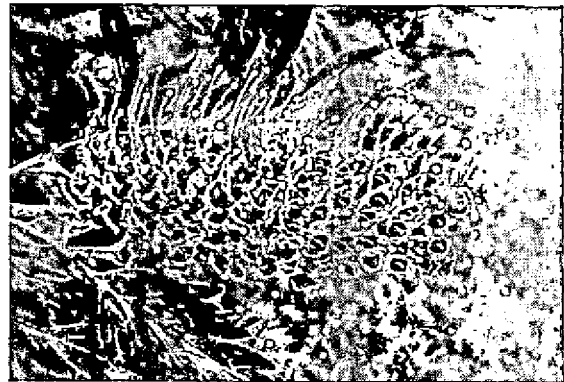
Fruiting season: December to January; June to August (Sen Gupta, 1937; Chacko *et al.*, 2002).

Flowers: Flowers orange coloured, solitary, borne in racemes, 10 to 15 cm long, on short branchlets; perianth lobes 4, reflexed; stamens 4, projecting beyond the perianth with the style (Bose *et al.*, 1998).

Fruits: Follicle, oblique, oblong, compressed coriaceous, 1.5 cm long, containing one or two seed.



Habit



Twig with flower and seeds

Fruit type: Follicle.

Seeds: Seeds one or two and papery (Luna, 1996; Chacko *et al.*, 2002).

Seed dimension:

Seed length: 1.21 cm (Chacko *et al.*, 2002).

Seed width: 0.83 cm (Chacko *et al.*, 2002).

Seed thickness:

Seed weight: 35,000 seeds/kg (Kindt *et al.*, 1997) - 95,000 seeds/kg (Kumar and Bhanja, 1992; Chacko *et al.*, 2002).

Seed dispersal: Wind dispersal.

Seed collection: Capsules are collected from the tree when they turn brown in colour (Kumar and Bhanja, 1992). The capsules dehisce while still attached to the tree (Chacko *et al.*, 2002).

Transportation of seeds: Capsules collected in cotton bags are transported to the processing centre as quickly as possible (Chacko *et al.*, 2002).

Seed processing: The fruits are dried under sun to release the seeds (Kumar and Bhanja, 1992; Chacko *et al.*, 2002).

Seed storage: Orthodox (CABI, 1998). Seeds with less than 10% moisture content can be stored for two years at -6.7°C to -3.3°C (Chacko *et al.*, 2002).

Viability period: Short, up to two months (Kumar and Bhanja, 1992; Chacko *et al.*, 2002).

Seed emptiness: Moderate (Chacko *et al.*, 2002).

Seed pre treatment: Soak the seeds in hot water for 3 min (Kindt *et al.*, 1997; Chacko *et al.*, 2002). Soak in cold water for 12 to 24 hrs (Edwards and Naithani, 1999).

Germination type: Epigeal (Chacko *et al.*, 2002).

Germination percentage: 20 to 90 (Carlowitz, 1991; Kumar and Bhanja, 1992; Devaraj *et al.*, 1999; Chacko *et al.*, 2002).

Germination period: 11 to 29 days (Chacko *et al.*, 2002).

Nursery technique: Seeds are sown in nursery bed during August and the seedlings are transplanted when they are 6 to 8 cm tall into polythene bags. Seedlings are ready for outplanting in ten months (Kumar and Bhanja, 1992; Chacko *et al.*, 2002).

Propagation:

Method of propagation: By seeds.

Vegetative propagation:

Pests: No information (Chacko *et al.*, 2002).

Diseases: No information (Chacko *et al.*, 2002).

Medicinal properties: The flowers are important source of honey and the bark yields tannin and gum.

Uses: The leaves of the tree are valued as green manure in coffee and tea plantation. The bark of the tree yields a yellow gum containing moisture, resin and CaO₂. The main uses include shading over tea and coffee plantation, production of mulch and honey, beautification and wood production for fuel and poles. The heartwood is strong, durable and excellent for cabinetwork. The timber is also used in parquetry and turnery, making railroad ties, plywood panelling, air-freight cases and furniture. Hydrocyanic acid has been detected in the fruit and flowers.

Wood properties: Wood light reddish brown, sapwood greyish white. It is

moderately hard and moderately heavy. 640 kg/m³.
Pores moderate sized. Air dry weight about

References:

Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 244.

CABI. 1998. The Forestry Compendium – A Silvicultural Reference. Module 1. CABI Publishing, CAB International, Wallingford, Oxon, OX108DE, UK.

Carlowitz, P.G.V. 1991. Multipurpose Trees and Shrubs: Source of seeds and Inoculants. International Council for Research in Agroforestry, Nairobi, Kenya.

Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 136-137.

Devaraj, P., Sugavanam, V. and Durairaj, S. 1999. Monograph on Silver Oak (Grevillea robusta). International Book Distributors, Dehra Dun, India.

Edwards, D.G. and Naithani, S.C. 1999. Seed and Nursery Technology of forest trees. New Age, New Delhi.

Gamble, J.S. 1922. A manual of Indian timbers. London Sampson Low, Marton and Company Ltd, Calcutta, India.

Kindt, R., Mausya, S., Kimotho, J. and Waruhiu. 1997. Tree seed suppliers Directory: Sources of Seeds and Microsymbionts. International Centre for Research in Agro Forestry (ICRAF), Nairobi, Kenya.

Kumar, S.V. and Bhanja, M. 1992. Forestry Seed Manual of Andhra Pradesh. Andhra Pradesh Forest Department, Hyderabad, India.

Luna, R.K. 1996. Plantation Trees. International Book Distributors, Dehra Dun, India.

Sen Gupta, J.N. 1937. Seed weights, plant percents, etc. for forest plants in India. Indian Forest Records (New Series) Silviculture, 2:221pp. Manager of Publications, Delhi.

Grewia tiliifolia

Nomenclature:

Scientific name: *Grewia tiliifolia* Vahl

Vernacular name: Chadachi, Unnam (Malayalam); Chadachi, Unam (Tamil); Batala, Thadsal (Kannada) (Chacko *et al.*, 2002); Dhamni (Sanskrit).

Common name: Chadachi, Dhaman (Chacko *et al.*, 2002).

Synonyms: *G. asiatica* Mast.

Family: Tiliaceae

Subfamily:

Origin:

Distribution: Occurs in Sub Himalayan tract, common in Western Ghats, Tropical East Africa; Peninsular India; Sri Lanka; Myanmar (Bose *et al.*, 1998).

Description: A moderate to large sized, deciduous tree, with cylindrical bole.

Flowering season: February to August; February to April (Bourdillon, 1908).

Fruiting season: May to August; May to June (Bourdillon, 1908).

Flowers: Flowers yellow in colour, these are borne on thick, axillary peduncles; sepals oblong, 8-12 mm long, subacute, pubescent outside, glabrous within; petals oblong or spatulate, about 4-5 mm long; stamens about 5 mm long; ovary villous (Bose *et al.*, 1998).

Fruits: Drupes usually glabrous at maturity, black, globose.

Fruit type: Drupe.

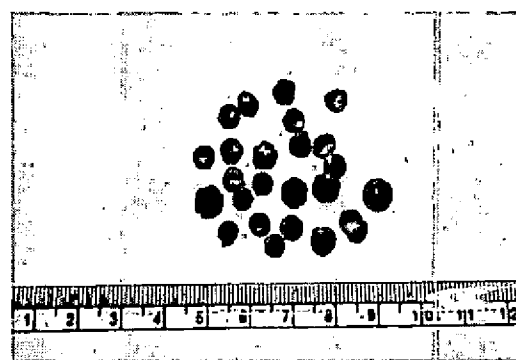
Seeds: 2 lobed, reddish-purple coloured.

Seed dimension:

Seed length: 0.51 cm (Chacko *et al.*, 2002).

Seed width: 0.49 cm (Chacko *et al.*, 2002).

Seed thickness:



Seeds

Seed weight: 5,290 to 6,540 (with pulp) (Nair *et al.*, 2002) 16,000 to 19,400 (Sen Gupta, 1937) de-pulped seeds/kg.

Seed dispersal: Wind dispersal.

Seed collection: Ripe fruits fall abundantly during the pre-monsoon showers. It is convenient to gather fruits on tarpaulin sheets below the trees in advance (Chacko *et al.*, 2002).

Transportation of seeds: Fruits are transported to the processing centre as quickly as possible (Chacko *et al.*, 2002).

Seed processing: Fruits are de-pulped, washed and dried under shade. A fruit will normally have two seeds (Nair *et al.*, 1991; Chacko *et al.*, 2002).

Seed storage: Probably intermediate. Seeds are stored in gunny bags mixed with BHC to avoid insect attack (Rai, 1999; Chacko *et al.*, 2002).

Viability period: Keeps well for four months in gunny bags or sealed tins (Dent, 1948; Chacko *et al.*, 2002).

Seed emptiness: Low (Chacko *et al.*, 2002).

Seed pre treatment: No information (Chacko *et al.*, 2002).

Germination type: Epigeal (Chacko *et al.*, 2002).

Germination percentage: Up to 10 (Nair *et al.*, 1991; Chacko *et al.*, 2002).

Germination period: 5 to 60 days (Nair *et al.*, 1991; Chacko *et al.*, 2002).

Nursery technique: The seeds are sown in germination trays containing vermiculite and watered. The seedlings are pricked out at two leaf stage and planted in 22.5 x 17.5 cm polythene bags filled with potting mixture (Chacko *et al.*, 2002).

Propagation:

Method of propagation: By seeds.

Vegetative propagation:

Pests: Low (Chacko *et al.*, 2002).

Diseases: Moderate (61%). More than 23 fungi, bacteria and actinomycetes are recorded on seeds. *Corynespora* sp.,

Curvularia lunata, *Cylindrocladium* sp., *Fusarium* sp., *Myrothecium* sp., *Phomopsis* sp., are the important fungi (Mohanan and Sharma, 1991; Chacko *et al.*, 2001).

Medicinal properties: The bark is astringent, sweet, acrid, refrigerant, oleaginous and tonic. It is useful in seminal weakness and general debility, ulcers, wounds. The fruits sweet, sour, cooling and edible and are useful in vitiated conditions of Vata and Kapha.

Uses: Timber is excellent quality, strong, elastic as good as teak. The fruit is eaten and the inner bark made into cordage. Wood is used for shafts, furniture, poles, frames, pannels, tool handles, agricultural implements, etc.

Wood properties: Sapwood is white to brownish grey. Heartwood is reddish brown, close grained, moderately heavy and hard. Annual rings marked by a line and the harder autumn wood. Pores moderately sized, numerous, uniformly distributed. Medullary rays fine, prominent on a radial section, giving a handsome silver grained; the distance between the rays equal to the diameter of the pores (Gamble, 1922).

References:

Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 245.

Bourdillon, T.F. 1908. Forest trees of Travancore. International Book Distributors, Dehradun. pp. 57.

Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 138-139.

Dent, T.V. 1948. Seed storage with particular reference to the storage of seed of Indian forest plants. Indian Forest Records (New Series) Silviculture, 7: 134 pp. Manager of Publications, Delhi.

Gamble, J.S. 1922. A manual of Indian timbers. London Sampson Low, Marton and Company Ltd, Calcutta, India.

Mohanan, C. and Sharma, J.K. 1991. Seed pathology of forest tree species in India – Present status, practical problems and future prospects. Commonwealth Forestry Review, 70: 113-151.

Nair, K.K.N., Chacko, K.C., Menon, A.R.R., Bhat, K.V., Mathew, G., Mohamed Ali, M.I. and Pandalai, R.C. 1991. Studies on Selected Indigenous Species for Future Plantation Programmes in Kerala. Kerala Forest Research Institute, Peechi, Kerala, India.

Nair, K.K.N., Mohanan, C. and George Mathew, 2002. Plantation technology for nine selected indigenous tree species of Kerala State. KFRI Research Report No. 231. Kerala Forest Research Institute, Peechi, Kerala, India P. 110.

Rai, S.N. 1999. Nursery and Planting Techniques of Forest Trees in Tropical South-Asia. Eastern Press, Bangalore, India.

Sen Gupta, J.N. 1937. Seed weights, plant percents, etc. for forest plants in India. Indian Forest Records (New Series) Silviculture, 2:221pp. Manager of Publications, Delhi.

Haldina cordifolia

Nomenclature:

Scientific name: *Haldina cordifolia* (Roxb.) Ridsd.

Vernacular name: Manjakadambu, Veembu (Malayalam) (Sasidharan, 2004); Bandaru, Manjakadambi (Tamil).

Common name: Haldu (Chacko *et al.*, 2002).

Synonyms: *Adina cordifolia* (Roxb.) Hk. f. ex Brand.; *Nauclea cordifolia* (Roxb.) (Chacko *et al.*, 2002; Sasidharan, 2004).

Family: Rubiaceae

Subfamily:

Origin:

Distribution: Occurs throughout the greater parts of India and Myanmar, also in the dry regions of Sri Lanka (FRI, 1985). In Kerala, it occurs in the moist deciduous forests up to 450 m (Chacko *et al.*, 2002).

Description: Large deciduous tree attaining a height of more than 40 m and a breast height diameter of 76 cm (Chacko *et al.*, 2002).

Flowering season: June to September (Bose *et al.*, 1998).

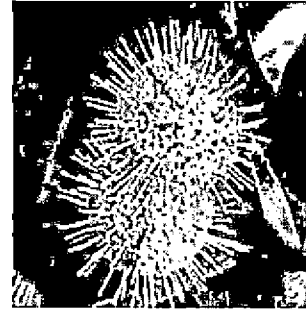
Fruiting season: October to January (Sen Gupta, 1937; Chacko *et al.*, 2002).

Flowers: Flower heads yellow, 2-2.5 cm diameter, peduncled 5 to 10 cm long, calyx and corolla densely pubescent.

Fruits: Fruit aggregate of capsules, about 12 mm in diameter (Bose *et al.*, 1998).

Fruit type: Capsule.

Seeds: Seed are oblong minute, brown, shortly winged.



Flower



Twig with fruits



Seeds

Seed dimension:

Seed length: 0.15 to 0.3 cm (FRI, 1985; Chacko *et al.*, 2002).

Seed width:

Seed thickness:

Seed weight: 90,00,000 to 1,30,00,000 seeds/kg (Chacko *et al.*, 2002).

Seed dispersal: Animals.

Seed collection: The ripe fruits (heads) which are yellowish black are collected from the trees by lopping off branches (Chacko *et al.*,2002).

Transportation of seeds: The heads are packed in cotton bags and transported to the processing centre as quickly as possible (Chacko *et al.*,2002).

Seed processing: The heads are dried in the sun and when dry, are broken up and immersed in water to separate the seeds from the husk. The heavier seeds settle at the bottom and the husk floating on water are removed by decantation. The seeds are then dried and cleaned by winnowing (FRI, 1985; Chacko *et al.*, 2002).

Seed storage: Most probably orthodox. The cleaned seeds can be stored in sealed plastic or aluminium tins for one year (FRI, 1985; Chacko *et al.*,2002).

Viability period: Seeds are viable up to one year in sealed tins (FRI, 1985; Chacko *et al.*, 2002).

Seed emptiness: Low (Chacko *et al.*,2002).

Seed pre treatment: Not required (Chacko *et al.*,2002). Soak in water for 12 hrs, then dry slightly to facilitate sowing. Some after-ripening may be required (Edwards and Naithani, 1999).

Germination type: Epigeal (Chacko *et al.*,2002).

Germination percentage: Up to 90 (Sen Gupta, 1937; Chacko *et al.*, 2002).

Germination period: 10 to 15 days (Kumar and Bhanja, 1992; Chacko *et al.*,2002).

Nursery technique: Seeds are sown in germination trays filled with vermiculite or on moist polyurethane foam. Seedlings are

pricked out into 22.5 x 17.5 cm polythene bags filled with potting mixture (Chacko *et al.*,2002).

Propagation:

Method of propagation: By coppice shoots.

Vegetative propagation:

Pests: No information (Chacko *et al.*,2002).

Diseases: Low (10 to 16%). *Aspergillus* spp., *Chaetomium* sp., *Penicillium* spp. are the storage moulds recorded on seeds. *Fusarium* sp. is the important field fungi associated with the discoloured seeds (Mohan and Sharma, 1991; Chacko *et al.*, 2001).

Medicinal properties: The bark is acrid and bitter and it is used in biliousness. The root is used as an astringent in dysentery (Bose *et al.*, 1998).

Uses: It is one of the most popular timber for turnery articles and is largely used for toys, handles of chisels, files and screw drivers. It is also used for folding chairs and camp furniture and household fitments. Leaves are used as a fodder. Chloroform extract of *H. cordifolia* stems contains 7-Hydroxycoumarin and it shows moderate inhibition of H⁺/K⁺ ATPase activity (Kasinadhuni *et al.*,1999).

Wood properties: Sapwood is pale yellow, gradually merges into deep yellow heartwood, which turns brownish or reddish yellow on ageing. It is moderately hard, yellow and lustrous, usually with a straight or interlocked grain. Weight about 689 kg/m³.

References:

Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 33.

Chacko, K.C., Mohanan, C., Seethalakshmi, K.K. and George Mathew. 2001. Seed handling and nursery practices for selected forest trees of Kerala. Final Technical Report of ICFRE – World Bank Forestry Research Education and Extension Project. Kerala Forest Research Institute, Peechi.

Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 140-141.

Edwards, D.G. and Naithani, S.C. 1999. Seed and Nursery Technology of forest trees. New Age, New Delhi.

FRI. 1985. Troup's The Silviculture of Indian Trees. Vol. VI. The Controller of Publications, Delhi.

Kasinadhuni, V.R.R., Rajashekhar, G., Rajagopalan, R., Sharma, V.M., Krishna, C.V., Sairam, P., Prasad, G.S., Sadhukhan, S. and Rao, G.G. 1999. Anti-ulcer potential of Haldinia cordifolia. Fitoterapia.70(1): 93-95.

Kumar, S.V. and Bhanja, M. 1992. Forestry Seed Manual of Andhra Pradesh. Andhra Pradesh Forest Department, Hyderabad, India.

Mohanan, C. and Sharma, J.K. 1991. Seed pathology of forest tree species in India – Present status, practical problems and future prospects. Commonwealth Forestry Review, 70: 113-151.

Sasidharan, N. 2004. Forest Trees of Kerala. Kerala Forest Research Institute, Peechi, Kerala, India.

Sen Gupta, J.N. 1937. Seed weights, plant percents, etc. for forest plants in India. Indian Forest Records (New Series) Silviculture, 2:221pp. Manager of Publications, Delhi.

Hardwickia binata

Nomenclature:

Scientific name: *Hardwickia binata*
Roxb.

Vernacular name: Acha (Malayalam);
Anjan (Hindi); Kamara (Kannada); Acha
(Tamil).

Common name: Anjan.

Synonyms:

Family: Leguminosae

Subfamily: Caesalpinaceae

Origin:

Distribution: The tree is found in the Deccan Peninsula, Central India, Uttar Pradesh and Bihar. The tree is distributed on the drier districts of Western Peninsula and Bihar. It is also extensively planted by the Forest Department in the plains as well as up to 750 m in the foothills (Bose *et al.*, 1998).

Description: It is a deciduous tree, approximately 36 m in height and 4.5 m in girth. It has a clean, cylindrical bole. A large gregarious tree up to 30 m high; branchlets slender, drooping, heartwood dark red, extremely hard (Bose *et al.*, 1998).

Flowering season: July to September (Bose *et al.*, 1998).

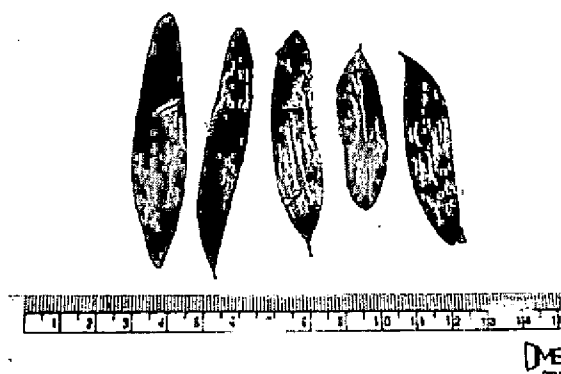
Fruiting season: April and May of the following year. January to March (Bose *et al.*, 1998).

Flowers: They are yellowish green, borne in lax panicles, in ample axillary and terminal panicles; calyx lobes 5, petaloid; petal absent; stamens 10; ovary sessile; ovules 2; stigma peltate (Bose *et al.*, 1998).

Fruits: They are pods tapering at both the ends, strap-shaped, with a seed near the tip.

Fruit type: Pod.

Seeds: Seeds are flat, with a hard testa, pointed at one end and rounded at the other, coriaceous, oblong-lanceolate with parallel longitudinal veins (Bose *et al.*, 1998).



Seeds

Seed dimension:

Seed length: 2 x 1 cm.

Seed width:

Seed thickness:

Seed weight: 3,000 – 5,000 seeds/kg.

Seed dispersal: Wind dispersal.

Seed collection: Ripe fruits are collected from the trees during May to June, dried for 3 to 4 days, cleaned and stored (Vanangamudi *et al.*, 2006). The winged fruit fall to the ground in May to June. The ripe fruits are collected from the tree by plucking during the month of May.

Transportation of seeds:

Seed processing:

Seed storage: Storage can be done in metal tins or polythene containers. However, attack by microbial flora cannot be prevented by seed dressing with fungicide (Aswathanarayana *et al.*, 1997).

Viability period:

Seed emptiness:

Seed pre treatment: The seeds should be soaked in water for 24 hrs. Soak in cold water for 24 hrs prior to sowing (Edwards and Naithani, 1999). IAA at lower concentrations (1-20 ppm) increase germination and plant percentages of *H. binata*. Higher concentrations of IAA has an inhibitory effect. But, IBA promote marginal increases in germination and plant percentages at lower concentrations and has an inhibitory effect at higher concentrations (Tiwari *et al.*, 1999).

Germination type: Epigeal.

Germination percentage: 75 to 80

Germination period:

Nursery technique: Seeds can be put in the bigger bags since growth of root is fast and one year old seedlings can be planted. Also standard sized stumps can be treated with cow's urine for six hrs and put in polybags. The one year old, sprouted stumps can be planted in the field. Seeds sown in mother bed in May-June should be lightly covered by soil. Germination within 20 days (Vanangamudi *et al.*, 2006). Placing the seeds with the embryo in a horizontal or inverted position at a depth of 1.5 cm and 3.0 cm give early and higher germination, higher root and shoot length, greater dry

matter production and vigour index (Masilamani *et al.*, 1999).

Propagation:

Method of propagation: It happens normally by the seeds, but the root suckers also produce seedlings during the rainy season.

Vegetative propagation:

Pests: Defoliation by curculionids, scarabaeids and chrysomelids is very common, especially after the rains. Sap suckers such as psyllids, aphids and membracids play an equally devastating role, causing heavy mortality of seedlings (Sivaramakrishnan and Remadevi, 1996).

Diseases:

Medicinal properties:

Uses: The wood is used as a Timber. The bark yields a fibre used for well ropes. Oleo resin extracted from the heartwood is used in the manufacture of varnishes. Leaves are lopped for fodder. Whole plant extract of *H. binata* has a novel diterpenoid, harbinatic acid (Deng JingZhen *et al.*, 1999).

Wood properties: Wood is dark red to reddish brown with darker streaks. It is coarse textured and dull with an oily feel. It is extremely hard, heavy and durable. It is a diffuse porous wood with growth rings delimited by fine lines of soft tissues which are distinct only under hand lens. Medullary rays fine, numerous, undulating, bent where they text the pores, visible on a radial section as fine plates giving a pretty silver grain. Occasional scanty, fine, concentric lines (Gamble, 1922).

References:

- Aswathanarayana, S.C., Mahadevappa, M., Ranganathaiah, K.G., Kalappa, V.P., Reddy, Y.A.N. 1997. Seed viability and microflora of forest tree species. *Indian Journal of Forestry*. 19(4): 326-329.
- Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 247-248.
- Deng JingZhen, Starck, S.R., Hecht, S.M., Ijames, C.F. and Hemling, M.E. 1999. Harbinatic acid, a novel and potent DNA polymerase beta inhibitor from Hardwickia binata. *Journal of Natural Products*. 62(7): 1000-1002.
- Edwards, D.G. and Naithani, S.C. 1999. Seed and Nursery Technology of forest trees. New Age, New Delhi.
- Gamble, J.S. 1922. A manual of Indian timbers. London Sampson Low, Marton and Company Ltd, Calcutta, India.
- Masilamani, P., Singh, B.G., Chinnusamy, C. and Annadurai, K. 1999. Influence of seed orientation and depth of sowing on germination and vigour of anjan (Hardwickia binata Roxb). *Tropical Agricultural Research and Extension*. 2(1): 76-78.
- Sivaramakrishnan, V.R. and Remadevi, O.K. 1996. Insect pests in forest nurseries in Karnataka, India, with notes on insecticidal control of a psyllid on *Albizia lebbeck*. Impact of diseases and insect pests in tropical forests Proceedings of the IUFRO Symposium, Peechi, India. 460-463.
- Tiwari, P.K., Ravi Agrawal, and Savita Kiran. 1999. Studies on the effect of growth regulators on germination percent and plant percent of some leguminous forest tree species. *Journal of Tropical Forestry*. 15(3): 196-201.
- Vanangamudi, K., Natarajan, K., Saravanan, T., Natarajan, N., Umarani, R., Bharathi, A. and Srimathi, P. 2006. *Advances in Seed Science and Technology*, Vol. 3 : Forest Tree Seed Technology and Management. Agrobios, India.

Holoptelea integrifolia

Nomenclature:

Scientific name: *Holoptelea integrifolia* (Roxb.) Planch.

Vernacular name: Aaval (Malayalam); Ayal (Tamil); Thavasai (Kannada); Papri, Kanju (Hindi) (Chacko *et al.*, 2002).

Common name: Kanju, Rajain (Chacko *et al.*, 2002); Indian elm.

Synonyms: *Ulmus integrifolia* Roxb. (Sasidharan, 2004; Chacko *et al.*, 2002).

Family: Ulmaceae

Subfamily:

Origin:

Distribution: Occurs throughout the greater part of India and extending to Indonesia and Sri Lanka. In Kerala, it occurs in the moist deciduous and semi-evergreen forests at low elevations (Chacko *et al.*, 2002). Sub-Himalayan tract, Kashmir to Nepal, ascending to 600 m Bihar, Bengal, Rajasthan, Madhya Pradesh and the Peninsular India; upper and lower Myanmar; Sri Lanka (Bose *et al.*, 1998).

Description: Fast growing, medium to large sized deciduous tree, with a compact crown.

Flowering season: January to February.

Fruiting season: April to June (FRI, 1981; Chacko *et al.*, 2002).

Flowers: These are separate and greenish yellow in colour. They are small, yellowish green, in short, lateral often compound corymbs, male and bisexual flowers mixed; perianth cleft nearly to the base, segments 8,

hairy; bisexual flowers; stamens 5; ovary compressed, one-celled (Bose *et al.*, 1998).

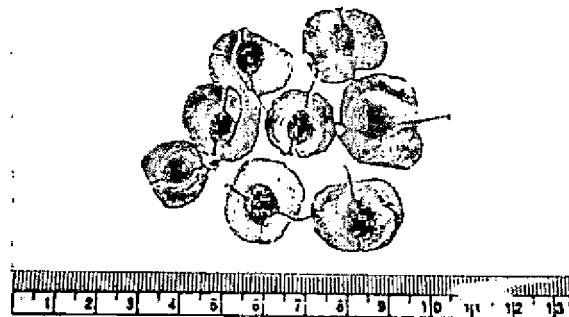
Fruits: Fruit is a samara, 2.5 cm in diameter, on a slender stalk, wings membranous.

Fruit type: Samara.

Seeds: Seeds samara with membranous reticulately veined wings.



Habit



Fruits

Seed dimension:

Seed length: 3 cm (Chacko *et al.*, 2002).

Seed width: 2.33 cm (Chacko *et al.*, 2002).

Seed thickness:

Seed weight: 29,300 fruits/kg (Chacko *et al.*,2002).

Seed dispersal: Wind dispersal (Troup, 1921).

Seed collection: Fruits are collected from the tree by lopping off the branches (Chacko *et al.*,2002).

Transportation of seeds: Samara collected in cotton bags are sent to the processing centre as quickly as possible (Chacko *et al.*, 2002).

Seed processing: Seeds are sun-dried (Chacko *et al.*,2002).

Seed storage: Probably intermediate. Seeds are thoroughly dried and store under low temperature in airtight containers. Seeds do not retain viability more than 7 to 8 months (Chacko *et al.*,2002).

Viability period: Seeds are viable up to six months (Chacko *et al.*,2002).

Seed emptiness: Moderate (Chacko *et al.*,2002).

Seed pre treatment: Not essential (Chacko *et al.*,2002).

Germination type: Epigeal (Chacko *et al.*,2002).

Germination percentage: Up to 64 (Chacko *et al.*,2002).

Germination period: 7 to 20 days (Chacko *et al.*,2002).

Nursery technique: Seeds are sown in germination trays filled with vermiculite and

watered regularly. Overhead shade is necessary. Seedlings are transplanted to polybags (22.5 x 17.5 cm) filled with potting mixture when they are about 5 to 6 cm in height (Chacko *et al.*,2002).

Propagation:

Method of propagation: By seeds.

Vegetative propagation:

Pests: No information (Chacko *et al.*,2002).

Diseases: Damping off is caused by *Rhizoctonia solani*, and blight caused by *Sclerotium rolfsii* [*Corticium rolfsii*] (Mehrotra and Pandey, 1998). Moderate. Thirty-three fungi, a bacterium and actinomycetes are recorded on seeds. Of these, *Alternaria* sp., *Cercospora* sp., *Curvularia* sp., *Fusarium oxysporum* and *Phoma* sp. are the important fungi (Chacko *et al.*,2001).

Medicinal properties: The bark and leaves are bitter, astringent, carminative, laxative. They are useful in vitiated conditions of kapha and pitta.

Uses: Wood is used for brush-backs and handles of dusting brooms, also for indoor purpose. Leaves are used as a fodder. It is also used for reclamation of rocky stream banks, gullied and ravine lands. Bark pulp is made into hardboard and insulation boards. Seeds contain a fatty oil.

Wood properties: Wood light yellowish grey, moderately hard, no heartwood, little used except as fuel.

References:

Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 257.

Chacko, K.C., Mohanan, C., Seethalakshmi, K.K. and George Mathew. 2001. Seed handling and nursery practices for selected forest trees of Kerala. Final Technical Report of ICFRE – World Bank Forestry Research Education and Extension Project. Kerala Forest Research Institute, Peechi.

Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 142-143.

FRI. 1981. Troup's The Silviculture of Indian Trees. Vol. III. The Controller of Publications, Delhi.

Mehrotra, M.D. and Pandey, P.C. 1998. Two destructive nursery diseases of Holoptelia integrifolia and their management. Indian Forester. 124(1): 79-81.

Sasidharan, N. 2004. Forest Trees of Kerala. Kerala Forest Research Institute, Peechi, Kerala, India.

Troup, R. S. 1921. The Silviculture of Indian Trees. (Vol. III) International Book Distributors, Dehra Dun.

Hopea parviflora

Nomenclature:

Scientific name: *Hopea parviflora* Bedd.

Vernacular name: Kambakam, Thambakam, Irumbukam, Urippu (Malayalam); Irumbugam, Vellai Kongu, Pongu (Tamil); Bovige (Hindi) (Chacko *et al.*, 2002); Kongu (Gamble, 1922).

Common name: Iron wood of Malabar (Bose *et al.*, 1998); *Hopea* (Chacko *et al.*, 2002).

Synonyms:

Family: Dipterocarpaceae

Subfamily:

Origin:

Distribution: Common in moist tropical evergreen forests of the Western Ghats. Found in Kerala, Tamil Nadu and Karnataka. Fairly common in the Western Ghats from Karnataka, Kerala and extends to Tirunelveli district of Tamil Nadu (FRI, 1980). In Kerala, it is found in the evergreen and semi-evergreen forests (Chacko *et al.*, 2002).

Description: A large evergreen tree with a dense crown reaching 30 to 37 m height and 4 to 4.5 m breadth (Bose *et al.*, 1998).

Flowering season: January to February (Troup, 1921), March to April (Bose *et al.*, 1998). Flower during the last week of March to first week of April (Sunilkumar and Sudhakara, 1998).

Fruiting season: May and June (Troup, 1921). Fruits ripen by the end of May (Sunilkumar and Sudhakara, 1998).

Flowers: Small cream coloured fragrant flowers, tomentose, in lax panicles of unilateral cymes; calyx segments lanceolate, grey tomentose (Bose *et al.*, 1998).

Fruits: They are small nuts, black, ovoid, apiculate with two straw coloured wings.

Fruit type:



Habit



Fruits

Seeds: Light seeds. At the time of shedding, seeds have a moisture content of 41% (wet

weight basis). Among the seed components, the embryo has the highest moisture percentage (Sunilkumar and Sudhakara, 1998).

Seed dimension:

Seed length: 0.7 cm (Tompsett and Kemp, 1996; Chacko *et al.*, 2002).

Seed width: 0.6 cm (Tompsett and Kemp, 1996; Chacko *et al.*, 2002).

Seed thickness:

Seed weight: 2,470 fruits /kg (with wings) (FRI, 1980; Chacko *et al.*, 2002); 4,100 to 4,586 seeds/kg (without wings) (Tompsett and Kemp, 1996; Chacko *et al.*, 2002).

Seed dispersal: Wind dispersal.

Seed collection: Fruits may be collected from the tree when the wing colour changes from green to brown (Tomposett and Kemp, 1996). Seed collection from tree is laborious. Mature seeds falling during the pre-monsoon showers, can be conveniently collected from the ground. As the fallen seeds germinate soon, collection may be done soon after seed fall. Always check a small sample of seeds before collecting, since insect infestation may be excessive in some localities (Chacko *et al.*, 2002).

Transportation of seeds: The fruits are transported in ventilated containers. If the wings are left intact, a reservoir of air is created which provides support for respiration; this method will limit both the imbibition of moisture and the accumulation of heat produced by respiration, thereby reducing the chance of germination during transport. Polythene bags with small ventilation holes, and open-weave sacks are different types of containers used for transport. Where greater rigidity is required, these containers should in turn be closed in cardboard or wooden boxes provided with

ventilation holes (Tompsett and Kemp, 1996; Chacko *et al.*, 2002).

Seed processing: Wings are removed for ease in handling and reduction of bulk (Tompsett and Kemp, 1996; Chacko *et al.*, 2002).

Seed storage: Recalcitrant (Tompsett and Kemp, 1996; Chacko *et al.*, 2002). Seeds can be stored for about a week without loss of viability under normal conditions (Dent, 1948). For larger quantities of seed, storage at or near harvest moisture content in media such as softwood sawdust (16% moisture content) and perlite (0 to 4% moisture content) is recommended (Tompsett and Kemp, 1996; (Chacko *et al.*, 2002). The critical moisture content of the seeds of *H. parviflora* is 26% and those of *H. ponga* was 28%. When subjected to desiccation in a freezer (0+or-2°C) the seeds of *H. parviflora* will loose their viability within six hrs, and those of *H. ponga* within four hrs. The duration for initiation and completion of germination increases when the temperature is decreased to below 20°C and the seeds fail to germinate at temperatures below 5°C. The germination and vigour of the seeds germinated between 30 to 35°C are high, but the optimal temperature for germination of the seeds of the two species is 30°C (Dayal and Kaveriappa, 2000). Germination is maintained in storage in mud pots with or without sand medium. When seeds are treated with Emisan (1% a.i.) and stored at 10°C, 87% germination will be obtained at the end of 40 days. Storing at 10°C without Emisan result in markedly decreased germination percentage (18%). Treatment with Emisan will not affect the germination parameters (Sunilkumar and Sudhakara, 1998). Storage at temperature 10°C and 4°C retain the viability up to one and four weeks for the intact and synthetic seeds, respectively. Both synthetic seeds and intact

seeds stored at room temperature (27±2°C and 29±2°C, respectively) retain the viability only up to one week with approximately 30% germination. Synthetic seeds obtained from seeds pre-treated with 2 and 3 mg/litre abscisic acid show tolerance to low storage temperature and retain higher percentage germination (Sunilkumar and Sudhakara, 2000).

Viability period: Seed is viable up to 10 days under normal conditions (Chacko *et al.*, 2002). Intense rainfall at the time of fruit ripening often induces vivipary of most of the seeds (Sunilkumar and Sudhakara, 1998).

Seed emptiness: Low (Chacko *et al.*, 2002).

Seed pre treatment: De-winging prior to sowing is recommended. Ideal germination temperature is 31°C (Tompsett and Kemp, 1996; Chacko *et al.*, 2002).

Germination type: Epigeous (Chacko *et al.*, 2002).

Germination percentage: 68 to 84 (Tompsett and Kemp, 1996; Chacko *et al.*, 2002). Seeds sown immediately after collection gave 96% germination. After 12 days of storage, seeds had lost 39% of the initial moisture content and were not viable (Muralikrishna and Chandrashekar, 1997).

Germination period: 11 to 37 days (Dent, 1948; Chacko *et al.*, 2002).

Nursery technique: Seeds may be dibbled in vermiculite or river sand medium (in trays) with or without wings, horizontally or with wings downwards. Germinated seedlings can be pricked out to polythene bags or root-trainers filled with appropriate potting mixture (Chacko *et al.*, 2002).

Propagation:

Method of propagation: Vegetative propagation.

Vegetative propagation: Branch cuttings of 2 mm to 3 mm thickness and 7 cm length when dipped for one minute in IBA 2000 ppm solution results in 30% rooting and sprouting (Chacko *et al.*, 2002).

Pests: High infestation due to *Bruchus chinensis* Lin. (Coleoptera: Bruchidae) (Chacko *et al.*, 2002).

Diseases: High (67%). Seeds are harboured by a rich microflora. Nineteen fungi, actinomycetes and bacteria are recorded on seeds. *Fusarium* sp., *Botryodiplodia theobromae*, *Cylindrocladium quinqueseptatum* are the important field fungi associated with seed discolouration and rot (Chacko *et al.*, 2002).

Medicinal properties: The tannin content ranges from 14 to 28% of the exudate and is very astringent with a slow rate of diffusion. Used to keep off land leeches (Nazarudeen, 2003).

Uses: Wood is used for building purposes, piles for bridges, platform boards, ladders, carts, carriages, turnery etc. The bark contains tannin used in leather industries (Bose *et al.*, 1998).

Wood properties: Wood brown and close grained, strong and durable. Pores small and moderate sized. The average air dry weight of wood, 929 kg/m³. Medullary rays moderately broad, prominent, generally bent where they touch the pores, uniform and equidistant (Gamble, 1922).

References:

- Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 258-259.
- Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 144-145.
- Dayal, B.R. and Kaveriappa, K.M. 2000. Effect of desiccation and temperature on germination and vigour of the seeds of *Hopea parviflora* Beddome and *H. ponga* (Dennst.) Mabb. *Seed Science and Technology*. 28(2): 497-506.
- Dent, T.V. 1948. Seed storage with particular reference to the storage of seed of Indian forest plants. *Indian Forest Records (New Series) Silviculture*, 7: 134 pp. Manager of Publications, Delhi.
- FRI. 1980. Troup's The Silviculture of Indian Trees. Vol. II. The Controller of Publications, Delhi.
- Gamble, J.S. 1922. A manual of Indian timbers. London Sampson Low, Marton and Company Ltd, Calcutta, India.
- Muralikrishna, H. and Chandrashekar, K.R. 1997. Regeneration of Hopea ponga: influence of wing loading and viability of seeds. *Journal of Tropical Forest Science*. 10(1): 58-65 .
- Nazarudeen, A. 2003. Leech repellents of plant origin used by the tribal communities of Kerala. *Journal of Economic and Taxonomic Botany*. 27: 804-807.
- Sunilkumar, K.K. and Sudhakara, K. 1998. Effect of temperature, media and fungicide on the storage behavior of Hopea parviflora seeds. *Seed Science and Technology*. 26(3): 781-797.
- Sunilkumar, K.K., Sudhakara, K. and Vijayakumar, N.K. 2000. An attempt to improve storage life of Hopea parviflora seeds through synthetic seed production *Seed Research*. 28(2): 126-130.
- Tompsett, P.B. and Kemp, R. 1996. Database of Tropical Tree Seed Research with Special Reference to Dipterocarpaceae, Meliaceae and Araucariaceae. Royal Botanic Garden, Kew, U.K.
- Troup, R. S. 1921. The Silviculture of Indian Trees. (Vol. I) International Book Distributors, Dehra Dun.

Hydnocarpus pentandra

Nomenclature:

Scientific name: *Hydnocarpus pentandra* (Buch.-Ham.) Oken

Vernacular name: Marotti, Neerutti (Malayalam); Maravetti (Tamil) (Chacko *et al.*, 2002).

Common name: Marotti oil tree (Chacko *et al.*, 2002).

Synonyms: *Hydnocarpus wightiana* Bl.; *H. laurifolia* Dennst. ex Sleumer; *Chilmoria pentandra* Buch.-Ham. (Chacko *et al.*, 2002); *Hydnocarpus inebrians* Wall.

Family: Flacourtiaceae

Subfamily:

Origin:

Distribution: Common in the Western Ghats from Konkan southwards and in Kerala it occurs in semi-evergreen and evergreen forests up to 600 m (Chacko *et al.*, 2002).

Description: Moderate sized evergreen tree reaching a height of 20 m and a breast height diameter of 32 cm (Chacko *et al.*, 2002).

Flowering season: February to March (Bourdillon, 1908) or in July to August.

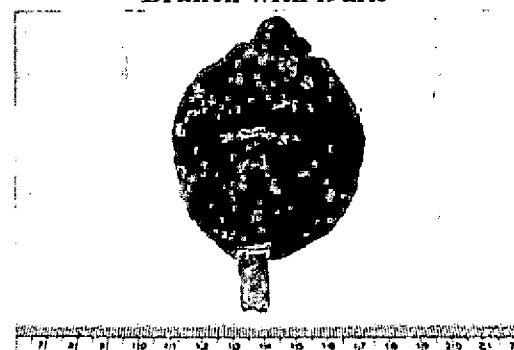
Fruiting season: October to December (Bourdillon, 1908) or March to April; May and June (Sen Gupta, 1937; Chacko *et al.*, 2002).

Flowers: Flowers greenish yellow in solitary or few flowered, axillary cymes or fascicles. Flowers white, petals ciliate, twice as long as the ovate fimbriate scales. Flowers in short fascicles about 2.5 cm long

or solitary, white, 0.6 cm in across (Bourdillon, 1908).



Branch with fruits



Fruit



Seeds

Fruits: Fruit is a berry, globose (Chacko *et al.*, 2002). A large hard rinded berry, tomentose. Fruits brown, woody and tubercled, globose, 5-10 cm diameter (Bourdillon, 1908).

Fruit type: Berry.

Seeds: Seeds dark grey, up to 1.5 cm long, obtusely angular, blunt at apex.

Seed dimension:

Seed length: 2-2.5 cm (Chacko *et al.*, 2002).

Seed width:

Seed thickness:

Seed weight: 700 to 900 seeds/kg (Chacko *et al.*, 2002).

Seed dispersal:

Seed collection: Mature fruits are collected from the tree by lopping off the branches. Seed collection from the ground should be avoided, as most of the fallen seeds are predated and attacked by animals (Chacko *et al.*, 2002).

Transportation of seeds: No special care is needed (Chacko *et al.*, 2002).

Seed processing: Pericarp is broken, depulped, and the seeds are extracted by hand and sun-dried (Chacko *et al.*, 2002).

Seed storage: Recalcitrant (CABI, 1998). Seeds do not retain viability for more than two months (Chacko *et al.*, 2002).

Viability period: No information (Chacko *et al.*, 2002).

Seed emptiness: Low (Chacko *et al.*, 2002).

Seed pre treatment: Soaking in cold water for 24 hrs (Chacko *et al.*, 2002).

Germination type: Epigeal (Chacko *et al.*, 2002).

Germination percentage: No information (Chacko *et al.*, 2002).

Germination period: No information (Chacko *et al.*, 2002).

Nursery technique: Freshly collected and pretreated seeds are sown in vermiculite in germination trays and watered regularly. The seedlings are pricked out and potted in polythene bags of 20 x 10 cm size and maintained under shade (Chacko *et al.*, 2002).

Propagation:

Method of propagation:

Vegetative propagation:

Pests: Low (Chacko *et al.*, 2002).

Diseases: Moderate (21-57.5%). Ten fungi and actinomycetes were recorded. *Chaetominum*, *Cephalosporium*, and *Fusarium* species were the important fungi recorded on seeds (Mohanan and Anil Chandran, 2001; Chacko *et al.*, 2002).

Medicinal properties: It is medicinally important for rheumatic and other complaints. Seed oil is used internally and externally for leprosy and worms. Seeds pound with sandal and applied to sores and ulcers.

Uses: Seeds of the tree yield hydnocarpus oil. The oil is used as an illuminant.

Wood properties: Wood whitish and perishable. Wood dull greyish white, coarse and soft. No heart, pores very small, numerous and well distributed (Bourdillon, 1908).

References:

Bourdillon, T.F. 1908. Forest trees of Travancore. International Book Distributors, Dehradun. pp. 18-19.

CABI. 1998. The Forestry Compendium – A Silvicultural Reference. Module 1. CABI Publishing, CAB International, Wallingford, Oxon, OX108DE, UK.

Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 146-147.

Mohanan, C. and Anil Chandran. 2001. Microorganisms associated with seeds of tropical forest species and their management for improving the storability and seedling production. Seed Science and Technology (in press).

Sen Gupta, J.N. 1937. Seed weights, plant percents, etc. for forest plants in India. Indian Forest Records (New Series) Silviculture, 2:221pp. Manager of Publications, Delhi.

Jacaranda mimosifolia

Nomenclature:

Scientific name: *Jacaranda mimosifolia*
D. Don.

Vernacular name: Jacaranda
(Malayalam) (Chacko *et al.*, 2002)

Common name: Brazilian rosewood,
Mimosa-leaved Jacaranda (Chacko *et al.*, 2002)

Synonyms: *Jacaranda ovalifolia* R. Br.
(Chacko *et al.*, 2002)

Family: Bignoniaceae

Subfamily:

Origin:

Distribution: Native of South America. In Kerala it is often planted in tea gardens as shade tree (Chacko *et al.*, 2002).

Description: Small to medium sized evergreen tree, attaining a height up to 20 m (Luna, 1996; Chacko *et al.*, 2002).

Flowering season: March and also in other times.

Fruiting season: November to January (Chacko *et al.*, 2002).

Flowers: Blue mauve flowers, borne profusely in loose pyramidal terminal panicles of 40 to 100.

Fruits: Fruit is a capsule, 7.5 cm x 5 cm in size, broadly ovate or sub orbicular in shape with many compressed winged seeds (Chacko *et al.*, 2002).

Fruit type: Capsule.

Seeds: Seed winged.

Seed dimension:

Seed length:

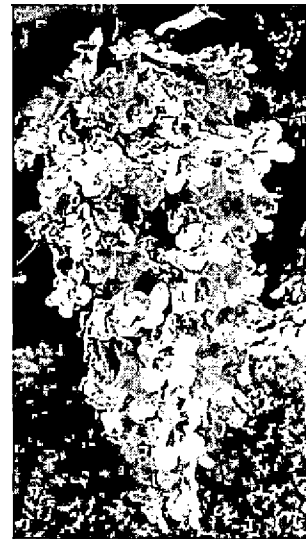
Seed width:

Seed thickness:

Seed weight: 11,000 to 1,00,000 seeds/kg (Carlowitz, 1991; Chacko *et al.*, 2002).

Seed dispersal:

Seed collection: Mature pods are collected from the tree by lopping off the branches (Chacko *et al.*, 2002).



Inflorescence



Fruits

Transportation of seeds: Pods collected in cotton bags are transported, to the processing centre (Chacko *et al.*, 2002).

Seed processing: The pods are dried in the sun. When they open, seeds are extracted by hand. Care should be taken during extraction of seeds as they are easily carried away by wind. Seeds are sun-dried (Chacko *et al.*, 2002).

Seed storage: Orthodox (Kindt *et al.*, 1997). Seeds can be stored in airtight containers for one year (Chacko *et al.*, 2002).

Viability period: Seeds retain viability up to one year (Chacko *et al.*, 2002).

Seed emptiness: Low (Chacko *et al.*, 2002).

Seed pre treatment: Not required (Chacko *et al.*, 2002).

Germination type: Epigeal (Chacko *et al.*, 2002).

Germination percentage: 50 to 90 (Carlowitz, 1991; Chacko *et al.*, 2002).

Germination period: 10 to 15 days (Chacko *et al.*, 2002). Germination percentage and rate are highest at 25°C. White light slightly enhance germination at temperatures ranging from 20 to 35°C (compared with seeds in the dark), indicating the possible role of phytochrome B in the control of seed germination in this species. Germination percentage and rate decreased as water stress increase from 0 to -0.9 MPa (Socolowski and Takaki, 2004).

Nursery technique: Seeds are sown in germination trays filled with soil and watered regularly. Overhead shade is necessary. Seedlings are potted in poly bags (22.5x17.5 cm) containing potting mixture when they attain about 5 to 6 cm height (Chacko *et al.*, 2002).

References:

Carlowitz, P.G.V. 1991. Multipurpose Trees and Shrubs: Source of seeds and Inoculants. International Council for Research in Agroforestry, Nairobi, Kenya.

Propagation:

Method of propagation: Cuttings of half-ripened wood.

Vegetative propagation:

Pests: Nil (Chacko *et al.*, 2002). In forest nurseries defoliation by curculionids, scarabaeids and chrysomelids is very common, especially after the rains. Sap suckers such as psyllids, aphids and membracids play an equally devastating role, causing heavy mortality of seedlings. Phorate is effective in preventing psyllid infestations of seedlings when added to polybags prior to transplantation (Sivaramakrishnan and Remadevi, 1996).

Diseases: No information (Chacko *et al.*, 2002).

Medicinal properties: The plant is used medicinally in Colombia : an infusion of the leaves is taken as a pectoral ; the powdered leaves are used as vulnerary ; an infusion of the bark is used as a lotion to wash ulcers ; the bark and the leaves are given internally for syphilis and blennorrhagia. Crude extracts show activity against *Salmonella typhi* and *Shigella dysenteriae* at low concentrations (Dada *et al.*, 2002). Infusions or decoctions of flowers or leaves of *Jacaranda mimosifolia* are traditionally used in Guatemala to treat amoebic dysentery (Magnez *et al.*, 1996).

Uses: It is an excellent ornamental tree in avenues, parks and gardens.

Wood properties: The wood is white, moderately hard and moderately heavy. It is characterised by diffuse porous structure with numerous small pores.

- Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 148-149.
- Dada, J.D., Alade, P.I., Ahmad, A.A. and Yadock, L.H. 2002. Antimicrobial activities of some medicinal plants from Soba Zaria, Nigeria. Nigerian Quarterly Journal of Hospital Medicine. 12(1): 55-56.
- Kindt, R., Mausya, S., Kimotho, J. and Waruhiu. 1997. Tree seed suppliers Directory: Sources of Seeds and Microsymbionts. International Centre for Research in Agro Forestry (ICRAF), Nairobi, Kenya.
- Luna, R.K. 1996. Plantation Trees. International Book Distributors, Dehra Dun, India.
- Magnez, I., Duriez, T., Delelis Dusollier, A. and Nicolas, J.P. 1996. Attempt at demonstrating the anti-amoebic activity of Jacaranda mimosifolia D. Don. Bulletin de la Societe Francaise de Parasitologie. 14(1): 89-93.
- Sivaramakrishnan, V.R. and Remadevi, O.K. 1996. Insect pests in forest nurseries in Karnataka, India, with notes on insecticidal control of a psyllid on Albizia lebbeck. Impact of diseases and insect pests in tropical forests Proceedings of the IUFRO Symposium, Peechi, India. 460-463.
- Socolowski, F. and Takaki, M. 2004. Germination of Jacaranda mimosifolia (D. Don - Bignoniaceae) seeds: effects of light, temperature and water stress. Brazilian Archives of Biology and Technology. 47(5): 785-792.

Knema attenuata

Nomenclature:

Scientific name: *Knema attenuata*
(Wall.ex Hk.f. & Thoms.)

Vernacular name: Chora - payin, Chen-
nelli, Chora panu, Chenalla (Malayalam)
(Gamble, 1922); Chora pathiri (Tamil)

Common name:

Synonyms: *Myristica attenuata* Wall.ex Hk.f.
& Thoms., *Myristica corticosa sensu* Bedd.
(Gamble, 1922; Sasidharan, 2004)

Family: Myristicaceae

Subfamily:

Origin:

Distribution: It is found in Western Ghats
and common in evergreen forests..

Description: A medium-sized or large tree,
15-18 m high; young branchlets and
inflorescence densely rusty-tomentose
(Bose et al., 1998)

Flowering season: December to March,
November to December (Bose et al., 1998)

Fruiting season: December to March,
February to April (Bose et al., 1998)

Flowers: Flowers dioecious. Male and
female in axillary or lateral fascicles, rusty
pubescent; perianth 3 lobed; stamens 8-20,
connate by their bases, form a peltate disc,
stalked; ovary ovoid, superior, 1-locular;
ovule 1, basal (Anil Kumar et al., 2005).
Male flowers nearly globose, 4-5 mm in
diameter (Bose et al., 1998)

Fruits: Capsule ellipsoid, rusty pubescent,
ovoid, 2.5-3.5 cm long with short point or
beak, densely rusty-tomentose; pericarp
thin; aril entire except the lobed apex (Bose
et al., 1998; Anil Kumar et al., 2005)

Fruit type: Capsule.

Seeds: Seeds arillate (Anil Kumar et al.,
2005)

Seed dimension:

Seed length:

Seed width:

Seed thickness:

Seed weight:

Seed dispersal:

Seed collection:

Transportation of seeds:

Seed processing:

Seed storage:

Viability period:

Seed emptiness:

Seed pre treatment:

Germination type:

Germination percentage:

Germination period:

Nursery technique:

Propagation:

Method of propagation:

Vegetative propagation:

Pests:

Diseases:

Medicinal properties: The roots, leaves and flowers are used in native medicine. The flowers are acrid with a flavour, useful in Kapha and vata, bilious diarrhoea, burning sensations. The root bark is an ingredient in dasamula.

Uses: *Knema attenuata* used to keep off land leeches by tribal communities in wet evergreen forests of Kerala (Nazarudeen, 2003)

Wood properties: The timber is useful for good board, packing cases, match boxes and splints. Seeds yield a fixed oil (Bose et al., 1998) The wood is pinkish to pale red, moderately hard (Bose et al., 1998). Wood pale brown, moderately hard of little value. Wood light reddish brown, soft (Gamble, 1922)

References:

- Anil Kumar, N., Sivadasan, M. and Ravi, N. 2005. Flora of Pathanamthitta (Western Ghats, Kerala, India). Daya publishing house, New Delhi.
- Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 274.
- Gamble, J.S. 1922. A manual of Indian timbers. London Sampson Low, Marton and Company Ltd, Calcutta, India.
- Nazarudeen, A. 2003. Leech repellents of plant origin used by the tribal communities of Kerala. Journal of Economic and Taxonomic Botany. 27(4): 804-807.
- Sasidharan, N. 2004. Forest Trees of Kerala. Kerala Forest Research Institute, Peechi, Kerala, India.

Kydia calycina

Nomenclature:

Scientific name: *Kydia calycina* Roxb.

Vernacular name: Vellachadachi (Malayalam); Vattakannu, Vendai (Tamil); Bellaka, Bendi (Kannada) (Chacko *et al.*, 2002); Patha, Puli, Pula (Hindi) (Troup, 1921)

Common name: *Kydia* (Chacko *et al.*, 2002)

Synonyms: *Kydia fraterna* Roxb.; *Kydiaroxburgiana* Wight (Chacko *et al.*, 2002)

Family: Malvaceae

Subfamily:

Origin:

Distribution: Common throughout India and Myanmar in mixed deciduous forests. In Kerala, it occurs in moist deciduous forests up to 900 m (Chacko *et al.*, 2002).

Description: Attaining a height of 12 m or often more; branchlets and inflorescence grey-tomentose (Bose *et al.*, 1998). Moderately fast growing, small to medium sized deciduous tree reaching a height of 18 m and breast height diameter of 25.5 cm (Chacko *et al.*, 2002). Moderate sized deciduous tree (Troup, 1921).

Flowering season: September to November. September to October (Troup, 1921).

Fruiting season: November to February, December to April (Sen Gupta, 1937; Chacko *et al.*, 2002). January to late March (Troup, 1921).

Flowers: Flowers in axillary or terminal panicle, greenish white or pink in colour and they are numerous. Flowers white, in

terminal paniculate cymes, polygamous, 1.5 cm across; epicalyx segments 4-6; petals obovate, emarginate, fimbriate, clawed; pistillode absent in male flowers; ovary 2- or 3-celled; ovules 1 or 2 per cell; staminodes absent in female flowers (Bose *et al.*, 1998).

Fruits: Fruit is a capsule, small and globose.

Fruit type: Capsule.

Seeds: The greyish brown, reniform seeds, furrowed with striations are enclosed in capsules, which are 3-valved, tomentose, globose, subtended by the dry persistent calyx, 8 mm across (Chacko *et al.*, 2002).

Seed dimension:

Seed length: 2-3 mm across (Chacko *et al.*, 2002).

Seed width:

Seed thickness:

Seed weight: 32,000 to 1,58,000 seeds/kg (Sen Gupta, 1937; Kindt *et al.*, 1997; Chacko *et al.*, 2002).

Seed dispersal: Wind dispersal.

Seed collection: Capsules are collected from the tree by lopping off the branches (Chacko *et al.*, 2002).

Transportation of seeds: Capsules collected in cotton/plastic/polythene bags are transported to the processing centre as quickly as possible (Chacko *et al.*, 2002).

Seed processing: Capsules are dried in cloth bags under the sun. By rubbing the capsules, seeds are extracted by hand and cleaned by winnowing (Chacko *et al.*, 2002).

Seed storage: Intermediate (CABI, 1998; Chacko *et al.*, 2002). Seeds are stored in

airtight containers for six months in cold conditions (Chacko *et al.*,2002).

Viability period: Seeds retain viability for about six months (Chacko *et al.*,2002).

Seed emptiness: Moderate (Chacko *et al.*, 2002).

Seed pre treatment: Cold water soaking for 24 hrs (Chacko *et al.*, 2002).

Germination type: Epigeal (Chacko *et al.*,2002; Troup, 1921).

Germination percentage: 12 (Sen Gupta, 1937) to 30 (Carlowitz, 1991; Chacko *et al.*,2002). Low (Troup, 1921).

Germination period: 28 to 71 days (Sen Gupta, 1937; Chacko *et al.*,2002).

Nursery technique: Due to high seed infertility seeds are sown in nursery beds or germination trays thickly and watered regularly. Seedlings are potted in polythene bags of size 20x10 cm filled with appropriate potting mixture (Chacko *et al.*,2002).

Propagation:

Method of propagation: By seeds.

Vegetative propagation:

Pests: Nil (Chacko *et al.*,2002).

Diseases: Moderate. *Fusarium moniliforme*, *F. semitectum*, *Phoma* sp. are the important fungi recorded on seeds. (Mohanani and Sharma, 1991; Chacko *et al.*,2002).

Medicinal properties: The leaves are applied as paste in body pain. It is also chewed in the formation of saliva. Locally, its poultice is used for skin diseases.

Uses: The tree is grown for ornamental and has particularly attractive flower in September-November. The tree is valued for the leaves which are lopped for fodder. Wood is used for small timbers and fuel wood.

Wood properties: The sapwood is creamy, wide and the heartwood, which is sharply defined, is greyish brown with purplish tinge, small. The wood is soft and light (average air dry weight 384 kg/m³. Annual rings marked by white lines. Pores scanty, moderate sized, often oval and subdivided. Medullary rays short, fine to broad, numerous, joined by white transverse bars (Gamble, 1922).

References:

Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 279.

CABI. 1998. The Forestry Compendium – A Silvicultural Reference. Module 1. CABI Publishing, CAB International, Wallingford, Oxon, OX108DE, UK.

Carlowitz, P.G.V. 1991. Multipurpose Trees and Shrubs: Source of seeds and Inoculants. International Council for Research in Agroforestry, Nairobi, Kenya.

Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 150-151.

Gamble, J.S. 1922. A manual of Indian timbers. London Sampson Low, Marton and Company Ltd, Calcutta, India.

Kindt, R., Mausya, S., Kimotho, J. and Waruhiu. 1997. Tree seed suppliers Directory: Sources of Seeds and Microsymbionts. International Centre for Research in Agro Forestry (ICRAF), Nairobi, Kenya.

Mohanan, C. and Sharma, J.K. 1991. Seed pathology of forest tree species in India – Present status, practical problems and future prospects. Commonwealth Forestry Review, 70: 113-151.

Sen Gupta, J.N. 1937. Seed weights, plant percents, etc. for forest plants in India. Indian Forest Records (New Series) Silviculture, 2:221pp. Manager of Publications, Delhi.

Troup, R. S. 1921. The Silviculture of Indian Trees. (Vol. I) International Book Distributors, Dehra Dun.

Lagerstroemia microcarpa

Nomenclature:

Scientific name: *Lagerstroemia microcarpa* Wight

Vernacular name: Vellilavu, Venthekku (Malayalam); Venteak, Chennanji, Benteak (Tamil); Benteak (Hindi); Billinandi, Benteak (Kannada) (Chacko *et al.*, 2002)

Common name: Benteak (Chacko *et al.*, 2002)

Synonyms: *L. lanceolata* Wall. ex Cl.; *L. thomsonii* Koehne (Sasidharan, 2004; Chacko *et al.*, 2002)

Family: Lythraceae

Subfamily:

Origin:

Distribution: Occurs in the west coast of Indian Peninsula in moist mixed deciduous forests, (FRI, 1984). In Kerala it occurs in moist deciduous and semi - evergreen forests (Chacko *et al.*, 2002). This is one of the most important tree of the West coast of the Indian Peninsula, where it is common along and below the western Ghats from Bombay Southwards to Travancore (Bose *et al.*, 1998).

Description: Moderately fast growing, medium sized to large deciduous tree attaining a height up to 30 m and a breast height diameter of 95 cm (Chacko *et al.*, 2002).

Flowering season: April to June (Bose *et al.*, 1998).

Fruiting season: March (Sen Gupta, 1937; Chacko *et al.*, 2002); Cold season (Bose *et al.*, 1998).

Flowers: Flowers small, white, in large terminal panicle cymes; calyx hoary, reflexed (Bose *et al.*, 1998).

Fruits: Capsules, ellipsoid, 8-12 mm long.

Fruit type: Capsule.



Fruits

Seeds: Small light seeds are enclosed in capsules, that are ellipsoid, smooth, 4-valved, 1.2 to 2 cm long (Chacko *et al.*, 2002).

Seed dimension:

Seed length: 0.8 cm (Chacko *et al.*, 2002).

Seed width:

Seed thickness:

Seed weight: 2,68,082 (Sen Gupta, 1937) to 3,00,000 (Nair *et al.*, 2002) seeds/kg (Chacko *et al.*, 2002).

Seed dispersal:

Seed collection: Ripe capsules, which are brown in colour, are collected from the tree before dehiscence, since the seeds are winged and wind dispersed (FRI, 1984; Chacko *et al.*, 2002).

Transportation of seeds: Capsules collected in cotton/plastic/polythene bags are transported to the processing centre as quickly as possible (Chacko *et al.*, 2002).

Seed processing: Capsules are dried in cloth bags under the sun. By rubbing the capsules, seeds are extracted by hand and cleaned by winnowing (Chacko *et al.*, 2002).

Seed storage: Intermediate (CABI, 1998; Chacko *et al.*, 2002). Seeds are stored in airtight containers for 6 months in cold conditions (Chacko *et al.*, 2002).

Viability period: Seeds retain viability for about 6 months (Chacko *et al.*, 2002).

Seed emptiness: Moderate (Chacko *et al.*, 2002).

Seed pre treatment: Cold water soaking for 24 hrs (Chacko *et al.*, 2002).

Germination type: Epigeal (Chacko *et al.*, 2002).

Germination percentage: 2 to 20 (FRI, 1984; Chacko *et al.*, 2002).

Germination period: 8 to 66 days (FRI, 1984; Chacko *et al.*, 2002).

Nursery technique: Seeds are sown in germination trays filled with vermiculite and watered regularly. After one month the seedlings are pricked out into 22.5 x 17.5 cm polybags. Seedlings are ready for planting in the next planting season (Rai, 1999; Chacko *et al.*, 2002).

Propagation:

Method of propagation: Stump cuttings (Chacko *et al.*, 2002).

Vegetative propagation:

Pests: No information (Chacko *et al.*, 2002).

Diseases: Moderate to High (24 to 94 %). 23 fungi belonging to 19 genera and actinomycetes are recorded. *Fusarium semitectum*, *Alternaria* sp., *Curvularia* sp., *Drechslera* sp., *Colletotrichum gloeosporioides*, *Helminthosporium* sp., *Phoma* sp., etc. are the important spermoplane fungi (Mohamed Ali and Sharma, 1996; Mohanan and Sharma, 1991 and Chacko *et al.*, 2001). Damping-off caused by *Pythium middletonii* is observed in *L. microcarpa* (Mohamed Ali and Sharma, 1996).

Medicinal properties:

Uses: Wood is used for house building, furniture, ships, boats etc. The leaves are used as green manure (FRI, 1984; Chacko *et al.*, 2002). Leaves and fruits contain tannin (Bose *et al.*, 1998).

Wood properties: The sapwood is greyish or pinkish white and the heartwood is light reddish brown to walnut brown. It is moderately hard and moderately heavy wood with straight to interlocked grain and medium coarse texture. Weight 673 kg/m³. Annual rings fairly distinct. Pores small to large, often subdivided and in patches or singly, joined by narrow, irregular, transverse, wavy bands of soft texture. Medullary rays very fine, very numerous, bent round small pores and either bend round or ending in the larger ones. Pores conspicuous on a longitudinal section (Gamble, 1922).

References:

Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 281.

CABI. 1998. The Forestry Compendium – A Silvicultural Reference. Module 1. CABI Publishing, CAB International, Wallingford, Oxon, OX108DE, UK.

Chacko, K.C., Mohanan, C., Seethalakshmi, K.K. and George Mathew. 2001. Seed handling and nursery practices for selected forest trees of Kerala. Final Technical Report of ICFRE – World Bank Forestry Research Education and Extension Project. Kerala Forest Research Institute, Peechi.

Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 152-153.

FRI. 1984. Troup's The Silviculture of Indian Trees. Vol. V. The Controller of Publications, Delhi.

Gamble, J.S. 1922. A manual of Indian timbers. London Sampson Low, Marton and Company Ltd, Calcutta, India.

Mohamed Ali, M.I. and Sharma, J.K. 1996. Seedling diseases of some indigenous trees of Kerala and their impact on seedling productivity. Impact of diseases and insect pests in tropical forests Proceedings of the IUFRO Symposium, Peechi, India. pp. 66-80.

Mohanan, C. and Sharma, J.K. 1991. Seed pathology of forest tree species in India – Present status, practical problems and future prospects. Commonwealth Forestry Review, 70: 113-151.

Nair, K.K.N., Mohanan, C. and George Mathew, 2002. Plantation technology for nine Selected indigenous tree species of Kerala State. KFRI Research Report No. 231. Kerala Forest Research Institute, Peechi, Kerala, India. P. 110.

Rai, S.N. 1999. Nursery and Planting Techniques of Forest Trees in Tropical South-Asia. Eastern Press, Bangalore, India.

Sasidharan, N. 2004. Forest Trees of Kerala. Kerala Forest Research Institute, Peechi, Kerala, India.

Sen Gupta, J.N. 1937. Seed weights, plant percents, etc. for forest plants in India. Indian Forest Records (New Series) Silviculture, 2:221pp. Manager of Publications, Delhi.

Lagerstroemia parviflora

Nomenclature:

Scientific name: *Lagerstroemia parviflora* Roxb.

Vernacular name: Chenanki (Malayalam); Ventek, Peikadukkai (Tamil); Adhuri (Hindi) (Chacko *et al.*, 2002)

Common name: Benteak, (Chacko *et al.*, 2002)

Synonyms:

Family: Lythraceae

Subfamily:

Origin:

Distribution: Occurs almost throughout India, often found along with sal, teak and other valuable species (Chacko *et al.*, 2002). Sub - Himalayan tract from the Jumna eastwards, ascending to 1000 m, Bengal, Assam, central India and the Western Peninsula, southwards to the Nilgiris and in Myanmar (Bose *et al.*, 1998).

Description: It is a moderate size to large deciduous tree up to 30 m in height and with a clean bole (Bose *et al.*, 1998).

Flowering season: April to May.

Fruiting season: December to February, December to May (Sen Gupta, 1937; Chacko *et al.*, 2002).

Flowers: White, fragrant, in axillary and terminal panicles, pedicels slender. Calyx not ribbed, hoary, with triangular to dentate short segments (Bose *et al.*, 1998).

Fruits: Fruit is a capsule, ellipsoid. 2 to 3 x 1.2 to 2 cm size, 4 celled, 3 to 6 valved

contains many compressed cultriform winged seeds (Chacko *et al.*, 2002).

Fruit type: Capsule.

Seeds: Seed is winged.

Seed dimension:

Seed length:

Seed width:

Seed thickness:

Seed weight: 26,000 (Carlowitz, 1991) to 56,400 seeds/kg (Sen Gupta, 1937; Chacko *et al.*, 2002).

Seed dispersal: By wind.

Seed collection: Ripe capsules are collected from the tree by lopping off the branches just before they dehisce (Chacko *et al.*, 2002).

Transportation of seeds: Capsules collected in cotton bags are transported to the processing centre (Chacko *et al.*, 2002).

Seed processing: Capsules are sun dried and when they dehisce the seeds are separated and cleaned by winnowing (Chacko *et al.*, 2002).

Seed storage: Intermediate (CABI, 1998). Seeds are thoroughly dried and stored under cold conditions in airtight containers for three months (Chacko *et al.*, 2002).

Viability period: Seeds retain viability up to three months (Chacko *et al.*, 2002).

Seed emptiness: Moderate (Chacko *et al.*, 2002).

Seed pre treatment: Cold water for soaking for 24 hrs (Chacko *et al.*, 2002).

Germination type: Epigeal (Chacko *et al.*, 2002).

Germination percentage: 2 to 50 (Chacko *et al.*, 2002). *L. parviflora* showed poor germination (4-9%) (Mamta Purohit *et al.*, 1998).

Germination period: 15 to 19 days (Kumar and Bhanja, 1992; Chacko *et al.*, 2002).

Nursery technique: Freshly collected seeds are sown in germination trays filled with vermiculite and watered regularly. Seedlings are potted in polythene bags (22.5 x 17.5 cm) filled with potting mixture (Chacko *et al.*, 2002).

Propagation:

Method of propagation: By seeds.

Vegetative propagation:

Pests: Very low (Chacko *et al.*, 2002).

Diseases: Very low (Chacko *et al.*, 2002).

Medicinal properties:

Uses: Wood is used for posts, beams and rafters. It is also used for agricultural implements, construction work etc. (Chacko *et al.*, 2002). The bark yields a fibre of inferior quality and bark and leaves contain tannin (Bose *et al.*, 1998).

Wood properties: Wood very hard, grey or greyish brown, often almost red, darker coloured near the centre, hard. Larger pores and no distinct annual rings. Medullary rays fine, very numerous, inconspicuous. Pores are conspicuously visible on a longitudinal section (Gamble, 1922).

References:

Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa, India. pp. 281.

CABI. 1998. The Forestry Compendium – A Silvicultural Reference. Module 1. CABI Publishing, CAB International, Wallingford, Oxon, OX108DE, UK.

Carlowitz, P.G.V. 1991. Multipurpose Trees and Shrubs: Source of seeds and Inoculants. International Council for Research in Agroforestry, Nairobi, Kenya.

Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 154-155.

Gamble, J.S. 1922. A manual of Indian timbers. London Sampson Low, Marton and Company Ltd, Calcutta, India.

Kumar, S.V. and Bhanja, M. 1992. Forestry Seed Manual of Andhra Pradesh. Andhra Pradesh Forest Department, Hyderabad, India.

Mamta Purohit, Jamaluddin and Mishra, G.P. 1998. Studies on germination and seed-borne fungi of some forest tree species and their control. *Indian Forester*. 124(5): 315-320.

Sen Gupta, J.N. 1937. Seed weights, plant percents, etc. for forest plants in India. *Indian Forest Records (New Series) Silviculture*, 2:221pp. Manager of Publications, Delhi.

Lagerstroemia speciosa

Nomenclature:

Scientific name: *Lagerstroemia speciosa* (Linn.) Pers.

Vernacular name: Manimaruthu, Poomaruthu (Malayalam); Kadali (Tamil); Arjuna, Jarul (Hindi) (Chacko *et al.*, 2002)

Common name: Queen of flowers, Queen crape myrtle (Chacko *et al.*, 2002)

Synonyms: *Lagerstroemia flos-reginae* auct.non Retz., *L. reginae* Roxb. (Chacko *et al.*, 2002)

Family: Lythraceae

Subfamily:

Origin:

Distribution: Occurs throughout India, Myanmar, Sri Lanka and Bangladesh (Chacko *et al.*, 2002). It is very common on river-banks and in marshy places. The tree is frequently found in Assam, Meghalaya, Western Ghats; Bangladesh; lower Myanmar; Sri Lanka; Malay Peninsula, also in China and Australia, often planted for the timber (Bose *et al.*, 1998).

Description: It is a fast growing medium sized deciduous tree. The branches grow fairly high up the trunk and produce a crown of leaves (Bose *et al.*, 1998).

Flowering season: April to June.

Fruiting season: November to January, December to February (Sen Gupta, 1937; Chacko *et al.*, 2002).

Flowers: Large, 5-7 cm diameter, large terminal paniculate cymes, calyx tomentose, 12-ribbed, segments 6; petals 6, margin

erose-undulate, usually brilliant lilac or purplish lilac in colour, fading when old; stamens numerous (Bose *et al.*, 1998).



Habit



Branch with inflorescence



Branch with fruits

Fruits: Fruit is a woody capsule, oblong, ovoid, 5-6 valved.

Fruit type: Capsule.

Seeds: Seeds are pale brown, glabrous, fairly hard seeds (Chacko *et al.*, 2002); angular, winged (Bose *et al.*, 1998).

Seed dimension:

Seed length: 1.2-1.4 cm (Chacko *et al.*, 2002).

Seed width: 0.6-0.8 cm (Chacko *et al.*, 2002).

Seed thickness:

Seed weight: 75,839 to 1,95,111 seeds/kg (Sen Gupta, 1937; Chacko *et al.*, 2002).

Seed dispersal: Wind dispersal.

Seed collection: Seed production starts at the age of 3 years. But fertile seeds are produced only by older trees of 15 years and above. Capsules are collected from the trees by lopping off the branches as soon as the capsules start to dehisce. Great care must be taken to see that only ripe fruits are collected (FRI, 1984; Chacko *et al.*, 2002).

Transportation of seeds: Capsules collected in polythene/cotton/plastic bags are transported to the processing centre as quickly as possible (Chacko *et al.*, 2002).

Seed processing: The capsules are spread out on mats in the sun for a few days until they are fully open and the seeds are extracted by hand or by gentle thrashing. The seeds are then dried and stored (FRI, 1984). Care is taken to see that seeds are not blown away by wind (Chacko *et al.*, 2002).

Seed storage: Probably orthodox. The seeds are stored in sealed gunny bags (FRI, 1984) and tins (Dent, 1948) in dry and well-ventilated sheds and are occasionally spread out in a shaded place. The seed retain

viability for one year (FRI, 1984; Chacko *et al.*, 2002).

Viability period: Seeds retain viability for one year in sealed tins (Chacko *et al.*, 2002).

Seed emptiness: High (Chacko *et al.*, 2002).

Seed pre treatment: Soaking the seeds in water for 12 hrs immediately before sowing hastens germination (FRI, 1984; Chacko *et al.*, 2002). Alternating temperature regime of 35/20°C (16/8 hrs) promote germination (Hung *et al.*, 2004).

Germination type: Epigeal (Chacko *et al.*, 2002).

Germination percentage: 14 to 90 (Chacko *et al.*, 2002); 54-56% (Ram Prasad *et al.*, 1988).

Germination period: 10 to 230 days (FRI, 1984; Chacko *et al.*, 2002). Start 15 days after sowing and will be complete in 2 days (Ram Prasad *et al.*, 1988).

Nursery technique: Seeds are sown in vermiculite and watering done regularly. The seedlings are potted in polybags of size 22.5 x 17.5 cm and kept under shade. As far as possible use of fresh seeds is recommended (Chacko *et al.*, 2002).

Propagation:

Method of propagation:

By seeds. The rooting response of stem cuttings can be increased by treatment with IAA or IBA at 10 and 100 ppm in March than in November. Air layering is also successful (Rahman, 1977).

Vegetative propagation:

Pests: Nil (Chacko *et al.*, 2002).

Diseases: Moderate (31.4%). Nine fungi, a bacterium and actinomycetes are recorded.

Cephalosporium macromonium, *Fusarium* sp., *Pestalotia* sp. are the seed pathogens (Mohanan and Anil Chandran, 2001; Chacko *et al.*, 2002).

Medicinal properties: The root is astringent and is considered as stimulant and febrifuge. The bark and leaves are purgative and the seeds have narcotic effect (Bose *et al.*, 1998).

Uses: It is an important timber tree. This tree is also widely grown for beautification

in many tropical countries and they are commonly known as queen of flowers. The wood is used for house construction, furniture etc. Bleached pulps for writing papers could be manufactured (Singh *et al.*, 1972). Wood is used in planking, scantlings, beams, posts, ship-building, railway wagons etc. Also used for country made guns and rifles (FRI, 1984; Chacko *et al.*, 2002).

Wood properties:

References:

- Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 281-282.
- Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 156-157.
- Dent, T.V. 1948. Seed storage with particular reference to the storage of seed of Indian forest plants. Indian Forest Records (New Series) Silviculture, 7: 134 pp. Manager of Publications, Delhi.
- FRI. 1984. Troup's The Silviculture of Indian Trees. Vol. V. The Controller of Publications, Delhi.
- Hung, L.Q., Hong, T.D. and Ellis, R.H. 2004. Factors influencing the germination of myrtle (*Lagerstroemia speciosa* (L.) Pers. and *L. floribunda* Jack) seeds. Seed Science and Technology. 32(1): 35-41.
- Mohanan, C. and Anil Chandran. 2001. Microorganisms associated with seeds of tropical forest species and their management for improving the storability and seedling production. Seed Science and Technology (in press).
- Rahman, A.H.M.M. 1977. Vegetative propagation of few forest species. Bano Biggyan Patrika. 6: 51-57.
- Ram Prasad, Chadhar, S.K. and Parvez Jalil. 1988. Some observations on germination of four useful but difficult forestry seeds. Journal of Tropical Forestry. 4(4): 395-398.

Sen Gupta, J.N. 1937. Seed weights, plant percents, etc. for forest plants in India. Indian Forest Records (New Series) Silviculture, 2:221pp. Manager of Publications, Delhi.

Singh, S.P., Handa, P.R., Singh, H., Chand, K., Gupta, M.L., Agarwal, G.C., Singh, M.M. and Guha, S.R.D. 1972. Pulping studies of Lagerstroemia speciosa and Terminalia myriocarpa. Indian Forester. 98: 244-251.

Macaranga peltata

Nomenclature:

Scientific name: *Macaranga peltata* (Roxb.) Muell.-Arg.

Vernacular name: Vatta, Uppila, Thodukanni (Malayalam) (Chacko *et al.*, 2002; Sasidharan, 2004); Vattakanni, Vatta (Tamil); Upaligi, (Kannada) (Chacko *et al.*, 2002)

Common name:

Synonyms: *Macaranga roxburghii* Wt.; *Osyris peltata* Roxb., *M. tomentosa* Wight (Chacko *et al.*, 2002; Sasidharan, 2004)

Family: Euphorbiaceae

Subfamily:

Origin:

Distribution: Widely distributed in India, also occurs in Sri Lanka and Andamans. In Kerala it occurs in the secondary, moist deciduous and semi-evergreen forests up to 900 m (Chacko *et al.*, 2002). In India the tree is found in West Bengal, Bihar, Orissa and the Western Ghats, mostly in the hills, and in Sri Lanka (Bose *et al.*, 1998).

Description: A medium-sized tree; branchlets stout; youngest shoots stellate-tomentose (Bose *et al.*, 1998). Fast growing, small to moderate sized evergreen tree attaining a height of 18 m and a breast height of diameter 25.5 cm (Chacko *et al.*, 2002).

Flowering season: Summer months.

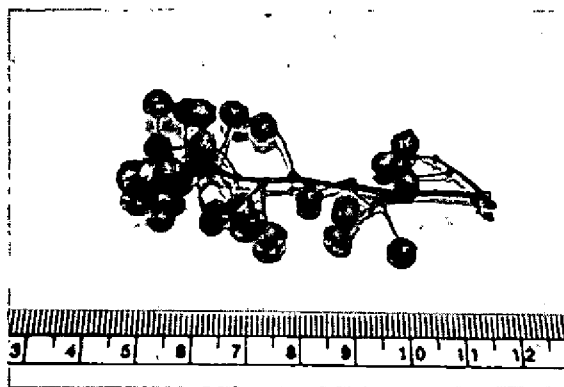
Fruiting season: February to April (Chacko *et al.*, 2002).

Flowers: Panicles rusty-tomentose; bracts tomentose, large, dentate, veined; bracteoles

concave; male flowers: in clusters enveloped in bracts and bracteoles; sepals 3; stamens 2-3; female flowers: ovary 1-celled (Bose *et al.*, 1998). Flowers are unisexual, dioecious, inflorescence axillary panicles with straight branches, bracts broadly ovate, dentate without apical glands, male flowers in clusters per bract and female flowers few per bract (De Candolle, 1866).

Fruits: Capsules 6-7 mm in diameter, covered with hairs and glands (Bose *et al.*, 1998). Capsule echinate when young.

Fruit type: Capsule.



Fruits

Seeds: Capsule, 5 to 6 mm across, globose and glandular contains one globose black coloured seed (Chacko *et al.*, 2002).

Seed dimension:

Seed length: 0.4 cm (Chacko *et al.*, 2002).

Seed width: 0.49 cm (Chacko *et al.*, 2002).

Seed thickness:

Seed weight: 21,168 seeds/kg (Chacko *et al.*, 2002).

Seed dispersal:

Seed collection: Ripe capsules are collected from the tree by lopping off the branches (Chacko *et al.*, 2002).

Transportation of seeds: Capsules collected in cotton bags are transported to the processing centre as quickly as possible (Chacko *et al.*, 2002).

Seed processing: Capsules are de-pulped and sun-dried (Chacko *et al.*, 2002).

Seed storage: Probably intermediate. Seeds can be stored for about 6 months in sealed polythene bags under cold conditions (Chacko *et al.*, 2002).

Viability period: Seeds retain viability for about 2 months (Chacko *et al.*, 2002).

Seed emptiness: No information (Chacko *et al.*, 2002).

Seed pre treatment: Sulphuric acid treatment (Chacko *et al.*, 2002).

Germination type: Epigeal (Chacko *et al.*, 2002).

Germination percentage: Up to 60 (Chacko *et al.*, 2002).

Germination period: 10 to 40 days (Chacko *et al.*, 2002).

Nursery technique: Pretreated seeds are sown in vermiculite taken in germination

trays and watered regularly. The seedlings are potted in polythene bags of size 22.5 x 17.5 cm and maintained under shade (Chacko *et al.*, 2002).

Propagation:

Method of propagation: *Macaranga peltata* has good coppicing power (Gopikumar *et al.*, 2002). By seeds.

Vegetative propagation:

Pests: Nil (Chacko *et al.*, 2002).

Diseases: Low (18.7 %). Seven fungi are recorded. *Fusarium moniliforme*, *Colletotrichum gloeosporioides*, *Phomopsis* sp. were the important seed pathogens (Mohan and Anil Chandran, 2001; Chacko *et al.*, 2002).

Medicinal properties: A paste of kino is used as an application for venereal sores. Leaves and bark boiled in water and used to cure ulcers. The oil content is less than 10% (Mannan *et al.*, 1986).

Uses: Leaves used as a green manure. The red gum can be used for taking impressions of leaves, coins etc. The wood is used for making match boxes and pencils. It is also used as shade tree in coffee plantations (Chacko *et al.*, 2002).

Wood properties: Wood reddish brown and soft (Gamble, 1922).

References:

Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 303.

Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 158-159.

de Candolle, 1866. Prodr. 15 (2): 1010.

Gamble, J.S. 1922. A manual of Indian timbers. London Sampson Low, Marton and Company Ltd, Calcutta, India.

Gopikumar, K., Vidyasagaran, K., Mini Chandran and Lakshmi Nandakumar. 2002. Coppicing behaviour of selected forest tree species. *Indian Forester*. 128(9): 971-975.

Mannan, A., Farooqi, J.A., Ahmad, I. and Asif, M. 1986. Studies on minor seed oils VII. Fette Seifen Anstrichmittel. 88: 301-302.

Mohanan, C. and Anil Chandran. 2001. Microorganisms associated with seeds of tropical forest species and their management for improving the storability and seedling production. *Seed Science and Technology* (in press).

Sasidharan, N. 2004. Forest Trees of Kerala. Kerala Forest Research Institute, Peechi, Kerala, India.

Mallotus philippensis

Nomenclature:

Scientific name: *Mallotus philippensis* (Lam.) Muell.-Arg.

Vernacular name: Rohini, Raini, Rauni, Kamala (Hindi); Kapila (Kannada and Tamil); Chenkolli, Kurangumanjal, Noorimaram (Malayalam) (Sasidharan, 2004)

Common name: Kamala tree

Synonyms: *Croton philippense* Lamk. (Sasidharan, 2004)

Family: Euphorbiaceae

Subfamily:

Origin:

Distribution: Sub Himalayan tracts and outer hills from the Indus eastwards (ascending 1666.5 m). Common in Sal forests and in certain mixed and scrub forests. Found almost throughout India, reaching up to 800 m; Bangladesh; Sri Lanka; Malay Peninsula and Archipelago; Australia (Bose *et al.*, 1998).

Description: A small to medium-sized branched evergreen tree, with a short and often fluted bole, attaining a height up to 20 m, with compact, oval crown; branchlets, young leaves and inflorescence rusty-pubescent (Bose *et al.*, 1998).

Flowering season: July, October to January (Bose *et al.*, 1998).

Fruiting season: Ripen during March to June.

Flowers: Flowers dioecious, small, sessile in stiff spikes, terminal, solitary or paniced; male flowers: clustered, greenish yellow, 3-5 mm across; tepals 4, free; female flowers:

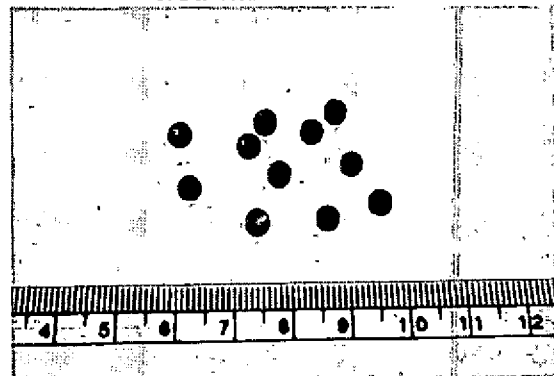
4 mm across; nearly sessile, greenish purple, in short spikes; tepals 3, bifid (Bose *et al.*, 1998).

Fruits: 3-lobbed capsule, 0.7-1.25 cm diameter, densely covered with red gland.

Fruit type: Capsule.



Branch with fruits



Seeds

Seeds: 0.35 cm diameter, black, sub globose, smooth with a moderately thick brittle testa.

Seed dimension:

Seed length:

Seed width:

Seed thickness:

Seed weight: 2,117 to 2,470 /100 g

Seed dispersal:

Seed collection:

Transportation of seeds:

Seed processing:

Seed storage:

Viability period:

Seed emptiness:

Seed pre treatment: Soaking seeds in water for 24 hrs and 120 hrs give 80% and 82% germination respectively. However, when the seeds are scarified with H₂SO₄ germination will be reduced to 24% and heavy fungal attack is also observed (Kalpana Dubey and Anjana Rajput, 1999).

Germination type: Epigeous.

Germination percentage: 15 to 20. 82% (120 hrs) and 80% (24 hrs water soaking) (Kalpana Dubey and Anjana Rajput, 1999).

Germination period:

Nursery technique: Use of a shaded bed, growing media of soil/sand/FYM at 1:1:1, and a sowing depth of 1.0 cm give the best results (Bahuguna and Pyare Lal, 1996).

Propagation:

Method of propagation: By seeds and vegetative method. Natural regeneration is not very successful for this tree for their growth and survival. The natural establishment of the seedlings under favourable conditions is greatly facilitated by its immunity to grazing and browsing by animals.

Vegetative propagation:

Pests:

Diseases:

Medicinal properties: The glandular hairs of the fruit is used as medicinal. Kamala is used in parasitic affections of the skin, particularly scabies, pimples and ringworms, weeping, eczema, boils and also useful in bile trouble. *Mallotus philippinensis* (Kamala) has therapeutic effect against fascioliasis in lactating cows (Upadhyay and Kumar, 2005). Three novel chalcone derivatives, having antiinflammatory and immunoregulatory effects were isolated from the fruits of *M. philippinensis* (Daikonya *et al.*, 2004). Used for treating helminthosis in ruminants (Abdul Jabbar *et al.*, 2006). Methanolic extract of *Mallotus philippensis* posses anthelmintic property (Singh *et al.*, 2004).

Uses: A dye called Kamala, used for drying silk is obtained from red glands on the surface of the capsule. The seasonal variations of sugar, starch and total carbohydrates (reserved food materials) have been investigated in leaf, bark, wood and seeds of *Mallotus philippensis* (Kadam, 2000). Three novel chalcone derivatives were isolated from the fruits of *M. philippinensis*. These compounds were identified using chemical and spectral data. They inhibited nitric oxide (NO) production and inducible NO synthase gene expression by a murine macrophage-like cell line. They down regulated cyclooxygenase-2 gene, interleukin-6 gene and interleukin-1 beta gene expression. These results suggest that they have antiinflammatory and immunoregulatory effects.

Wood properties: The wood is fairly closed and straight grained, medium fine and even textured. It is hard, heavy and tough. Air dry weight about 770 Kg/m³.

References:

- Abdul Jabbar, Raza, M.A., Zafar Iqbal, and Khan, M.N. 2006. An inventory of the ethnobotanicals used as anthelmintics in the southern Punjab (Pakistan). *Journal of Ethnopharmacology*. 108(1): 152-154.
- Bahuguna, V.K. and Pyare Lal. 1996. Studies on evolving nursery practices (soil mixture, depth of sowing and suitability of shade and mulch) for Mallotus phillipensis seeds. *Indian Forester*. 122(4): 298-305.
- Bose, T.K., Das, P. and Maiti, G.G. 1998. *Trees of the world*, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 307.
- Daikonya, A., Katsuki, S. and Kitanaka, S. 2004. Antiallergic agents from natural sources 9. Inhibition of nitric oxide production by novel chalcone derivatives from Mallotus philippinensis (Euphorbiaceae). *Chemical and Pharmaceutical Bulletin*. 52(11): 1326-1329.
- Kadam, V.B. 2000. Bio-chemical evaluation of three endangered medicinal taxa of South Gujarat Forests. *Journal of Phytological Research*. 13(1): 85-87.
- Kalpana Dubey and Anjana Rajput. 1999. Observation on germination behaviour of Mallotus philippinensis Lour. *Vaniki Sandesh*. 23(3): 14-18.
- Sasidharan, N. 2004. *Forest Trees of Kerala*. Kerala Forest Research Institute, Peechi, Kerala, India.
- Singh, M.P., Mahesh Kumar, and Ahmad, A.H. 2004. Efficacy of some ethnomedicinal plants against Haemonchus contortus. *Indian Journal of Veterinary Medicine*. 24(1): 1-4.
- Upadhyay, A.K. and Kumar, M. 2005. Herbal cure of fascioliasis in cows. *Indian Veterinary Journal*. 82(5): 498-500.

Mangifera indica

Nomenclature:

Scientific name: *Mangifera indica* L.

Vernacular name: Mavu, Moochy (Malayalam); Maa, Mamaram, Manga (Tamil); Mavena, Mavu (Kannada); Am, Ambi (Hindi) (Chacko *et al.*, 2002)

Common name: Spring tree, Mango (Chacko *et al.*, 2002)

Synonyms: *M. domestica* Gaertn.

Family: Anacardiaceae

Subfamily:

Origin: Indo-Myanmar region

Distribution: Originated in the Indo - Myanmar region. Found wild almost throughout India. Besides India, mango is cultivated in Pakistan; Bangladesh; Myanmar, Malaysia; Indonesia; Thailand; Sri Lanka; Philippines and tropical Australia; South Africa and many other African countries; Brazil; Venezuela; West Indies; Florida in the United states. In Kerala it occurs in evergreen and semi-evergreen forests (Bose *et al.*, 1998; Chacko *et al.*, 2002).

Description: A large spreading evergreen tree up to 45 m in height and a breast height diameter of 120 cm and a dome-shaped canopy (Bose *et al.*, 1998; Chacko *et al.*, 2002).

Flowering season: January to February; November to March (India) and June and October (Australia) (Bose *et al.*, 1998).

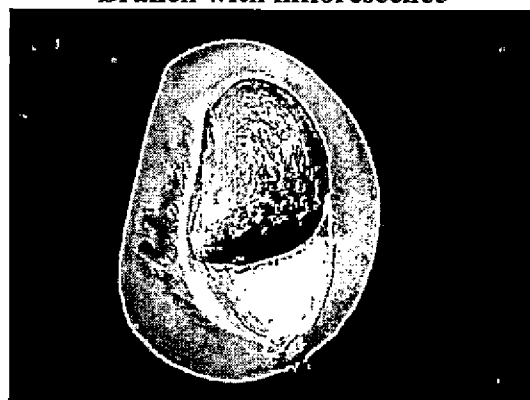
Fruiting season: April to July (FRI, 1981; Chacko *et al.*, 2002).

Flowers: The inflorescence is yellowish panicle with small inconspicuous flowers,

with a strong odour. Flowers small, yellowish or greenish yellow, scented, male and perfect, on terminal panicle cymes of about 30 cm long; perfect stamen 1, inserted on the inner side of the lobed disc; sterile stamens 2 or 4, minute (Bose *et al.*, 1998).



Branch with inflorescence



Seed

Fruits: Fruit is a drupe with large flesh, green orange, yellow or red, with varying shapes and size.

Fruit type: Drupe.

Seeds: Seeds solitary, 5 to 15 cm long, ovoid, yellowish in colour, contains single

seed, enclosed in a hard compressed fibrous endocarp (Chacko *et al.*, 2002).

Seed dimension:

Seed length: 5-10 cm (Chacko *et al.*, 2002).

Seed width: 5-6 cm (Chacko *et al.*, 2002).

Seed thickness:

Seed weight: 106 seeds/kg. Seed weight varies widely depending on the variety (Chacko *et al.*, 2002).

Seed dispersal: Bats, wind and insects such as wasps, ants and bees.

Seed collection: Ripe fruits are collected from the trees by shaking off the branches manually. Freshly fallen drupes are also collected from ground (Chacko *et al.*, 2002).

Transportation of seeds: Drupes collected in cotton/plastic/polythene bags are transported as quickly as possible to the processing centre (Chacko *et al.*, 2002).

Seed processing: The fleshy mesocarp is removed by allowing them to decay for 4 or 5 days and then soaked in water. The fruit is de-pulped and shade dried (Chacko *et al.*, 2002).

Seed storage: Recalcitrant. Seeds do not retain viability for more than 2 months (Chacko *et al.*, 2002). Seeds stored in charcoal powder will retain viability of 50-60% for up to 90 days (Teaotia and Singh, 1971).

Viability period: Seed is viable up to two months under moist storage (Chacko *et al.*, 2002).

Seed emptiness: No information (Chacko *et al.*, 2002).

Seed pre treatment: Not necessary (Chacko *et al.*, 2002). Decortication encourage all nucellar seedlings in the seed to develop and establish themselves but the presence of a seed coat inhibit sprouting of the weaker nucellar seedlings (Sinnadurai, 1975).

Germination type: Hypogeal (Chacko *et al.*, 2002).

Germination percentage: Up to 83 (Chacko *et al.*, 2002).

Germination period: 15 to 48 days (Chacko *et al.*, 2002).

Nursery technique: Freshly collected seeds are sown in nursery beds or germination trays containing vermiculite and watered. The seedlings are pricked out and potted in polythene bags of 22.5 x 17.5 cm size, filled with potting mixture and kept under shade (Chacko *et al.*, 2002). Sowing in root trainers improve root number, root length, seedling height and number of leaves per plant compared to sowing in earthenware pots.

Propagation:

Method of propagation: Budding, crown grafting, veneer grafting and side grafting. The cleft method is suitable for raising young plant material and for topworking. The scion should be more than 5 cm in length with more than 2 buds; after grafting it should be wrapped with polyethylene film to protect against rain. Rootstocks which are weak or too thick are not suitable for grafting, and scions that are too tender or too old are also not suitable (Prasad *et al.*, 1973; Yang JianPing and Chen XueMei, 1998)

Vegetative propagation:

Pests: The mango nut weevil *Cryptorhynchus mangiferae* Fb. (Coleoptera: Curculionidae) bores the seed

in the fruit. The developing fruits are frequently attacked by the mango fruit fly *Dacus dorsalis* Hendel. (Diptera: Trypetidae), (Beeson, 1941) (Chacko *et al.*, 2002). Mango, attacked by scale insects *Selenaspidus articulatus* (Morg.), *Pseudaonidia trilobitiformis* (Green) and *Ischnaspis longirostris* (Sign.) (Clavijo and Santiago Clavijo, 1977).

Diseases: Moderate (35%). Of the five fungi and a bacterium recorded, *Phoma* sp., *Fusarium* sp. were important. Seed rotting is caused by *Fusarium* sp. (Mohan and Anil Chandran, 2001; Chacko *et al.*, 2002).

Medicinal properties: Mangoes are exceedingly refreshing to eat and excellent source of vitamin A and C. The bark is astringent and it is used to cure diphtheria and rheumatism. The fruits are used for constipation because of its laxative property.

Uses: It is undoubtedly one of the best fruits of the world. Fruits contain Vitamin C.

Wood is extensively used for making boats, furniture and agricultural implements. The bark is used in Havan which is a ritual to please the Gods of Heaven. Although mango is chiefly consumed as fresh ripe fruit, squash, nectar, jam, mango lather, and toffee are produced from the ripe mango (Bose *et al.*, 1998).

Wood properties: The wood varies in colour from yellowish white to pale greyish brown usually without any distinct heartwood but fairly large dark brown heartwood may be present in some logs. It is a moderately hard and moderately heavy wood. Wood grey, in old trees sometimes dark brown with black streaks, and hard; in younger trees, coarse-grained, soft. Pores scanty, moderate-sized and large, distinctly marked on a longitudinal section, often subdivided and sometimes joined by short concentric bands. Medullary rays fine, wavy, closely packed, interrupted by, or bent round, the pores (Gamble, 1922).

References:

- Beeson, C.F.C. 1941. The Ecology and Control of the Forest Insects of India and the Neighbouring Countries. Govt of India, New Delhi.
- Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 309.
- Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 160-161.
- Clavijo, A.S. and Santiago Clavijo, A. 1977. Scale insects (Homoptera: Coccoidea) on nursery plants in the region of Maracay, Aragua State, Venezuela: Revista de la Facultad de Agronomia, Universidad Central de Venezuela. 9: 113-122.
- FRI. 1981. Troup's The Silviculture of Indian Trees. Vol. III. The Controller of Publications, Delhi.

Gamble, J.S. 1922. A manual of Indian timbers. London Sampson Low, Marton and Company Ltd, Calcutta, India.

Mohan, C. and Anil Chandran. 2001. Microorganisms associated with seeds of tropical forest species and their management for improving the storability and seedling production. Seed Science and Technology (in press).

Prasad, A., Singh, R.D. and Sirohi, R.S. 1973. Comparative study of veneer grafting and patch budding in Mangifera indica L. cv. Dashehari SO: Punjab Horticultural Journal. 13: 30-34.

Sinnadurai, S. 1975. The effect of decortication of seed on germination and the number of nucellar seedlings of some mango cultivars in Ghana : Acta Horticulturae. 49: 95-97.

Teotia, S.S and Singh, R.D. 1971. Studies on media for storage and germination of mango seeds (*Mangifera indica* L.). Punjab Horticulture J. 11: 1-2.

Yang JianPing and Chen XueMei. 1998. Some grafting methods for mango and their technical features. South China Fruits. 27(6): 29-31.

Melia azedarach

Nomenclature:

Scientific name: *Melia azedarach* L.

Vernacular name: Vayambu, Sima veppu, Karim vembu (Malayalam); Mallay vembu, Puvembu (Tamil); Hutchubevu (Kannada); Bakain (Hindi) (Chacko *et al.*, 2002). Drek (Hindi)

Common name: Persian lilac (Chacko *et al.*, 2002). China berry, Pride of India, Bead tree, Hoop tree

Synonyms: *Melia sempervirens* (L) Sw.; *Melia bukayun* Royle; *Melia japonica* G.Don (Chacko *et al.*, 2002)

Family: Meliaceae

Subfamily:

Origin:

Distribution: Native to west Asia and is found growing in Himalayas (Chacko *et al.*, 2002). The species is supposed to be indigenous in Baluchistan but it is now found in tropical and mild subtropical parts of India and in many countries (Bose *et al.*, 1998).

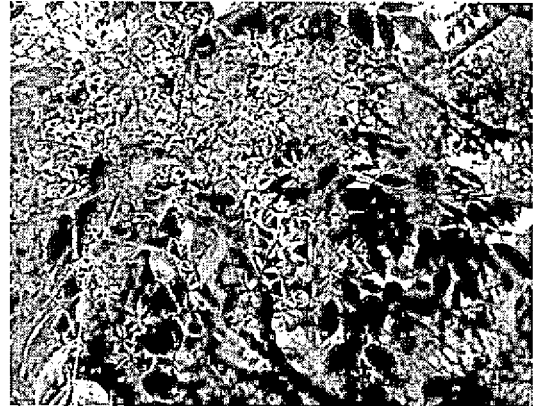
Description: Small to medium sized handsome deciduous tree attaining a height of 20 m and a breast height diameter of 60 cm (CABI, 2000; Chacko *et al.*, 2002).

Flowering season: February to March / May.

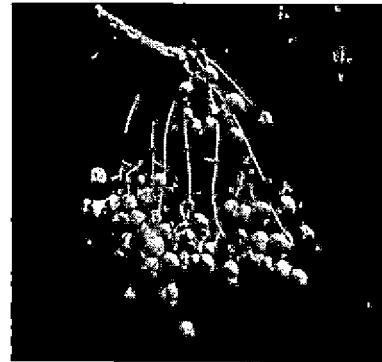
Fruiting season: April to May (Luna, 1996; Chacko *et al.*, 2002).

Flowers: Flowers are numerous and have lavender colour and emits mild scent during night. Bisexual, lilac or purple and bluish white, scented, 6-8 mm in diameter, in axillary paniculate cymes; petals 5 or 6,

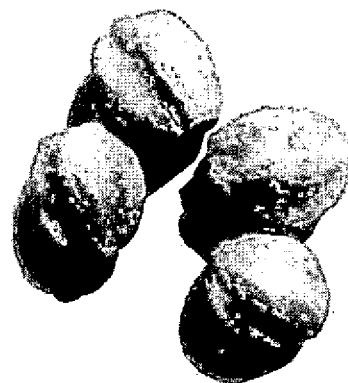
white or lilac surrounding deep purple tube formed by the stamens (Bose *et al.*, 1998).



Branch with inflorescence



Fruits



Seeds

Fruits: Fruit is a drupe, ellipsoid or globose, shining, oval, 1.5-2.0 cm long, green, turning greenish yellow and finally brown when ripe, in clusters (Bose *et al.*, 1998).

Fruit type: Drupe.

Seeds: Seeds 4, yellow when ripe, globose has a natural perforation in the centre (Luna, 1996; Chacko *et al.*, 2002).

Seed dimension:

Seed length: 1.04 cm (Chacko *et al.*, 2002).

Seed width: 0.77 cm (Chacko *et al.*, 2002).

Seed thickness:

Seed weight: 3,679 seeds/kg (Chacko *et al.*, 2002).

Seed dispersal: By wind.

Seed collection: The mature fruits are collected from the tree by lopping off the branches (Chacko *et al.*, 2002).

Transportation of seeds: The fruits collected in cotton / gunny bags are transported to the processing centre as quickly as possible (Chacko *et al.*, 2002).

Seed processing: Fruits are depulped by soaking in cold water for 48 hrs and are separated by squeezing with hand (Chacko *et al.*, 2002).

Seed storage: Intermediate / recalcitrant (CABI, 1998). Seeds are stored in sealed tins for more than one year (Dent, 1948; Chacko *et al.*, 2002). Storage of fruits or endocarps can be done at low temperatures (3°C) (Moncur and Gunn, 1990).

Viability period: The depulped fruits are dried and stored well for about four months (Chacko *et al.*, 2002).

Seed emptiness: No information (Chacko *et al.*, 2002).

Seed pre treatment: Seeds are treated with H₂SO₄ for 30 min (Sheikh, 1980). Soaking of the seeds in cold water for above 48 hrs

improve germination (Kindt *et al.*, 1997; Edwards and Naithani, 1999; Chacko *et al.*, 2002).

Germination type: Epigeal (Chacko *et al.*, 2002).

Germination percentage: 55 to 85 (Chacko *et al.*, 2002).

Germination period: 10 to 20 days (Chacko *et al.*, 2002).

Nursery technique: The pretreated seeds are sown in germination trays filled with vermiculite and watered regularly. When the seedlings are about 4 to 5 cm height, they are transplanted to poly bags of size 20 cm x 10 cm filled with potting mixture and maintained under shade till they establish (Chacko *et al.*, 2002).

Propagation:

Method of propagation: By seeds and vegetative methods.

Vegetative propagation:

Pests: No information (Chacko *et al.*, 2002).

Diseases: Low (Chacko *et al.*, 2002).

Medicinal properties: Leaves, fruits and seeds are useful in skin diseases as well as in rheumatic pains. The seeds contain oil that is used for soap and hair oil, prescribed in rheumatism, leprosy. The bark is bitter. The glycoside from the seeds show antibacterial activity (Srivastava, 1986).

Uses: Wood is extensively used for toys, small boxes, cigar boxes, museum cases, turnery, ornamental plywood, and musical instrument. The stony seeds are employed in making necklaces and rosaries. Root bark of *M. azedarach* posses, azedarachin C having antifeedant properties against *Spodoptera exigua* larvae (Saxena, 1987; Huang *et al.*, 1995).

Wood properties: Sapwood is yellowish white and the heartwood is reddish brown. It is a moderately hard and moderately heavy wood (Air dry weight about 700 kg/m³) with coarse texture and straight grain. The sapwood grey, heartwood red.

Annual rings doubtful. Pores scanty, moderate sized or large. Rays fine, numerous, white and prominent. The wood is scented and much resembles mahogany (Bourdillon, 1908).

References:

Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 316.

Bourdillon, T.F. 1908. Forest trees of Travancore. International Book Distributors, Dehradun. pp. 79.

CABI. 1998. The Forestry Compendium – A Silvicultural Reference. Module 1. CABI Publishing, CAB International, Wallingford, Oxon, OX108DE, UK.

CABI. 2000. Forestry Compendium – 2000 Edn. Commonwealth Agril. Bureau International, UK.

Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 162-163.

Dent, T.V. 1948. Seed storage with particular reference to the storage of seed of Indian forest plants. Indian Forest Records (New Series) Silviculture, 7: 134 pp. Manager of Publications, Delhi.

Edwards, D.G. and Naithani, S.C. 1999. Seed and Nursery Technology of forest trees. New Age, New Delhi.

Huang, R.C., Okamura, H., Iwagawa, T., Tadera, K. and Nakatani, M. 1995. Azedarachin C, a limonoid antifeedant from *Melia azedarach*. Phytochemistry. 38(3): 593-594.

Kindt, R., Mausya, S., Kimotho, J. and Waruhiu. 1997. Tree seed suppliers Directory: Sources of Seeds and Microsymbionts. International Centre for Research in Agro Forestry (ICRAF), Nairobi, Kenya.

Luna, R.K. 1996. Plantation Trees. International Book Distributors, Dehra Dun, India.

Moncur, M.W. and Gunn, B.V. 1990. Seed development and germination responses of Melia azedarach var. australasica. ACIAR Proceedings Series. (28): 24-28.

Saxena, R.C. 1987. Antifeedants in tropical pest management. *Insect Science and its Application*. 8: 4-6, 731-736.

Sheikh, M.I. 1980. Effect of different treatments to hasten tree seed germination *Pakistan Journal of Forestry*. 30: 176-180.

Srivastava, S.D. 1986. Limonoids from the seeds of Melia azedarach. *Journal of Natural Products*. 49: 56-61.

Melia dubia

Nomenclature:

Scientific name: *Melia dubia* Cav.

Vernacular name: Malavepu (Malayalam) (Sasidharan, 2004); Malai-
vembu (Tamil); Mahanim (Hindi) (Chacko *et al.*, 2002)

Common name: Malabar Neem Wood

Synonyms: *Melia composita* Willd. (Sasidharan, 2004); *M. robusta* Roxb., *M. superba* Roxb. (Chacko *et al.*, 2002)

Family: Meliaceae

Subfamily:

Origin:

Distribution: E. Himalayas (up to 1800 m) in N. Bengal, the Khasi, Indian peninsula, W. ghats in deciduous hill forests. Also in Sikkim and Bhutan. In Kerala, it occurs in the moist deciduous forests up to 600 m.

Description: A fairly, large, handsome, deciduous tree (1.2-1.5 m) with a spreading crown (Bose *et al.*, 1998).

Flowering season: February to March; January to March (Bose *et al.*, 1998). July to October; January to March (Bourdillon, 1908).

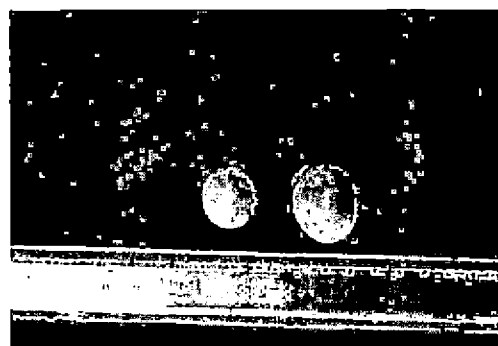
Fruiting season: Cold season, October to February. October to November, October to January (Bourdillon 1908). October to February (Chacko *et al.*, 2002).

Flowers: Greenish-white 0.6-1 cm long, fragrant, in 12-18 cm long paniculate cymes; calyx lobes 5, ovate; petals mealy, many flowered (Bose *et al.*, 1998).

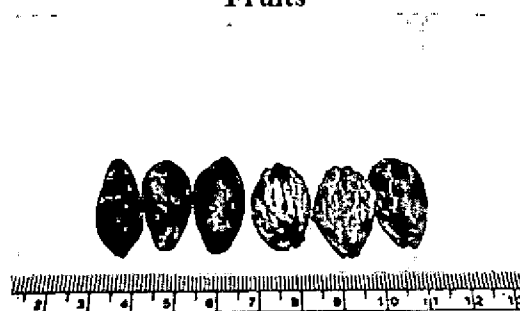
Fruits: Drupes 2 cm or more long, ovoid or ellipsoid, yellowish, smooth, with very hard endocarp and one seed.

Fruit type: Drupe.

Seeds: 1 to 6 seeded, black coloured (Bose *et al.*, 1998).



Fruits



Fruits and seeds

Seed dimension:

Seed length: 1 cm (Chacko *et al.*, 2002).

Seed width:

Seed thickness:

Seed weight: 250 to 300 seeds/kg, 250 to 320 fruits/kg (FRI, 1981; Chacko *et al.*, 2002).

Seed dispersal:

Seed collection: Ripe fruits are collected from the ground, as plenty of mature ripe

fruits are available on the ground during fruiting season (Chacko *et al.*, 2002).

Transportation of seeds: The fruits may be transported to the processing centre at the earliest (Chacko *et al.*, 2002).

Seed processing: The fruits collected in gunny bags are beaten with a wooden mallet or pounded in a wooden mortar to remove the pulp (FRI, 1981; Chacko *et al.*, 2002).

Seed storage: Probably intermediate. Depulped and dried seeds dressed with insecticides can be stored for about six months (Chacko *et al.*, 2002).

Viability period: Seeds are viable for about six months (Chacko *et al.*, 2002).

Seed emptiness: Low (Chacko *et al.*, 2002).

Seed pre treatment: Seeds buried in FYM pit for ten days are sown in mother bed. Splitting the hard endocarp longitudinally into two halves with a sharp nut cutter, soaking the seeds in cold water for a week and soaking in slaked lime for 48 hrs significantly improves germination (Vivekanandan, 1978).

Germination type: Epigeal (Chacko *et al.*, 2002).

Germination percentage: Usually very low (Chacko *et al.*, 2002).

Germination period: 48 days (FRI, 1981; Chacko *et al.*, 2002).

Nursery technique: The fruits after depulping are spread out in the seedbed, covered with a 7.5 cm layer of leaf litter and burnt. Immediately after the burn, the seeds are covered with a 7.5 to 10 cm layer of soil and watered frequently. Seedlings that are 20 to 30 cm in height are suitable for planting out at the commencement of the

southwest or northeast monsoon (FRI, 1981; Chacko *et al.*, 2002).

Propagation:

Method of propagation: By seeds. The cuttings are treated with rootone (Howard *et al.*, 1990).

Vegetative propagation:

Pests: Low (Chacko *et al.*, 2002).

Diseases: *Aspergillus* spp., *Penicillium* spp., *Chaetomium globosum* and *Trichoderma* spp. are the important storage moulds. *Bipolarismaydis*, *Botryodiplodia theobromae*, *Fusarium* sp., *Colletotrichum* sp., *Myrothecium* sp., etc. are the important field fungi associated with seed discolouration and seed rot (Mohanand Geetha Varma, 2001; Chacko *et al.*, 2002).

Medicinal properties: The fruit is bitter and is considered as anthelmintic (Bose *et al.*, 1998). The wood is rarely subjected to antiseptic treatment.

Uses: Used for making light packing cases, cigar boxes, ceiling planks, etc. match industry, plywood and as fuel. The wood is used for agricultural implements, furniture, plywood, boxes, poles, tool handles, cabinet making and in construction.

Wood properties: Sapwood greyish-white, with a yellow, heartwood light pink-light red which turns to pale brown, lustrous and no characteristic odour and taste. Very light, straight-grained, coarse and uneven textured. Pores even and medium sized to large, fewer in the autumn-wood, more numerous in the spring wood. Rays very fine, giving a silvery grain to the wood. Annual rings 3 or 4 to the inch (Bourdillon, 1908). Pores large, generally round, visible on a vertical section. The structure resembles that of Toon, but all the pores are of the same size and the wood is softer. The

annual rings are marked by more numerous, but not larger pores (Gamble, 1922).

References:

- Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 316.
- Bourdillon, T.F. 1908. Forest trees of Travancore. International Book Distributers, Dehradun. pp. 80.
- Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 164-165.
- FRI. 1981. Troup's The Silviculture of Indian Trees. Vol. III. The Controller of Publications, Delhi.
- Gamble, J.S. 1922. A manual of Indian timbers. London Sampson Low, Marton and Company Ltd, Calcutta, India.
- Howard, F.W., Verkade, S.D. and DeFilippis, J.V. 1990. Propagation of West Indies mahogany, Swietenia mahagoni, by cuttings. Turrialba. 40(1): 30-32.
- Mohanan, C. and Geetha Varma. 2001. Microorganisms associated with seeds of Dalbergia, Acacia and Albizia species and their management for optimum seed germination and seedling health. Journal of Tropical Forestry (in press).
- Sasidharan, N. 2004. Forest Trees of Kerala. Kerala Forest Research Institute, Peechi, Kerala, India.
- Vivekanandan, K. 1978. Pretreatment to improve the germination of lunumidella seed. Sri Lanka Forester. 13: 3-4, 69-70.

Melicope lunu-ankenda

Nomenclature:

Scientific name: *Melicope lunu-ankenda* (Gaertn.) Hartley

Vernacular name: Kanala, Kambili, Nasakam, (Sasidharan, 2004), Kanalei, Kanali, Kattuchampakam (Malayalam), Kattushampakam (Tamil), Midauma-baphang (Assam)

Common name:

Synonyms: *Fagara lunu-ankenda* Gaertn., *Euodia roxburghiana* Benth., *Euodia lunu-ankenda* (Gaertn.) Merr.

Family: Rutaceae

Subfamily:

Origin:

Distribution: Widely distributed in India- Western Ghats, Nilgiris, Palnis, Meghalaya; in Myanmar; Sri Lanka; Malay Peninsula and Archipelago (Bose et al., 1998). Throughout the W. Ghats in evergreen forests and secondary forests (2000 m). Also found in E. Ghats, Assam and Meghalaya

Description: A small to medium-sized tree, up to 15 m high (Bose et al., 1998)

Flowering season: May to July (Bose et al., 1998)

Fruiting season: September to October (Bose et al., 1998)

Flowers: Flowers white to pinkish, 4-5 mm across; panicles divaricate as long as or longer than petioles; sepals minute, ovate;

petals ovate-lanceolate, 1-2 mm long; stamens exerted with prominent anthers (Bose et al., 1998)

Fruits: Capsule of 4, 2-valved cells (Bose et al., 1998)

Fruit type: Capsule.

Seeds: Seeds hard, black, shining, globose or ellipsoid (Bose et al., 1998)

Seed dimension:

Seed length:

Seed width:

Seed thickness:

Seed weight: 88000-107000 /kg

Seed dispersal:

Seed collection:

Transportation of seeds:

Seed processing:

Seed storage:

Viability period:

Seed emptiness:

Seed pre treatment:

Germination type:

Germination percentage: 60 to 70

Germination period:

Nursery technique:

Propagation:

Method of propagation:

Vegetative propagation:

Pests:

Diseases:

Medicinal properties: Leaves and flowers are considered tonic and emmenagogue. The leaves are sour and aromatic when crushed. The leaves, root and root bark have several applications in Indian medicine.

Uses: The leaves are good fodder. Wood is employed for construction work, carriages, wagons, furniture and tool handles

Wood properties: Wood is used for planks, rafters, plywood, and match splints, also suitable for panelling and cabinet work (Bose et al., 1998). Used for match manufacture (both splint and box), planking, rafters and non standard plywood.

References:

Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 207.

Sasidharan, N. 2004. Forest Trees of Kerala. Kerala Forest Research Institute, Peechi, Kerala, India.

Troup, R.S. 1921. The Silviculture of Indian Trees. (Vol III) International Book Distributors, Dehra Dun.

Mesua ferrea

Nomenclature:

Scientific name: *Mesua ferrea* Linn.

Vernacular name: Nangal, Nangu (Tamil) (Gamble, 1922); Nanku, Churuli, Vayanavu, (Sasidharan, 2004); Nangu, Nagappuvu, Eliponku (Malayalam); Nagkesar (Hindi and Bengal)

Common name: Iron wood tree, Nagkesar, Mesua

Synonyms: *M. coromandelina*, *M. pendunculata*, *M. speciosa*, *M. roxburghii*, *M. sclerophylla*, *M. pulchella* (Troup, 1921); *M. nagassarium* (Burm.f.) Kosterm. (Sasidharan, 2004)

Family: Clusiaceae (Guttiferae)

Subfamily:

Origin:

Distribution: Tropical and semi tropical forests in Assam, Andaman, Hills of Western and Southern India. Extensively distributed in the Eastern Himalaya-Assam, Meghalaya, Arunachal Pradesh, in the Andaman Islands, South India, also in Sri Lanka; Myanmar and Malaysia; planted for valuable timber (Bose et al., 1998)

Description: A moderate sized to large evergreen tree, 10 to 25 m high with straight trunk

Flowering season: January to June, February to May, depending on the climate (Bose et al., 1998); January to April (Bourdillon, 1908); February to April, May to even June (Troup, 1921)

Fruiting season: Ripens during October to March (Bourdillon, 1908); May to June (Myanmar); in Assam it ripens from August to October

Flowers: Solitary, generally terminal, fragrant, bisexual, nearly sessile, 5 to 7 cm across; sepals four in 2 rows, ovoid; petals four, imbricate, up to 3 cm long, ovate; stamens numerous, yellow; ovary 2-celled. Large scented white flower with numerous prominent stamens (Bose et al., 1998)

Fruits: Ovoid, pointed, 3-4 cm in diameter, 2 valved, woody nature, valves tough, supported by the enlarged sepals

Fruit type:

Seeds: Seeds 1 to 4, testa hard, shining-brown, embryo a fleshy homogenous mass, oily and quickly lose vitality

Seed dimension:

Seed length:

Seed width:

Seed thickness:

Seed weight: 333 to 444 /kg

Seed dispersal: Animals, bats

Seed collection:

Transportation of seeds:

Seed processing:

Seed storage:

Viability period:

Seed emptiness:

Seed pre treatment: The seeds should be soaked in water for 24 hrs.

Germination type: Hypogeous (Troup, 1921)

Germination percentage:80 to 90

Germination period:

Nursery technique:

Propagation:

Method of propagation:By seeds and vegetative method

Vegetative propagation:

Pests:

Diseases:

Medicinal properties: Seeds yield a fatty oil which may be blanched and used for soap making and also used for skin troubles and rheumatism

Uses: Seed extremely rich in oils and it is used for the manufacture of soaps and certain types of varnishes. It is a good manure due to its being rich in nitrogen and phosphorous. The wood is very durable, it is rarely attacked by white ants and used for furniture and house building. The flowers are used in perfumery (Bose et al., 1998)

Wood properties: Sapwood is greyish white or pinkish white, sharply demarcated from the heartwood, which is brick red occasionally with darker streaks on the longitudinal surface. It is a very hard and heavy wood with medium fine texture and straight to interlocked grain. Wood somewhat resembling that of Calophyllum, but much harder and heavier. Heartwood dark red, extremely hard. Pores moderate size, scanty, often filled with yellow resin, singly or group, or in oblique strings of varying length. Medullary rays extremely fine, uniform, equidistant, very numerous (Gamble, 1922)

References:

- Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 318.
- Bourdillon, T.F. 1908. Forest trees of Travancore. International Book Distributors, Dehradun.
- Gamble, J.S. 1922. A manual of Indian timbers. London Sampson Low, Marton and Company Ltd, Calcutta, India.
- Purkayastha, S.K. 1996. A manual of Indian timbers. Sri Bhumi Publishing Company, Calcutta.
- Sasidharan, N. 2004. Forest Trees of Kerala. Kerala Forest Research Institute, Peechi, Kerala, India.
- Troup, R. S. 1921. The Silviculture of Indian Trees. (Vol I) International Book Distributors, Dehra Dun.

Michelia champaca

Nomenclature:

Scientific name: *Michelia champaca* Linn.

Vernacular name: Champakam (Malayalam); Shembuga, Sempangan (Tamil) (Chacko *et al.*, 2002). Champa (Hindi) (Gamble, 1922)

Common name: Champaca (Chacko *et al.*, 2002). Champak, Golden champaka, Yellow champaka (Bose *et al.*, 1998)

Synonyms: *M. aurantiaca* Wall. (Chacko *et al.*, 2002); *M. doltsopa* Hamm., *M. rheedii* Wight, *M. rufinervis* DC.

Family: Magnoliaceae

Subfamily:

Origin:

Distribution: It is a native of E. Himalayas, Assam and Western Ghats. It is cultivated throughout India and Myanmar for its fragrant flowers (Luna, 1996). It occurs in West Bengal, Bangladesh, Sri Lanka and Nepal. In Kerala, it occurs sporadically in evergreen forests (Chacko *et al.*, 2002).

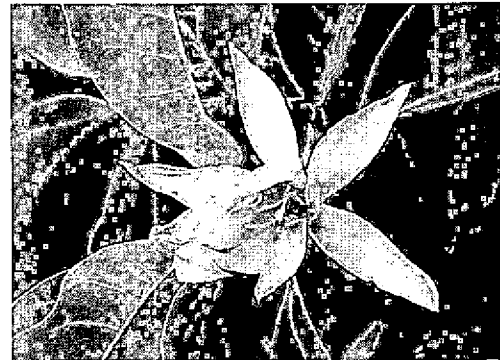
Description: A tall, evergreen tree attaining a height of 25 m, with a long clean cylindrical bole, branches densely tomentose. Large handsome, evergreen tree with a tapering crown of ascending branches attaining a height of 35 m and a breast height diameter of 111 cm (Luna, 1996; Chacko *et al.*, 2002).

Flowering season: Summer and in Rainy season. March to June and may continue till the end of rains (Bose *et al.*, 1998).

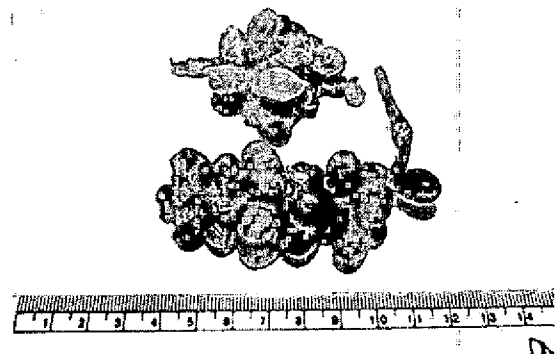
Fruiting season: Ripens in August, throughout the year (Bose *et al.*, 1998);

November to December (Bourdillon, 1908). August to September (FRI, 1975) and March to April (Luna, 1996; Chacko *et al.*, 2002).

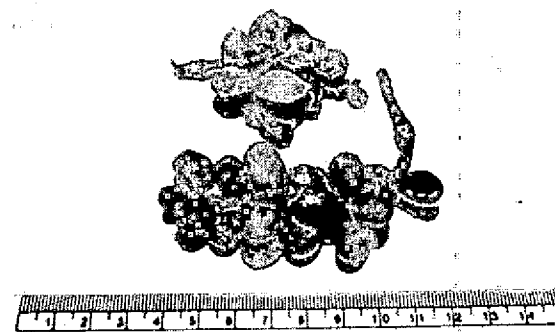
Flowers: Yellow to orange, very fragrant, solitary and axillary, strongly scented, 5 cm across; perianth 15, the outer oblong, the inner linear (Bose *et al.*, 1998).



Flower



Fruits



Seeds

Fruits: Fruit is a capsule, 5 to 10 cm long, in long clusters on a spike, dark brown, attached on long funicle, open at the back by two valves.

Fruit type: Capsule.

Seeds: Seeds 1 to 12, dark brown, polished, angular, covered with pink fleshy substance.

Seed dimension:

Seed length: 0.73 cm (Chacko *et al.*, 2002).

Seed width:

Seed thickness:

Seed weight: 12,000 to 16,900 seeds/kg (Luna, 1996; Chacko *et al.*, 2002).

Seed dispersal:

Seed collection: A Large quantity of seed is destroyed by birds rodents (Luna, 1996). Therefore care should be taken in planning seed collection. Capsules are collected from the tree by lopping off the branches when they start opening and seeds with red pulpy covering are seen fallen on the ground (Rai, 1999). Another indication of ripeness is when the parrots begin to feed on the fruits. However, seeds should never be collected from the ground, as they are usually insect damaged (Luna, 1996; Chacko *et al.*, 2002).

Transportation of seeds: Capsules collected in cotton / plastic / polythene bags are transported as soon as possible. If the seed has to be transported to another place for use, ripe fruits will keep better if packed in moist charcoal dust (Luna, 1996; Chacko *et al.*, 2002).

Seed processing: Capsules are heaped under shade for 2 to 3 days until they open. Seeds are, then separated out by gentle thrashing. The red pulp (aril) is washed off in water by rubbing on wire net and

hardware cloth and thereafter dried under shade. The light seeds, which float on water are discarded at the time of washing seeds (Luna, 1996; Chacko *et al.*, 2002).

Seed storage: Recalcitrant. De-pulped and dried seeds can be stored with maximum retention of viability up to 8 months in perforated polythene bags at 5°C (Luna, 1996; Chacko *et al.*, 2002).

Viability period: Seeds are viable for one month under ambient room temperatures in perforated polythene bags (Luna, 1996; Chacko *et al.*, 2002).

Seed emptiness: No information (Chacko *et al.*, 2002).

Seed pre treatment: No treatment is required. However, treatments such as mesocarp removal and treatment of seeds with gibberellic acid hasten germination. (Luna, 1996; Chacko *et al.*, 2002). Soaking the seeds in 1000 ppm GA₃ for 24 hrs give germination percentage of 72.5% (Deepu Mathew and Sivakumar, 2001). Depulped seeds extracted from fresh fruits are treated with 500 ppm GA₃ for 48-hrs than the 24-hrs treatment (Bahuguna *et al.*, 1988).

Germination type: Epigeal (Chacko *et al.*, 2002).

Germination percentage: Up to 80 (Chacko *et al.*, 2002).

Germination period: 2 to 30 days (Luna, 1996; Rai, 1999; Chacko *et al.*, 2002).

Nursery technique: Fresh seeds are sown in germination trays containing vermiculite and watered. Germination starts within 2 to 3 days and completes within a month. When germination is over the seedlings are pricked out into polybags of 22.5 x 17.5 cm filled with potting mixture and maintained under shade (Chacko *et al.*, 2002). Fruits are collected in October and heaped in the shade

until they open, and the fleshy portion is removed by washing and rubbing with a wire net. The depulped seeds are then dried in the shade, and dibbled at 1.5 to 2.0 cm depths in raised prepared nursery beds, with farmyard manure (FYM) and fine sand mixed in. The seeds are covered with soil/sand/FYM (2:1:1), and the beds are kept irrigated and weeded (Pyare Lal *et al.*, 1997).

Propagation:

Method of propagation: By seeds and vegetative method. Six- to eight-month-old seedlings are cut to a height of 25-30 cm above the ground and a slit was made in the rootstock. Defoliated scions are cut into a wedge shape and inserted into the slits and the junction is wrapped with a 200-gauge polyethylene sheet. The percentage of grafting success is 65-70% after 45 days (Gowda and Gowda, 1989). 8- to 10-month-old seedlings are decapitated to 25-30 cm from the ground and previously defoliated scions are grafted in early Aug (Nalawadi *et al.*, 1988).

Vegetative propagation:

Pests: Moderate (Chacko *et al.*, 2002).

References:

- Bahuguna, V.K., Rawat, M.M.S. and Naithani, K.C. 1998. Studies on dormancy and treatment to enhance germination of champa (*Michelia champaca*, Linn.) seed. *Indian Forester*. 114: 317-319.
- Bose, T.K., Das, P. and Maiti, G.G. 1998. *Trees of the world*, Vol. 1. Regional Plant Resource Centre, Orissa, India. pp. 319.
- Bourdillon, T.F. 1908. *Forest trees of Travancore*. International Book Distributors, Dehradun. pp. 2.

Diseases: Not reported so far (Chacko *et al.*, 2002).

Medicinal properties: The stem bark is astringent, febrifuge, diuretic and useful in fever, cough, chronic gastritic and cardiac debility. The flowers are useful in leprosy, skin diseases, wounds and ulcers. The oil from the flowers "Champaka oil" is employed in curing eye ailments and gout. The fruits and seeds are used for healing of cracks in the feet (Bose *et al.*, 1998). Seeds are also medicinal (Gamble, 1922).

Uses: Wood is used for making light furniture and indoor works. It is suitable for moisture proof plywood and tea chests, heavy packing cases, boxes, battery separators and pencils (Chacko *et al.*, 2002). Flowers are used in religious ceremonies. The wood is made into beads, and necklaces of the beads are sold to pilgrims at Haridwar (Gamble, 1922).

Wood properties: Softwood even grained; sapwood white, heartwood light olive brown. Annual rings distinctly marked by a dark line. Pores moderate sized, evenly distributed, often subdivided into 2-5 by thin partitions (Gamble, 1922).

Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 166-167.

Deepu Mathew and Sivakumar. 2001. Effect of mechanical, chemical and hormonal treatments on germination of golden champa. Current Research University of Agricultural Sciences Bangalore. 30(9/10): 147-148.

Gamble, J.S. 1922. A manual of Indian timbers. London Sampson Low, Marton and Company Ltd, Calcutta, India.

Gowda, J.V.N. and Gowda, V.N. 1989. Propagation of champaka (Michelia champaka L.) by soft wood wedge grafting. Crop Research Hisar. 2(2): 232.

Luna, R.K. 1996. Plantation Trees. International Book Distributors, Dehra Dun, India.

Nalawadi, U.G., Patil, A.A. and Swamy, P.N. 1988. 'Softwood wedge grafting' - a successful method of grafting for champaka. Current Research, University of Agricultural Sciences, Bangalore. 17: 53-54.

Pyare Lal, Bisht, N.S. and Aggarwal, S.K. 1997. Determination of proper depth of seed sowing in Michelia champaca in nursery. Indian Forester. 123(2): 118-122.

Rai, S.N. 1999. Nursery and Planting Techniques of Forest Trees in Tropical South-Asia. Eastern Press, Bangalore, India.

Mimusops elengi

Nomenclature:

Scientific name: *Mimusops elengi* L.

Vernacular name: Elengi, Ilanji (Malayalam); Mahizhampoo maram, Elengi, Magada (Tamil); Mulsari, Bolsari, Bakul (Hindi) (Chacko *et al.*, 2002)

Common name: Asian bullet wood (Chacko *et al.*, 2002). Spanish cherry, Indian medlar (Bose *et al.*, 1998)

Synonyms: *Mimusops parvifolia* R.Br. (Chacko *et al.*, 2002)

Family: Sapotaceae

Subfamily:

Origin:

Distribution: Occurs in the Western Ghats, in the dry evergreen forests of the Eastern Ghats, also in the Andamans, Myanmar and Sri Lanka (FRI, 1985). In Kerala, it occurs in the evergreen and semi - evergreen forests up to 1200 m, and also grown in homesteads (Chacko *et al.*, 2002).

Description: Slow growing, medium sized to large evergreen tree attaining a height of 25 m and a breast height diameter of 80 cm (FRI, 1985; Chacko *et al.*, 2002).

Flowering season: March to June.

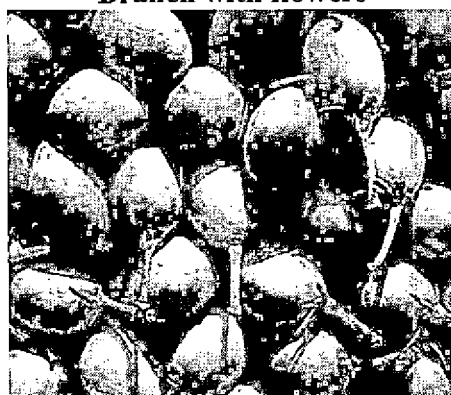
Fruiting season: February to June; June to July (Sen Gupta, 1937; Chacko *et al.*, 2002).

Flowers: The flowers are fragrant, axillary, borne solitary, star shaped and creamy white or dull white or greyish white in colour, about 1-1.5 cm across, solitary or in small clusters; calyx segments 8 in 2 series, lanceolate, corolla-lobes about 24, linear-oblong; stamens usually 8; staminodes

lanceolate, hairy below; ovary pubescent (Bose *et al.*, 1998).



Branch with flowers



Fruits



Seeds

Fruits: Fruit is a berry, about 2.5 cm in length, oval and yellow in colour when ripe.

Fruit type: Berry.

Seeds: Brown, ovoid, compressed seed. One seeded rarely two seeded (Bose *et al.*, 1998).

Seed dimension:

Seed length: 1.5-2.3 cm (FRI, 1985; Chacko *et al.*, 2002).

Seed width: 1-1.3 cm (FRI, 1985; Chacko *et al.*, 2002).

Seed thickness:

Seed weight: 2,000 to 3,000 seeds/kg, 1,940 to 2,152 seeds/kg (Sen Gupta, 1937; Chacko *et al.*, 2002).

Seed dispersal:

Seed collection: Fruits are collected from the ground after fall (Rai, 1999; Chacko *et al.*, 2002).

Transportation of seeds: The fruits are collected in cotton / polythene bags and transported to the processing centre as quickly as possible (Chacko *et al.*, 2002).

Seed processing: The fruits are squeezed in water for depulping and seeds separated and dried under shade (FRI, 1985; Rai, 1999; Chacko *et al.*, 2002).

Seed storage: Probably recalcitrant. Viability of seeds is about 2 months. Seeds are susceptible to damage by ants, and hence treatment is recommended (Rai, 1999). Store seeds in dry condition in closed aluminium or plastic containers (Chacko *et al.*, 2002).

Viability period: Seeds do not retain viability for long (Chacko *et al.*, 2002).

Seed emptiness: No information (Chacko *et al.*, 2002).

Seed pre treatment: Mild boiled water treatment may be given because of the hard testa. Cold - water treatment may be given to soften the hard testa (Chacko *et al.*, 2002).

Germination type: Epigeous (Chacko *et al.*, 2002).

Germination percentage: 30 to 60 (Chacko *et al.*, 2002).

Germination period: 30 to 45 days (Rai, 1999); Sometime up to 87 days (FRI, 1985; Chacko *et al.*, 2002).

Nursery technique: Freshly collected seeds are sown in germination trays containing vermiculite and watered under shade. In about 60 days, the seedlings attain 5 cm height and they are pricked out to polythene bags of size 22.5 cm x 17.5 cm and maintained under shade for about 60 days. Seedlings have to be maintained in the nursery for about 8 months. Adequate watering, twice a day, shall be provided (Rai, 1999; Chacko *et al.*, 2002).

Propagation:

Method of propagation: By seeds. The natural reproduction of this tree is satisfactory. The seeds fall to the ground and germinate with the onset of the monsoon.

Vegetative propagation:

Pests: Nil (Chacko *et al.*, 2002).

Diseases: *Rhizopus* sp., *Mucor* sp., *Torula* sp., *Aspergillus* sp. are the important spermatophyte fungi recorded (Mohan and Anil Chandran, 2001; Chacko *et al.*, 2002).

Medicinal properties: The seeds oil is used for medicine. Bark is tonic and febrifuge and is used as a gargle for odontopathi. Tender stems are used as toothbrushes. The fruits and seeds are effective in curing dental ailments. Various parts are used for treatment of wound and dysentery. The bark is used for disease of gums and flowers for blood diseases (Bose *et al.*, 1998).

Uses: The flowers are used as garlands, stuffing pillows, and in distilling an attar used in perfumes. The timber is mainly used for constructional work like bridges and piles and for boat building and agricultural implements. The bark yields a dye for colouring fabrics. Oil from seeds is used for several purposes (Bose *et al.*, 1998).

Wood properties: Sapwood is pale reddish brown and the heartwood which is sharply delineated from the sapwood, is dark reddish brown. The wood is very hard, strong, heavy and tough.

References:

Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 322, 327.

Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 168-169.

FRI. 1985. Troup's The Silviculture of Indian Trees. Vol. VI. The Controller of Publications, Delhi.

Mohanan, C. and Anil Chandran. 2001. Microorganisms associated with seeds of tropical forest species and their management for improving the storability and seedling production. Seed Science and Technology (in press).

Rai, S.N. 1999. Nursery and Planting Techniques of Forest Trees in Tropical South-Asia. Eastern Press, Bangalore, India.

Sen Gupta, J.N. 1937. Seed weights, plant percents, etc. for forest plants in India. Indian Forest Records (New Series) Silviculture, 2:221pp. Manager of Publications, Delhi.

Morinda citrifolia

Nomenclature:

Scientific name: *Morinda citrifolia* L.

Vernacular name: Cherumanjanathi (Malayalam) (Sasidharan, 2004). Nuna (Tamil)

Common name: Noni (Pawlus and Kinghorn, 2007); Indian Mulberry (Scots, 2006)

Synonyms:

Family: Rubiaceae

Subfamily:

Origin:

Distribution: This species is native to Southeast Asia (Indonesia) and Australia; and widely distributed in various parts of India; Myanmar; China; Malaya Archipelago and the Pacific Islands (Bose *et al.*, 1998; Scots, 2006).

Description: A small tree or large shrub, reaching 6 m high. The plant sometimes supports itself on other plants as a liana. There is much variation in overall plant form, fruit size, leaf size and morphology, palatability, odour of ripe fruit, and number of seeds per fruit (Bose *et al.*, 1998; Scots, 2006).

Flowering season: Summer and rains (Bose *et al.*, 1998). Continuous throughout the year (Scots, 2006).

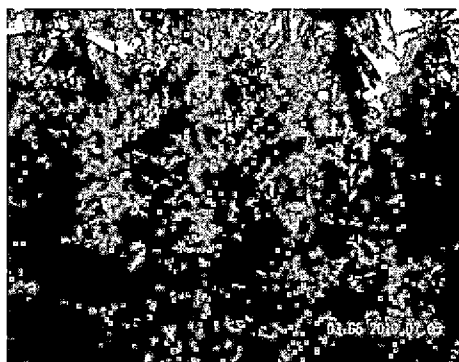
Fruiting season: Continuous throughout the year (Scots, 2006).

Flowers: Flowers fragrant, perfect, in dense globose heads; calyx truncate but often with a foliaceous lobe; corolla white, tubular, about 2.5 cm long; lobes acute. Peduncles are 10-30 mm long, five stamens, scarcely

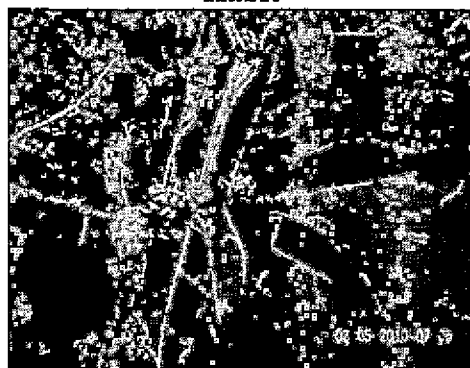
exserted, style is about 15 mm long (Bose *et al.*, 1998; Scots, 2006).

Fruits: Fruits green almost spherical fleshy mass, 2.5-3.5 cm in diameter, surface covered with small knobs, each representing a flower and bears a seed (Bose *et al.*, 1998).

Fruit type:



Habit



Branch with fruits

Seeds: Seeds have a distinct air chamber, and can retain viability even after floating in water for months (Scots, 2006).

Seed dimension:

Seed length:

Seed width:

Seed thickness:

Seed weight: 40,000 seeds/kg (Scots, 2006).

Seed dispersal: Birds and rodents (Scots, 2006).

Seed collection: Fruits are harvested when they start turning white, or even when they have become fully ripe, i.e., turned soft, translucent, and characteristically odorous. For seed production, the riper the fruit, the better. Collect fruit from plants that have desirable characteristics, such as large fruit for fruit production, vigorous leaf growth for hedges, etc. (Scots, 2006).

Transportation of seeds:

Seed processing: After picking, fruit is allowed to ripen fully until it all turns soft (almost mushy) and translucent. This may take 3-5 days if only semi-ripe fruits were collected. Once the fruits have fully softened, press them against a screen or colander with holes slightly smaller than the seeds. The soft, fibrous pulp will slowly be removed from the seeds as they are rubbed. It may take 15 minutes to completely remove the clinging flesh. Rinsing in water periodically helps float off the pulp. The seeds have an air bubble trapped inside, so unlike most other seeds, healthy noni seeds float in water. If the seeds are to be used immediately, soft fruits can be suspended in water and subjected to short pulses in a blender, very sparingly, to remove most of the flesh while slightly scarifying the seed (Scots, 2006).

Seed storage: Flesh should be removed completely, air-dried and stored in a paper bag in a cool room with low humidity (Scots, 2006).

Viability period: Eventhough length of viability of the seeds is unknown, seeds retain viability for 1 year (Scots, 2006).

Seed emptiness:

Seed pre treatment: Scarification of the tough seed coat, shorten the time required for seed germination and increase the overall germination percentage. Scarification includes any physical method that abrades, damages, penetrates, or cuts open the seed coat. A simple method is to place ripe fruits in a blender and pulse the blending mechanism a few times to cut open the noni seeds before separating them from the pulp. Clipping off the tip of noni seeds near the embryo results in higher germination percentage eventhough it is a more time-consuming method (Scots, 2006).

Germination type:

Germination percentage: Fresh seeds give 90% germination (Scots, 2006).

Germination period: 20 - 120 days (Scots, 2006).

Nursery technique: Natural or local forest soil free from weed and nematode is mixed with sand, volcanic cinder and/or composted organic matter are excellent for seedling production. A preferred pot- inherently moisture-retaining, slightly acidic to slightly alkaline (depending on locally available source material), aerobic, and high in organic matter derived from compost or peat. Nematode-infested soils or media should be avoided or treated with heat (at least 50°C for 15 minutes) prior to using. Most nurseries prefer natural potting media rather than commercial media for noni production. Mulch (e.g., cinder, sawdust, leaf litter, or sand) may be placed over the seeds for weed control and moisture retention (Scots, 2006).

Propagation:

Method of propagation: Varying sizes of stem cuttings 20-40 cm can be used. Stem cuttings may root in 3 weeks and be ready for outplanting in 6-9 weeks.

As with plants derived from seeds, rooted stem cuttings may be grown in pots for up to 26 weeks or more with excellent results when outplanted (Scots, 2006).

Vegetative propagation:

Pests: Insects, such as aphids (e.g., the melon aphid, *Aphis gossypii*), scales (e.g., the green scale, *Coccus viridis*), weevils, leaf miners, whiteflies (e.g., the Kirkaldy whitefly, *Dialuerodes kirkaldyi*), caterpillars (e.g., *Croton caterpillar*, *Achaea janata*), thrips (e.g., the greenhouse thrips, *Heliothrips haemorrhoidalis*), and an unidentified species of eriophyid mite. Over use of fertilizer attract sap-feeding insects (e.g., aphids, whiteflies, scales) causing sooty mold on noni leaves. Stress from lack of nutrients or root problems may also lead to infestations of whiteflies or scales. Whiteflies and scales are perhaps the most destructive. They can be controlled with sprays of insecticidal soaps and oils. In some locations, leaf miners periodically cause severe damage to noni leaves (Scots, 2006).

Diseases: Leaf spots (*Colletotrichum* sp. and others) and stem, leaf, and fruit blights (*Phytophthora* sp. and *Sclerotium rolfsii*) are caused in damp, high-rainfall or flooded areas. The fungal leaf spot diseases are relatively minor but can be a nuisance in some locations. They can be minimized by sanitation (picking up or removing severely diseased leaves) or by periodic application of approved fungicides. Foliar diseases caused by *Phytophthora* may significantly inhibit leaf growth and fruit development. The most common and severe pest problem is rootknot disease caused by root-knot nematodes (*Meloidogyne* sp.). These soil-dwelling, root-parasitic roundworms are very destructive to noni and must be kept out of the nursery. The disease can cause farm failure. To keep nematodes out of

nurseries, use soil-less media or only heat-treated soil for seedlings. Once established in a field, root-knot nematodes are virtually impossible to eradicate and can eventually result in plant death. Therefore infected seedlings should be destroyed. It also displays a wide range of abnormal foliar symptoms due to deficiencies in fertility elements (e.g., nitrogen, iron, and phosphorous). Deficiencies in iron or other minor elements are expressed as interveinal chlorosis or scorching of leaf margins. Deficiencies in phosphorous are expressed as leaf curling, purpling, and marginal necrosis (Scots, 2006).

Medicinal properties: Used for treatment of malaria, general febrifuge, and analgesic (leaf tea); laxative (all parts of the plant); jaundice (decoctions of stem bark); hypertension (extract of leaves, fruit, or bark); boils and carbuncles (fruit poultice); stomach ulcers (oils from the fruit); scalp insecticide (seed oil); tuberculosis, sprains, deep bruising, rheumatism (leaf or fruit poultices); sore throat (gargling a mash of the ripe fruit); body or intestinal worms (whole fresh fruits); laxative (seeds); fever (leaf poultice); cuts and wounds, abscesses, mouth and gum infections, toothaches (fruit); sties (flowers or vapor from broken leaves); stomach ache, fractures, diabetes, loss of appetite, urinary tract ailments, abdominal swelling, hernias, stings from stonefish, and human vitamin A deficiency (leaves). The leaves are also used as a medicinal poultice or body wrap (e.g., Micronesia). The terminal bud has medicinal uses (e.g., Northern Marianas). Purported value of noni, include treatment of ailments including attention deficit disorder, addictions, allergies, arthritis, asthma, brain problems, burns, cancer, cardiovascular disease, chemical sensitivity, chronic fatigue, diabetes, digestive problems, endometriosis, fibromyalgia, gout, hypertension, immune deficiency, infection,

inflammation, jet lag, multiple sclerosis, muscle and joint pain, polio, rheumatism, severed fingers, sinus, and veterinary medicine have yet to be validated (Scots, 2006). The root is used as cathartic and laxative, febrifuge and as a remedy for the pain or cure of swollen gums (Bose *et al.*, 1998). Ripe fruit has a strong butyric acid smell and flavour. The leaves and especially the fruit are consumed in different forms by various communities (e.g., the Polynesians) throughout the world; the root is used as a dye. fruit has antibiotic and antioxidant properties in vitro (Chan Blanco *et al.*, 2006). The dominant substances in the fruit are fatty acids and polysaccharides, while the roots and bark contain anthraquinone (Seidemann, 2002). Plant possess antibacterial, analgesic, emollient, emmenagogue, anticongestive, hypotensive and sedative activities (Dittmar, 1993; Leach *et al.*, 1988). Seeds contain 16.1% oil. It has 2.3% unsaponifiable matter, 121.3 iodine value and 198.5 saponification value. The main fatty acid components of the oil are linoleic (55.0%), oleic (20.5%), palmitic (12.8%), ricinoleic (6.8%) and stearic (4.9%) (Daulatabad *et al.*, 1989). A crude ethanol extract and hexane fraction from *M. citrifolia* (collected from Lipata, Quezon,

Philippines) show antitubercular (anti-*Mycobacterium tuberculosis*) activity (Saludes *et al.*, 2002). Noni fruit is a good source of vitamin C, containing 155 mg ascorbic acid/100 g (Shovic and Whistler, 2001).

Uses: Fruits are used in local medicines (juice, poultice) and as a famine food. Unripe fruits are cooked in curries and ripe fruits are consumed raw with salt (e.g., Myanmar). Fruit is cooked and mixed with coconut and eaten as stimulant on long sea voyages. Very young leaves are cooked as vegetables and eaten with rice in Java and Thailand; mature leaves are wrapped around fish before cooking and then eaten with the cooked fish. The terminal bud is used as food. Dried leaves or fruits are used to make infusions and teas for medicinal use. The root yield a dye, known as *Al* dye (Bose *et al.*, 1998; Chan Blanco *et al.*, 2006; Scots, 2006).

Wood properties:

The wood is fairly hard and can be used in light construction, canoe parts and paddles, axe and adze handles, and digging sticks (Bose *et al.*, 1998; Scots, 2006).

References:

- Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 328.
- Chan Blanco, Y., Vaillant, F., Perez, A.M., Reynes, M., Brillouet, J.M. and Brat, P. 2006. The noni fruit (*Morinda citrifolia* L.): a review of agricultural research, nutritional and therapeutic properties. *Journal of Food Composition and Analysis*. 19(6/7): 645-654.
- Daulatabad, C.D., Mulla, G.M. and Mirajkar, A.M. 1989. Ricinoleic acid in *Morinda citrifolia* seed oil. *Journal of the Oil Technologists' Association of India*. 21(2): 26-27.
- Dittmar, A. 1993. *Morinda citrifolia* L. use in indigenous Samoan medicine. *Journal of Herbs, Spices and Medicinal Plants*. 1(3):

Leach, A.J., Leach, D.N. and Leach, G.J. 1988. Antibacterial activity of some medicinal plants of Papua New Guinea. *Science in New Guinea*. 14: 1-7.

Saludes, J.P., Garson, M.J., Franzblau, S.G., and Aguinaldo, A.M. 2002. Antitubercular constituents from the hexane fraction of *Morinda citrifolia* Linn. (Rubiaceae). *Phytotherapy Research*. 16(7): 683-685.

Sasidharan, N. 2004. *Forest Trees of Kerala*. Kerala Forest Research Institute, Peechi, Kerala, India.

Scot C. N. 2006. *Morinda citrifolia* (Noni) at <http://www.traditionaltree.org>.

Seidemann, J. 2002. Noni - a questionably magic fruit from the South Seas. *Zeitschrift fur Phytotherapie*. 23(2): 62-67.

Shovic, A.C. and Whistler, W.A. 2001. Food sources of provitamin A and vitamin C in the American Pacific. *Tropical Science*. 41(4): 199-202.

Muntingia calabura

Nomenclature:

Scientific name: *Muntingia calabura* L.

Vernacular name: Pancharapazham
(Malayalam)

Common name: Chinese cherry, Couplin

Synonyms:

Family: Tiliaceae

Subfamily:

Origin:

Distribution: Native of tropical South America and West Indies (CABI, 1998; Chacko *et al.*, 2002).

Description: Small fast growing tree, up to 6 m high, with spreading and drooping branches.

Flowering season: Throughout the year.

Fruiting season: May to June.

Flowers: Flowers white, solitary, 2 cm across, on long stalks, arising above the axils; sepals 5; petals obcordate, 1.2 cm long; stamens many (Bose *et al.*, 1998).

Fruits: Fruit is a globose berry, containing many small seeds, red when ripe, resembling a cherry (Bose *et al.*, 1998).

Fruit type: Berry.

Seeds: Seeds are minute, many in soft sweet pulp (Bose *et al.*, 1998).

Seed dimension:

Seed length:

Seed width:

Seed thickness:

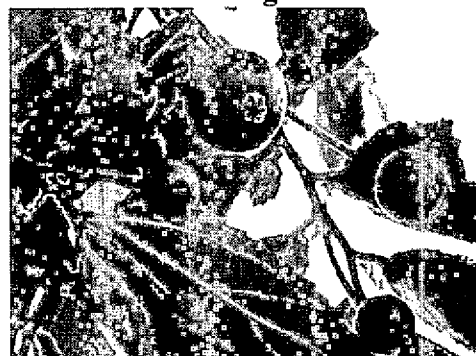
Seed weight: 27,550 seeds/kg

Seed dispersal:

Seed collection: Mature fruits (Berry) are collected from the floor or from the tree (Chacko *et al.*, 2002).



Twig



Branch with fruits

Transportation of seeds: No special care is needed (Chacko *et al.*, 2002).

Seed processing: The fruits are crushed in water inside a vessel and strained through a piece of cloth. The seeds are then sundried or oven-dried and pure seeds are separated by sieving (Chacko *et al.*, 2002).

Seed storage: Orthodox seed storage behaviour (CABI, 1998).

Viability period: No information (Chacko *et al.*, 2002).

Seed emptiness: Very low (Chacko *et al.*, 2002).

Seed pre treatment: Nil (Chacko *et al.*, 2002).

Germination type: No information (Chacko *et al.*, 2002).

Germination percentage: Up to 87 (Chacko *et al.*, 2002).

Germination period: 30 days (Chacko *et al.*, 2002).

Nursery technique: Seeds are sown in moist polyurethane foam sheet or vermiculite, and seedlings are picked out into polythene bags of 25x20 cm filled with soil based potting mixture. The seedlings attain a height of 40 cm in about 4 months (Chacko *et al.*, 2002).

Propagation:

Method of propagation:

Vegetative propagation:

Pests: No information (Chacko *et al.*, 2002).

Diseases: No information (Chacko *et al.*, 2002).

Medicinal properties:

Uses: An ornamental tree in most parts of tropical Asia and tropical America. The fruits are processed and in West Indies leaves are used for making tea. Bark yields a cordage fibre (Bose *et al.*, 1998). Wood is used for fuel and in some areas for pulp. The sweet berry is edible. It is planted as intercrop with agricultural crops and also makes a good shade tree for livestock (CABI, 1998; Chacko *et al.*, 2002).

Wood properties:

References:

- Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa, India. pp. 330.
- CABI. 1998. The Forestry Compendium – A Silvicultural Reference. Module 1. CABI Publishing, CAB International, Wallingford, Oxon, OX108DE, UK.
- Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 170-171.

Myristica fragrans

Nomenclature:

Scientific name: *Myristica fragrans* Houtt.

Vernacular name: Jathi kai, Japatri (Malayalam); Jaiphal (Hindi); Jajikai (Kannada)

Common name: Nutmeg tree

Synonyms: *M. moschata* Thunb.,
Myristica officinalis L.

Family: Myristicaceae

Subfamily:

Origin:

Distribution: The tree is native to the Bunda islands of Indonesia. This tree is cultivated in the Southern parts of India. It is grown in Tamilnadu, Andhra Pradesh, Kerala and other places in the moist evergreen forests of the Western Ghats.

Description: It is a spreading, aromatic, evergreen lofty tree, usually reaching a height of 9-12 m. Sometimes it attains a height of 20 m or more (Bose *et al.*, 1998).

Flowering season: June to October, September to October (Bose *et al.*, 1998).

Fruiting season: Throughout the year. Fruits mature in February to April (Bose *et al.*, 1998).

Flowers: These are pale yellowish brown. The flowers are fragrant, creamy yellow and borne in umbellate cymes. Male racemes: lax, supra-axillary, 2.5-5 cm long; flowers 6 mm long, ellipsoid or urceolate, nodding; bracteole as scale under glabrate perianth; anthers 9-12; female racemes: few-flowered; ovary ovoid-globose, pubescent (Bose *et al.*, 1998).

Fruits: Berry, ovoid, globose or pyriform, about 6 to 9 cm long and yellow. The pericarp is fleshy, splitting into two halves at maturity.

Fruit type: Berry.



Fruit



Seeds

Seeds: The seeds are broadly ovoid with a purplish brown testa.

Seed dimension:

Seed length: 6-9 cm.

Seed width:

Seed thickness:

Seed weight: 800 to 1,000 seeds/kg

Seed dispersal:

Seed collection:

Transportation of seeds:

Seed processing:

Seed storage: Seeds are recalcitrant and lose viability after only 20% loss in water, which happens after only 7 days of storage. Seeds stored in sealed plastic bags maintain viability for up to 45 days (Madhusudanan and Babu, 1994). Seeds lose germinability at moisture contents <45% when dried at selected temperatures. Germination of stored seeds can be maintained for a longer period of time when stored at 5°C in sealed transparent polythene bags than stored at room temperature (Sangakkara, 1993).

Viability period:

Seed emptiness:

Seed pre treatment: Soaking seeds in 100 ppm GA give 85% germination and vigour index 3945 (Gunasekaran *et al.*, 2001). Seeds soaked in GA3 at 200 ppm for 24 hrs give 75% germination. Germination percentage increases as soaking time is increased for 100 and 200 ppm treatments but decrease as soaking time increase at 1000 ppm (Mathew, 1997). Hulled seeds treated with 0.1% carbendazim give 97.5% germination (Chezhiyan and Ananthan, 1997).

Germination type:

Germination percentage: 98

Germination period:

Nursery technique: Seedlings are transplanted in potted soil inoculated with *Azospirillum brasilense* and *Azotobacter chroococcum* isolates show increased growth, increased number of leaves and branches compared to untreated (Nair and Naja Chandra, 2001).

Propagation:

Method of propagation: Vegetative propagation.

Vegetative propagation:

Pests:

Diseases:

Medicinal properties: Fruit is used as medicinal. Nutmeg butter or fat obtained from nutmeg is used as a mild external stimulant in ointments, hair lotions and plasters, and forms a useful application in cases of rheumatism, sprains and paralysis (Bose *et al.*, 1998). The methanolic extract of arils show antibacterial activity against cariogenic bacterium, *Streptococcus mutans*. Dehydrodiisoeugenol and 5'-methoxy dehydrodiisoeugenol are the major active principles. Guaiacin and a new compound are also isolated from the phenolic fraction (Hattori *et al.*, 1986). Petroleum ether and water extracts of seeds show antidiarrhoeal activity (Shidore *et al.*, 1985). *Myristica fragrans* (MF) seeds has complex actions on the central nervous system. It also exhibits anticonvulsant activity against maximum electroshock (Sonavane *et al.*, 2002). *M. fragrans* is used for both culinary and medicinal purposes. Most important medicinal uses are the treatment of diarrhoea, mouth sores and insomnia. It also has mild sedative action, hallucinogenic or other psychoactive properties (Gils and Cox, 1994).

Uses: Nutmeg is used as a spice. Its oil is used in the perfume industry. Nutmeg butter is used in the hair lotion. Pericarp is used in pickles and jellies (Bose *et al.*, 1998). Seeds of *Myristica fragrans* contains 11-29 mg/g free amino acid (Kadam, 2001).

References:

- Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 331.
- Chezhiyan, N. and Ananthan, M. 1997. Effect of seed grading on the germination of tree spices clove and nutmeg. *South Indian Horticulture*. 45(5/6): 249-251.
- Gils, C van and Cox, P.A. 1994. Ethnobotany of nutmeg in the Spice Islands. *Journal of Ethnopharmacology*. 42(2): 117-124.
- Gunasekaran, M., Prasath, D. and Krishnasamy, V. 2001. Effect of chemical treatment on germination of nutmeg (*Myristica fragrans* Houtt.) seeds. *Journal of Spices and Aromatic Crops*. 10(1): 57-58.
- Hattori, M., Hada, S., Watahiki, A., Ihara, H., Shu, Y., Kakiuchi, N., Mizuno, T. and Namba, T. 1986. Studies on dental caries prevention by traditional medicines. X. Antibacterial action of phenolic components from mace against *Streptococcus mutans*. *Chemical and Pharmaceutical Bulletin*. 34: 3885-3893.
- Kadam, V.B. 2001. Protein and amino acid in seeds of some medicinally important tree species. *Plant Archives*. 1(1/2): 57-59.
- Madhusudanan, K.N. and Babu, V. 1994. Recalcitrancy, viability and germination of nutmeg seeds. *Journal of Plantation Crops*. 22(1): 25-29.
- Mathew, K.L. 1997. Effect of gibberellic acid on seed germination and seedling growth of nutmeg (*Myristica fragrans*). *Indian Cocoa, Arecanut and Spices Journal*. 21(2): 34-36.
- Nair, S.K. and Naja Chandra. 2001. Effect of biofertilizer application on growth of nutmeg (*Myristica fragrans* Houtt.) seedlings. *Journal of Tropical Agriculture*. 39(1): 65-66.
- Sangakkara, U.R. 1993. Effect of time of harvest and storage conditions on germination of nutmeg (*Myristica fragrans* Houtt). *Journal of Agronomy and Crop Science*. 170(2): 97-102.
- Shidore, P.P., Mujumdar, S.M., Shrotri, D.S. and Mujumdar, A.M. 1985. Anti-diarrhoeal and anti-inflammatory activity of nutmeg extracts. *Indian Journal of Pharmaceutical Sciences*. 47: 188-190.
- Sonavane, G.S., Palekar, R.C., Kasture, V.S. and Kasture, S.B. 2002. Anticonvulsant and behavioural actions of *Myristica fragrans* seeds. *Indian Journal of Pharmacology*. 34(5): 332-338.

Myristica malabarica

Nomenclature:

Scientific name: *Myristica malabarica* Lamk.

Vernacular name: Kattu- Jathikka, Panampalika, Pathiri- Poov, Ponnampoo (Malayalam); Malabar Nutmeg (English); Tam. - Patthiri, Katjathika (<http://ces.iisc.ernet.in/hpg/cesmg/pew/myrmal.html>).

Common name: False nutmeg, Bombay mace tree (Bose *et al.*, 1998).

Synonyms:

Family: Myristicaceae

Subfamily:

Origin:

Distribution: India - Western Ghats (Endemic); Western Ghats - Savanthwadi (Mah.); Districts - Uttara Kannada, Hassan, Chikmangalur, Coorg (Karn.); Cannanore, Palakkad, Trivandrum (Kerala); Tamil Nadu; Goa (<http://ces.iisc.ernet.in/hpg/cesmg/pew/myrmal.html>).

Description: Trees up to 15 to 25 m high.

Flowering season: February to March.

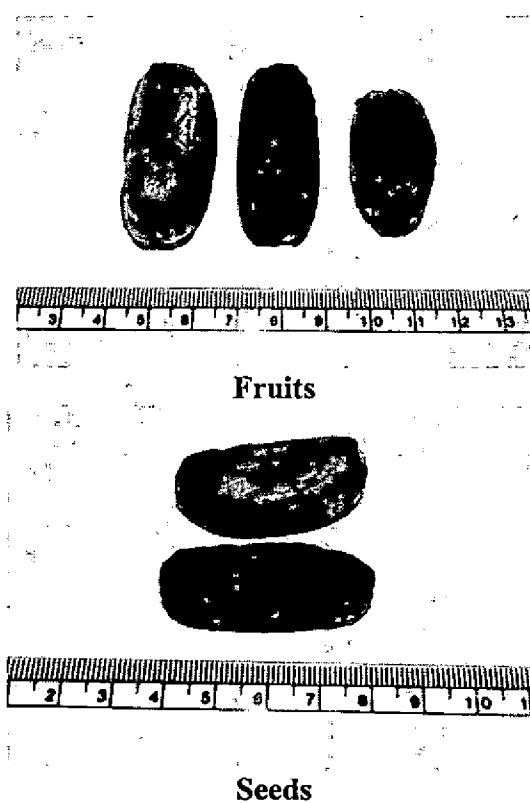
Fruiting season: March to April (Bose *et al.*, 1998).

Flowers: Yellow, unisexual in axillary pedunculate, dichasial cyme, perianth 3 lobed with lobes up to 0.4 cm long, ovoid. Male panicles 2.5-4 cm long, axillary or sub-axillary; peduncles naked below, subumbellately cymose above; perianth 4 mm long, puberulous, 3-toothed; female

panicles few-flowered, flowers larger (Bose *et al.*, 1998).

Fruits: Capsules yellow, oblong, densely deciduous tomentose.

Fruit type: Capsule.



Seeds: Seeds arillate, up to 2 cm long, ovoid with yellow, irregularly lobed.

Seed dimension:

Seed length: 2 cm

Seed width:

Seed thickness:

Seed weight: 100 to 150 seeds/kg

Seed dispersal:

Seed collection:**Transportation of seeds:****Seed processing:**

Seed storage: Seeds are sensitive to temperatures below 10°C, is an indication of recalcitrant nature. Seeds with 27% moisture content stored in polyethylene bags at 30°C / 80% RH retain their viability up to one year (Anil Kumar *et al.*, 2002).

Viability period: 1 week under natural conditions (Anil Kumar *et al.*, 2002).

Seed emptiness:**Seed pre treatment:****Germination type:**

Germination percentage: 40

Germination period:**Nursery technique:****Propagation:**

Method of propagation: By seeds.

Vegetative propagation:**Pests:****Diseases:**

Medicinal properties: The seeds and the aril cover both are used as medicine. Fat from the seed is used as an embroction in rheumatism, sores and pain. Seeds are used externally for indolent ulcers. Aril of the seeds is cooling, febrifuge and expectorant, and is useful in vitiated conditions of Vata, cough, bronchitis, fever and burning sensation. The fat obtained from the seeds is good for myalgia, sprains and sores.

Uses: The bark of the tree yield a gum. Seed kernels contain a resin which is phenolic in nature and can be used as an antioxidant for the protection of oils and fats. Wood is suitable for plywood, packing cases and crates.

Wood properties: It is reddish brown and is moderately hard, light and not so durable. It is a diffuse porous wood with indistinct growth rings.

References:

Anil Kumar, C., Babu, K.P. and Krishnan, P.N. 2002. Seed storage and viability of Myristica malabarica Lam. an endemic species of Southern Western Ghats (India). Seed science and technology. International Seed Testing Association, Zürich, SUISSE (1973) (Revue) 30(3): 651-657.

Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 331.

<http://ces.iisc.ernet.in/hpg/cesmg/pew/myrmal.html> (last visited on October 2009).

Neolamarckia cadamba

Nomenclature:

Scientific name: *Neolamarckia cadamba* (Roxb.) Bosser

Vernacular name: Kadambu, Aatuthekku, Kodavara (Malayalam); Vellacadamba, Kola-aiyila (Tamil); Bale, Kada (Kannada); Kadam (Hindi) (Chacko *et al.*, 2002).

Common name: Bur-flower tree (Chacko *et al.*, 2002); Wild Cinchona, Kadam.

Synonyms: *Nauclea cadamba* Roxb., *Anthocephalus chinensis* (Lam.) A. Rich. ex Walp., *Anthocephalus cadamba* (Roxb.) Miq., *Anthocephalus indicus* A. Rich. (Chacko *et al.*, 2002); *Cephalanthus chinensis* Lamk., *Sarcocephalus cadamba* Kurz

Family: Rubiaceae

Subfamily:

Origin:

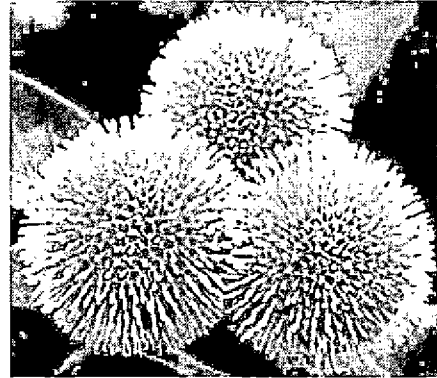
Distribution: Occurs often on alluvial soil along rivers and also in swampy areas. The tree has wide distribution in Nepal eastwards, Bengal, Assam, Bihar, Myanmar, Andhra Pradesh, and the west coast from North Kanara southwards. It also occurs in Sri Lanka. It is cultivated in many parts of India (FRI, 1985; Chacko *et al.*, 2002). They are found in moist, warm type of deciduous and evergreen forests. It is found in sub Himalayan tract from Nepal, West Bengal and found in all over India.

Description: Fast growing large deciduous tree attaining a height of more than 25 m and a breast height diameter of 80 cm (Chacko *et al.*, 2002).

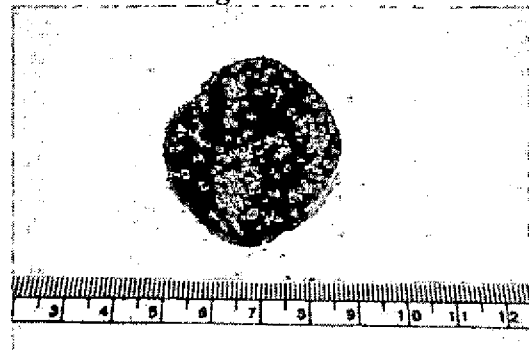
Flowering season: May to September.

Fruiting season: August to October (Chacko *et al.*, 2002); January to February.

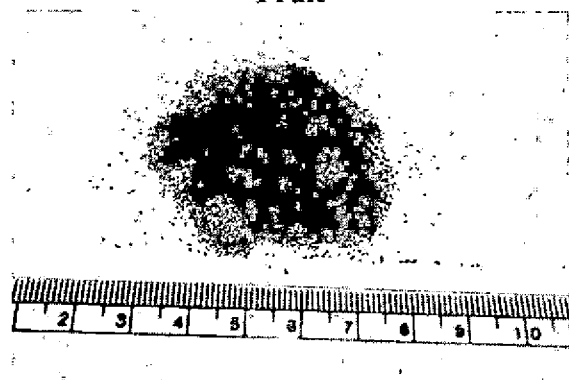
Flowers: Orange or yellow in globose heads. Flowers yellow, solitary, terminal consisting of small yellow or orange coloured scented flowers.



Twig with fruits



Fruit



Seeds

Fruits: Fruit is a fleshy orange, globose pseudocarp of compressed angular capsules,

each containing a number of seeds with persistent calyx.

Fruit type:

Seeds: Small, Muriculate.

Seed dimension:

Seed length: 0.59-0.68 mm (Chacko *et al.*, 2002).

Seed width: 0.41-0.48 mm (Chacko *et al.*, 2002).

Seed thickness:

Seed weight: 9,20,651 (Sen Gupta, 1937); 23,000,000-31,200,000 seeds/kg (Chacko *et al.*, 2002).

Seed dispersal: Animals, birds and bats.

Seed collection: Fruits are collected from the ground and heaped under shade. Mature fruits change colour from green to orange, can be collected from the trees also (Chacko *et al.*, 2002).

Transportation of seeds: No special care is needed (Chacko *et al.*, 2002).

Seed processing: The fruits are allowed to rot for 3 to 4 days and the pulp is made into a slurry by hand in a bucket containing water. Seeds are then thoroughly dried and stored in a dry place (FRI, 1985; Chacko *et al.*, 2002). Ripe fruits are air dried, crushed, and shaken through a No. 35 US Standard Sieve to separate seed from chaff. Fruits are soaked in the open until rotted, ground by hand into a thick slurry, air dried, and passed through a series of sieves terminating with a No. 35 (Venatore and Zambrana, 1972).

Seed storage: Probably orthodox. Seeds can be stored in dry place for one year (Dent, 1948; Chacko *et al.*, 2002).

Viability period: Seeds are viable up to one year (Dent, 1948; Chacko *et al.*, 2002).

Seed emptiness: No information (Chacko *et al.*, 2002).

Seed pre treatment: Not required (Chacko *et al.*, 2002).

Germination type: Epigeal (Chacko *et al.*, 2002).

Germination percentage: 67 to 75 (Chacko *et al.*, 2002). Freshly extracted seed: 90% (Venatore and Zambrana, 1972). Clean seeds (pulp removed): 75% (laboratory) and 52% (nursery). Seeds with pulp: 4.85% (Beniwal and Dhawan, 1991).

Germination period: 7 to 21 days (Sen Gupta, 1937) 15 to 30 days (Rai, 1999), 11 to 50 days (FRI, 1985; Chacko *et al.*, 2002).

Nursery technique: The seeds, being very minute are mixed with fine sand before sowing at the rate of about 130 g of seeds per square meter of bed (FRI, 1985). The bed should be made with more sand. Cover the bed with straw. The entire bed should be sprayed with fungicide and dusted with insecticide like BHC to prevent fungal and insect damage. Water the bed with a fine rose can twice a day. In each bed of one square meter about 2000 seedlings are expected. When the seedlings are about 1 to 2 cm in height, prick out along with the ball of earth and into polythene bags of size 22.5 x 17.5 cm. Keep these young seedlings under shade for about 60 days (Chacko *et al.*, 2002).

Propagation:

Method of propagation: By seeds.

Vegetative propagation:

Pests: Moderate damage due to an unidentified caterpillar (Chacko *et al.*, 2002).

Euchlora viridis, *Holotrichia constricta*, *H. helleri*, *Lepidiota stigma* and *Leucopholis rorida*. One or more of these species damage 1- to 2-year-old trees of *Anthocephalus cadamba* (Intari and Natawiria, 1973). The nematodes found associated with the roots of *Anthocephalus cadamba* are *Meloidogyne* spp., *Hemicriconeoides*, *Tylenchorhynchus* and *Hoplolaimus* and *M. javanica* in root galls. Application of D-D (Mixture of 1,3-dichloropropene and 1,2-dichloropropane) at 250 litres/hectare reduce the attack (Gupta and Dalal, 1973). *Thyridopteryx ephemeraeformis* damage leaf area of *Anthocephalus cadamba* (Srivastva and Attri, 2004).

Diseases: Low (18 to 29%). *Colletotrichum gloeosporioides*, *Drechslera* sp., *Fusarium* sp., and *Phoma* sp., are the important field fungi on seeds. Storage moulds include *Aspergillus* spp., *Chaetomium* sp., and *Mucor* sp. (Mohanan and Geetha Varma, 2001; Chacko and Mohanan, 2002; Chacko *et al.*, 2002). A disease of unknown etiology occur in patches and affected trees show cambial and sapwood staining spreading upwards from the roots. Also, symptoms like root infection, and the death of feeding roots occur (Gibson and Nylund, 1976). Brown leaf spot caused by *Phaeoisariopsis anthocephala* (Kobayashi, 1987). Leaf blight caused by *Rhizoctonia solani* affects 40-80% of the foliage in seedlings. Can be controlled by the use of sterilized soil or application of Bayleton [triadimefon] (Mehrotra, 1993).

Medicinal properties: Bark and roots are used for medicinal purposes (FRI, 1985). It is useful in vitiated conditions of pitta, inflammation, haemoptysis, fever, cough,

ulcers and debility. Bark is considered to be a tonic and febrifuge, astringent, febrifugal and anti diuretic properties, and is given in cough. Tender shoots are taken internally to cure dysentery and increase digestion. The juice of the bark forms a constituent of a compound to treat inflammation of the eye (Chacko *et al.*, 2002). Ethanolic and aqueous extracts of the *N. cadamba* bark possess anthelmintic activity also (Gunasekaran *et al.*, 2006). Chlorogenic acid (CGA), isolated from the leaves of *N. cadamba* has hepatoprotective activity because of its antioxidative action (Kapil *et al.*, 1995).

Uses: The bark contain tannins. The flowers are used as vegetable. On steam distillation, the flowers yield an essential oil. Anthocephalus alkaloids: cadamine and isocadamine are isolated from the leaves (Brown and Chapple, 1976). Oil is obtained from flower (Chandra, 1985). Extracts from *N. cadamba* show inhibition against the mycelium growth of *Alternaria brassicae* (Bhardwaj and Laura, 2007). A flavonoid glycoside is isolated from the air-dried bark. This flavonoid glycoside and its aglycone show potent inhibition against sorbitol accumulation in human red blood cells (Haraguchi *et al.*, 1998). Wood is used for ceiling boards, packing cases, light furniture. The wood is highly preferred for pencil making (Chacko *et al.*, 2002) and can also be used as a raw material for papermaking (Chittenden and Palmer, 1972).

Wood properties: Wood is white with yellowish tinge turning greyish with age without any distinct heartwood. It is a soft and light wood. Air dry weight about 500 kg/m³.

References:

- Bhardwaj, S.K. and Laura, J.S. 2007. Antifungal potential of some botano-extracts against Alternaria brassicae. *Journal of Plant Disease Sciences*. 2(2): 135-137.
- Beniwal, B.S. and Dhawan, V.K. 1991. Standardisation of nursery technique (use of different germination and watering methods) of Anthocephalus chinensis. *Indian Forester*. 117(2): 105-109.
- Brown, R.T. and Chapple, C.L. 1976. Anthocephalus alkaloids: cadamine and isocadamine. *Tetrahedron Letters*, No. 19. pp. 1629-1630.
- Chacko, K.C. and Mohanan, C. 2002. Development of technology for collection, processing and testing seeds of five important tree species of Kerala. Final report of project KFRI 279 / 97. Kerala Forest Research Institute, Peechi.
- Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 172-173.
- Chandra, G. 1985. Investigations on essential oils and isolates of potential value at HBTI, Kanpur. *Indian Perfumer*. 29: 1-2, 23-30.
- Chittenden, A.E. and Palmer, E.R. 1972. Pulping trials of a sample of Anthocephalus cadamba from North Borneo. *International Paper Board Industry*. 14: 11, 32-34, 36-37.
- Dent, T.V. 1948. Seed storage with particular reference to the storage of seed of Indian forest plants. *Indian Forest Records (New Series) Silviculture*, 7: 134 pp. Manager of Publications, Delhi.
- FRI. 1985. Troup's The Silviculture of Indian Trees. Vol. VI. The Controller of Publications, Delhi.
- Gibson, I.A.S. and Nylund, J. 1976. Sudden death, a disease of Cadam (Anthocephalus cadamba (Roxb.) Miq.). *Commonwealth Forestry Review*. 55: 165, 219-227.
- Gunasekaran, R., Senthilkumar, K.L., Gopalkrishnan, S., Manikandar, R.V.M., Divyakant, A. and Pagariya Ashish. 2006. Anthelmintic activity of bark of Neolamarckia cadamba. *Indian Journal of Natural Products*. 22(1): 11-13.
- Gupta, D.C. and Dalal, M.R. 1973. Meloidogyne javanica associated with Kadam (Anthocephalus cadamba Roxb.). *Pesticides*. 7: 29.
- Haraguchi, H., Kanada, M., Fukuda, A., Naruse, K., Okamura, N. and Yagi, A. 1998. An inhibitor of aldose reductase and sorbitol accumulation from Anthocephalus chinensis. *Planta Medica*. 64(1): 68-69.
- Intari, S.E. and Natawiria, D. 1973. White grubs in forest tree nurseries and young plantations. *Laporan, Lembaga Penelitian Hutan*. 167: 22.

Kapil, A., Koul, I.B. and Suri, O.P. 1995. Antihepatotoxic effects of chlorogenic acid from *Anthocephalus cadamba*. *Phytotherapy Research*. 9(3): 189-193.

Kobayashi, T. 1987. Diseases in tropical forest nurseries. (10). Leaf spot diseases. *Tropical Forestry*. (10): 63-66.

Mehrotra, M.D. 1993. Rhizoctonia leaf blight, a new disease of *Anthocephalus chinensis*. *Indian Forester*. 119(7): 590-591.

Mohanani, C. and Geetha Varma. 2001. Microorganisms associated with seeds of *Dalbergia*, *Acacia* and *Albizia* species and their management for optimum seed germination and seedling health. *Journal of Tropical Forestry* (in press).

Rai, S.N. 1999. *Nursery and Planting Techniques of Forest Trees in Tropical South-Asia*. Eastern Press, Bangalore, India.

Sen Gupta, J.N. 1937. Seed weights, plant percents, etc. for forest plants in India. *Indian Forest Records (New Series) Silviculture*, 2:221 pp. Manager of Publications, Delhi.

Srivastva, S.K. and Attri, B.L. 2004. Bag worm (*Thyridopteryx ephemeraeformis* (Haworth)), an emerging pest in coastal agroecosystem of Orissa. *Insect Environment*. 10(2): 70-71.

Venatore, C.R. and Zambrana, J.A. 1972. Extraction and germination of Kadam seed. USDA Forest Service Research Note, Institute of Tropical Forestry, Puerto Rico. No. ITF 14, 2 pp.

Ochlandra ebracteata

Nomenclature:

Scientific name: *Ochlandra ebracteata*
Raizada & Chatterjee

Vernacular name: Velleeta (Malayalam),
Eeral (Tamil) (Chacko *et al.*, 2002).

Common name: Reed (Chacko *et al.*,
2002).

Synonyms:

Family: Poaceae (Graminae)

Subfamily:

Origin:

Distribution: Confined to the hilly tracts of Southern Kerala along the stream - banks (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002). In Kerala it occurs in Trivandrum district mainly in the midlands.

Description: Erect, shrubby reed-like bamboo reaching a height of 4.6 m and a diameter of 1.9 to 3.8 cm (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Flowering season:

Fruiting season: April (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Flowers: (Spikelets) green, cylindro-conical in flagellate, spicate panicles of verticillate clusters with sessile and comparatively large fertile spikelets.

Fruits: Fruit is a caryopsis, light chocolate brown in colour, oblong, somewhat wrinkled and with a conical beak (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Fruit type: Caryopsis.

Seeds:

Seed dimension:

Seed length: 3.2-4.1 cm (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Seed width:

Seed thickness:

Seed weight: 200 to 280 seeds/kg (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Seed dispersal:

Seed collection: Seeds are collected either from the clump or from the ground (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Transportation of seeds: Seeds are collected in moist gunny bags and transported to the nursery site without delay (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Seed processing: Except spreading out the seeds in a ventilated room, no special processing is necessary (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Seed storage: Recalcitrant (Seethalakshmi and MukteshKumar, 1998). Seeds remain viable for a month (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*,2002).

Viability period: Seeds retain viability for about a month (Seethalakshmi and Muktesh kumar, 1998; Chackoet *al.*,2002).

Seed emptiness: No information (Chacko *et al.*, 2002).

Seed pre treatment: Not required (Chacko *et al.*, 2002).

Germination type: Hypogeal (Chacko *et al.*, 2002).

Germination percentage: 57 to 73 (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Germination period: 3 to 10 days (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Nursery technique: Seeds are sown horizontally soon after collection in raised nursery beds filled with a mixture of soil and sand (5:3 by volume) under partial shade for at least two months. Seedlings are pricked out when they attain 5 to 6 cm height and potted in polythene bags of size 23 cm x 18 cm filled with soil based potting mixture. Seedlings reach 0.5 to 1 m height within one year (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Propagation:

References:

Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 174-175.

Mohanan, C. 1997. Diseases of Bamboo in Asia: An Illustrated Manual. International network for Bamboo and Rattan. Beijing, Eindhoven.

Seethalakshmi, K.K. and Muktesh Kumar, M.S. 1998. Bamboos of India – a Compendium. Bamboo Information Centre – India, Kerala Forest Research Institute, Peechi and International Network for Bamboo and Rattan, Beijing, Eindhoven, New Delhi.

Method of propagation:

Vegetative propagation:

Pests: Caterpillars of *Achroia grisella* Fb. (Lepidoptera: Galleriidae) bore into the seeds lying on the forest floor. Feeding by this insect often injures the embryo and up to 10% of seeds are usually damaged (Chacko *et al.*, 2002).

Diseases: Stored seeds are affected by fungi like *Alternaria*, *Aspergillus*, *Penicillium*, *Dactylaria*, *Mucor* and *Rhizopus* species (Mohanan, 1997; Chacko *et al.*, 2002).

Medicinal properties:

Uses: Culm is used for paper industry and for making basket and mats. Dried seeds are powdered and used as a cattle feed (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Wood properties:

Ochlandra scriptoria

Nomenclature:

Scientific name: *Ochlandra scriptoria* (Dennst.) Fischer

Vernacular name: Ammei, Ottal, Bheesa, Kolanji (Malayalam) (Chacko et al., 2002).

Common name:

Synonyms: *Bambusa scriptoria* Dennst., *Bheesa rheedii* Kunth, *Ochlandra rheedii* (Kunth) Benth. & Hook. f.ex. Gamble (Chacko et al., 2002).

Family: Poaceae (Graminae)

Subfamily:

Origin:

Distribution: Restricted to the southern Western Ghats of Kerala, Karnataka and Tamil Nadu, growing mostly on river banks (Seethalakshmi and Muktesh Kumar, 1998; Chacko et al., 2002). In Kerala it occurs in Wayanad, Calicut, Ernakulam, Idukki, and Trivandrum districts.

Description: Gregarious, shrubby reed bamboo with erect smooth culms reaching up to 5 m high and 2.5 cm diameter at 5th internode (Seethalakshmi and Muktesh Kumar, 1998; Chacko et al., 2002).

Flowering season: February to May.

Fruiting season: April to May., March to April (Seethalakshmi and Muktesh Kumar, 1998; Chacko et al., 2002).

Flowers: Flowers are short, terminal or axillary spike or spicate panicle on leafy branchlets.

Fruits: Fruit is caryopsis, oblong, large, with long-beak (Seethalakshmi and Muktesh Kumar, 1998; Chacko et al., 2002).

Fruit type: Caryopsis.

Seeds:

Seed dimension:

Seed length: 2.8-3.9 cm (Seethalakshmi and Muktesh Kumar, 1998; Chacko et al., 2002).

Seed width: 1.2 cm (Seethalakshmi and Muktesh Kumar, 1998; Chacko et al., 2002).

Seed thickness: 2.7-3.4 cm long beak (Seethalakshmi and Muktesh Kumar, 1998; Chacko et al., 2002).

Seed weight: 625 to 640 fruits/kg (Seethalakshmi and Muktesh Kumar, 1998; Chacko et al., 2002).

Seed dispersal:

Seed collection: Seeds are either plucked out from the branches or collected from the ground. Wrinkled fruits should be discarded (Seethalakshmi and Muktesh Kumar, 1998; Chacko et al., 2002).

Transportation of seeds: Seeds are collected in moist gunny bags and transported to the nursery without much delay (Seethalakshmi and Muktesh Kumar, 1998; Chacko et al., 2002).

Seed processing: No special processing is required (Seethalakshmi and Muktesh Kumar, 1998; Chacko et al., 2002).

Seed storage: Recalcitrant (Seethalakshmi and Muktesh Kumar, 1998; Chacko et al., 2002). Seeds are viable only for a month and it is always better to use fresh seeds for

sowing (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Viability period: Seeds retain viability for about a month (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Seed emptiness: No information (Chacko *et al.*, 2002).

Seed pre treatment: None (Chacko *et al.*, 2002).

Germination type: Hypogeal (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Germination percentage: 70 to 80 (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Germination period: 30 to 17 days (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Nursery technique: Seeds are sown horizontally in a raised nursery bed filled 5 parts soil and 3 parts sand under partial

shade. Seedlings are pricked out when they attain 5 to 6 cm in length into polythene bags of size 23 cm x 18 cm filled with soil: sand (3:1) mixture. Seedlings reach 0.5 to 1 m height within one year (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Propagation:

Method of propagation: By seeds.

Vegetative propagation:

Pests: No information (Chacko *et al.*, 2002).

Diseases: No information (Chacko *et al.*, 2002).

Medicinal properties:

Uses: Culms for pulp and paper industry, for making mats, boxes, baskets, floats and rafts (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

References:

Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 176-177.

Seethalakshmi, K.K. and Muktesh Kumar, M.S. 1998. Bamboos of India – a Compendium. Bamboo Information Centre – India, Kerala Forest Research Institute, Peechi and International Network for Bamboo and Rattan, Beijing. Eindhoven, New Delhi.

Ochlandra setigera

Nomenclature:

Scientific name: *Ochlandra setigera*
Gamble

Vernacular name: Eetta, Eera
(Malayalam) (Chacko *et al.*, 2002).

Common name:

Synonyms:

Family: Poaceae (Graminae)

Subfamily:

Origin:

Distribution: Restricted to the Eastern Ghats of Tamil Nadu (Nilgiris) and Kerala (Nilambur) (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Description: Erect or scandent reed bamboo attaining a height above 6 m and diameter 1.2 to 1.8 cm. Culms smooth, without branches below, and much branched above (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Flowering season:

Fruiting season: May (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Flowers:

Fruits: Fruit is a caryopsis, oblong in shape with fleshy pericarp and persistent glumes (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Fruit type: Caryopsis.

Seeds: 6.8 x 1.3 cm with long beak (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Seed dimension:

Seed length: 6.8 cm (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Seed width: 1.3 (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Seed thickness: 3 cm long beak (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Seed weight: 70 to 100 fruits/kg (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Seed dispersal:

Seed collection: Wrinkle-free mature fruits are collected both from the clumps and from the ground (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Transportation of seeds: Fruits collected in moist gunny bags are transported to the nursery site without delay (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Seed processing: Spread out the fruits in a ventilated room. No special processing is needed (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Seed storage: Recalcitrant (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002). The seeds are viable only for a maximum period of one month due to recalcitrant nature (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Viability period: Seeds retain viability only for 1 to 2 weeks (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Seed emptiness: No information (Chacko *et al.*, 2002).

Seed pre treatment: Not required (Chacko *et al.*, 2002).

Germination type: Hypogeal (Chacko *et al.*, 2002).

Germination percentage: 62 to 80 (Chacko *et al.*, 2002).

Germination period: 3 to 7 days (Chacko *et al.*, 2002).

Nursery technique: Fresh seeds are sown horizontally soon after collection in raised nursery beds filled with soil and sand mixture under partial shade. Seedlings are potted in polythene bags of size 23 cm x 18

cm filled with soil. Seedlings reach 0.5 to 1 m height within one year (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Propagation:

Method of propagation:

Vegetative propagation:

Pests: No information (Chacko *et al.*, 2002).

Diseases: No information (Chacko *et al.*, 2002).

Medicinal properties:

Uses: Culms used for basket and mat making (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

References:

Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 178-179.

Seethalakshmi, K.K. and Muktesh Kumar, M.S. 1998. Bamboos of India – a Compendium. Bamboo Information Centre – India, Kerala Forest Research Institute, Peechi and International Network for Bamboo and Rattan, Beijing. Eindhoven, New Delhi.

Ochlandra travancorica

Nomenclature:

Scientific name:*Ochlandra travancorica* (Bedd.) Benth.ex Gamble

Vernacular name:Eetta, Kareetta, Era (Malayalam), Eeral Eerakalli, Nanal (Tamil), Hudi (Kannada) (Chacko *et al.*,2002).

Common name:Travancore reed bamboo, Travancore elephant grass (Chacko *et al.*, 2002)

Synonyms:*Beesha travancorica* Bedd. (Chacko *et al.*,2002).

Family:Poaceae (Graminae)

Subfamily:

Origin:

Distribution:Occurs throughout the Western Ghats. In Kerala, occurs as an undergrowth in the low level evergreen and semi evergreen forests often along the banks of rivers and streams (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Description:Fast growing, erect clump, reaching a height of 2-8 m and a height diameter at 5th internode of 2.5-5 cm (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Flowering season:

Fruiting season:April to June (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Flowers:

Fruits:Fruit is a caryopsis, brown in colour, oval oblong with long pointed beak (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Fruit type:Caryopsis.

Seeds: Caryopsis, length 4.1 cm - 5.7 cm, diameter 0.8 to 1 cm (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Seed dimension:

Seed length:4.1-5.7 cm (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Seed width:0.8-1 cm (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Seed thickness:

Seed weight:45 to 57 fruits/kg (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Seed dispersal:

Seed collection:Mature fruits are collected either from the clumps or from the ground by hand picking prior to the appearance of wrinkles on the seed coat (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Transportation of seeds:Fruits collected in moist gunny bags are transported to the nursery as early as possible (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Seed processing:Spread out the fruits in a ventilated room. No special processing is necessary (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Seed storage:Recalcitrant (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002). The seeds are viable for only 10 to 30 days and thus cannot be stored for long (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Viability period:Fruits viable only for about 10 to 30 days (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Seed emptiness:No information (Chacko *et al.*, 2002).

Seed pre treatment: Not required (Chacko *et al.*, 2002).

Germination type:Hypogeal (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Germination percentage:90 (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Germination period:13 to 20 days (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Nursery technique:Fresh seeds are sown horizontally soon after collection in raised nursery beds filled with soil and sand mixture under partial shade. Seedlings are pricked out when they are 5 to 6 cm tall and

potted in polythene bags of 22.5 cm x 17.5 cm filled with soil. Seeds are also dibbled directly in polythene bags (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Propagation:

Method of propagation:

Vegetative propagation:

Pests:No information (Chacko *et al.*, 2002).

Diseases:No information (Chacko *et al.*, 2002).

Medicinal properties:

Uses:This is one of the main raw material of the paper pulp and also commonly used for making mats, umbrella handles, fishing rods, handicrafts and for making walls of huts. Leaves are used for thatching (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Wood properties:

References:

Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 180-181.

Seethalakshmi, K.K. and Muktesh Kumar, M.S. 1998. Bamboos of India – a Compendium. Bamboo Information Centre – India, Kerala Forest Research Institute, Peechi and International Network for Bamboo and Rattan, Beijing. Eindhoven, New Delhi.

Ochlandra travancorica

Nomenclature:

Scientific name:*Ochlandra travancorica*
var. *hirsuta* Gamble

Vernacular name:Eetta, Kareetta, Eera (Malayalam), Eeral, Eerakalli, Irul, Ittakalli, Nanal, Odai (Tamil) (Chacko *et al.*, 2002).

Common name:Elephant grass, Reed, Reed bamboo (Chacko *et al.*, 2002).

Synonyms:

Family:Poaceae (Graminae)

Subfamily:

Origin:

Distribution:Restricted to the Western Ghats in Thenmala, Ranni, Konni and Thiruvananthapuram Forest Divisions (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Description:Erect reed like gregarious bamboo, culms 2-6 m tall and 2.5-5 cm diameter; internodes 55-60 cm long, sometimes even 1.5 m long (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Flowering season:December to January.

Fruiting season:February to April (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Flowers:Ovate or oblong ovate, glabrous, striate, supported by 2 to 4 small sheathing bracts.

Fruits:Fruit is a caryopsis, very large, brown, oval-oblong, with a long beak, pericarp fleshy with persistent glumes

(Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Fruit type:Caryopsis.

Seeds: 5.2-7.4 cm long with 4.1-5.7 cm long beak (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Seed dimension:

Seed length:5.2-7.4 cm (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Seed width:

Seed thickness:4.1-5.7 cm long beak (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Seed weight:31 to 41 fruits/kg (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Seed dispersal:

Seed collection:Mature fruits are collected either from the fruit bearing clumps and / or from the ground prior to the appearance of wrinkles on the seed coat (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Transportation of seeds:Fruits collected in moist gunny bags are packed and transported to the nursery site without delay (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Seed processing:Spread out the fruits in a ventilated room. No special processing is necessary (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Seed storage:Recalcitrant. The seeds are viable only for about a month

(Seethalakshmi and Muktesh Kumar, 1998
Chacko *et al.*, 2002).

Viability period:10 to 35 days (Chacko *et al.*,2002).

Seed emptiness:No information (Chacko *et al.*, 2002).

Seed pre treatment: Not required (Chacko *et al.*,2002).

Germination type:Epigeal (Chacko *et al.*, 2002).

Germination percentage:80 to 85 (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Germination period:6 to 15 days (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Nursery technique:Fresh seeds are sown horizontally soon after collection in raised nursery beds filled with soil and a sand mixture under partial shade. Seedlings are pricked out when they attain 5 to 6 cm tall

and potted in polythene bag of 22.5 cm x 17.5 cm filled with soil (Chacko *et al.*, 2002).

Propagation:

Method of propagation:Seeds and rhizomes.

Vegetative propagation:

Pests:No information (Chacko *et al.*, 2002).

Diseases:No information (Chacko *et al.*, 2002).

Medicinal properties:

Uses:Culms are used for basket making, umbrella handles, fishing rods, handicrafts and makings walls of hut. Leaves are used for thatching. The mats made from this reed bamboo are used for making "Bamboo Ply". (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002). In agriculture articles such as wheels, pipes, threshing boards, handles and hoes, and such tools are made of this bamboo.

References:

Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 182-183.

Seethalakshmi, K.K. and Muktesh Kumar, M.S. 1998. Bamboos of India – a Compendium. Bamboo Information Centre – India, Kerala Forest Research Institute, Peechi and International Network for Bamboo and Rattan, Beijing. Eindhoven, New Delhi.

Ochlandra wightii

Nomenclature:

Scientific name: *Ochlandra wightii*
(Munro) Fischer

Vernacular name: Etta, Era
(Malayalam), Eerakalli (Tamil), Hudi
(Kannada) (Chacko *et al.*, 2002).

Common name: Reed (Chacko *et al.*,
2002).

Synonyms: *Bambus wightii* Munro,
Ochlandra brandisii Gamble (Chacko *et al.*,
2002).

Family: Poaceae

Subfamily:

Origin:

Distribution: Restricted to the Western
Ghats of Karnataka and Kerala up to an
altitude of 1000 m (Seethalakshmi and
Muktesh Kumar, 1998; Chacko *et al.*,
2002).

Description: Fast growing, reed bamboo
with erect tufted culms reaching to a height
of 6.5 m and a diameter (at 5th internode) of
1.5-2 cm; internodes up to 48 cm
(Seethalakshmi and Muktesh Kumar, 1998;
Chacko *et al.*, 2002).

Flowering season: February.

Fruiting season: January to March
(Seethalakshmi and Muktesh Kumar, 1998;
Chacko *et al.*, 2002).

Flowers: Spikelets, conical, terminal,
verticillate spikes with thick, glabrous
rachis.

Fruits: Fruit is a caryopsis and is brown
coloured, oval to oblong with long pointed

beak (Seethalakshmi and Muktesh Kumar,
1998; Chacko *et al.*, 2002).

Fruit type: Caryopsis

Seeds: Length 1.8-5.5 cm to 5.7 cm;
diameter 0.6-0.8 cm (Seethalakshmi and
Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Seed dimension:

Seed length: 1.8-5.5 cm (Seethalakshmi
and Muktesh Kumar, 1998; Chacko *et al.*,
2002).

Seed width: 0.6-0.8 cm (Seethalakshmi
and Muktesh Kumar, 1998; Chacko *et al.*,
2002).

Seed thickness:

Seed weight: 160 to 180 fruits/kg
(Seethalakshmi and Muktesh Kumar, 1998;
Chacko *et al.*, 2002).

Seed dispersal:

Seed collection: Mature fruits are collected
either from the clumps or from the ground
prior to the appearance of the wrinkle on the
seed coat (Chacko *et al.*, 2002).

Transportation of seeds: Fruits collected in
moist gunny bags are transported to the
nursery as quickly as possible
(Seethalakshmi and Muktesh Kumar, 1998;
Chacko *et al.*, 2002).

Seed processing: Spread out the fruits in a
ventilated room. No special processing is
necessary (Seethalakshmi and Muktesh
Kumar, 1998; Chacko *et al.*, 2002).

Seed storage: Recalcitrant (Seethalakshmi
and Muktesh Kumar, 1998; Chacko *et al.*,
2002). The seeds can be stored only up to
10 to 30 days (Seethalakshmi and Muktesh
Kumar, 1998; Chacko *et al.*, 2002).

Viability period: Seeds are viable only for about 10 to 30 days (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Seed emptiness: No information (Chacko *et al.*, 2002).

Seed pre treatment: Not required (Chacko *et al.*, 2002).

Germination type: Hypogeal (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Germination percentage: 90 (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Germination period: 13 to 20 days (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Nursery technique: Fresh seeds are sown horizontally soon after collection in raised nursery beds filled with soil and sand mixture under partial shade. Seedlings are pricked out when they are 5 to 6 cm high

and potted in polythene bags of size 22.5 cm x 17.5 cm filled with soil based potting mixture. Seeds are also dibbled directly in polythene bags of the above size (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Propagation:

Method of propagation:

Vegetative propagation:

Pests: No information (Chacko *et al.*, 2002).

Diseases: No information (Chacko *et al.*, 2002).

Medicinal properties:

Uses: Culm is used for basket, mat, paper pulp and hut making. The leaves of this bamboo make a fodder and also roofing material (Seethalakshmi and Muktesh Kumar, 1998; Chacko *et al.*, 2002).

Wood properties:

References:

Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 184-185.

Seethalakshmi, K.K. and Muktesh Kumar, M.S. 1998. Bamboos of India – a Compendium. Bamboo Information Centre – India, Kerala Forest Research Institute, Peechi and International Network for Bamboo and Rattan, Beijing. Eindhoven, New Delhi.

Oroxylum indicum

Nomenclature:

Scientific name: *Oroxylum indicum* (L.) Vent.

Vernacular name: Pharrai, Ullu, Suana (Hindi), Pana, achi (Tamil) (Bose et al., 1998), Palakappayyani, Valpathiri (Malayalam) (Sasidharan, 2004).

Common name: Indian trumpet tree

Synonyms: *Calosanthes indica* Bl., *Spathodea indica* Vent., *Bignonia indica* Roxb. (Gamble, 1922; Sasidharan, 2004).

Family: Bignoniaceae

Subfamily:

Origin:

Distribution: Throughout the greater parts of India except in drier regions, chiefly in deciduous forests, but sometimes scattered in evergreen forests. Also in Andamans, Sri Lanka, and Sub Himalayan tract (up to 1100 m).

Description: A small deciduous tree with few branches, 5 to 8 m high.

Flowering season: May - August (Bose et al., 1998).

Fruiting season: October to January. Large fruits ripen in autumn (Bose et al., 1998).

Flowers: Flowers large, fleshy and purplish but not handsome in stout terminal racemes, thick and stout peduncles. Calyx is fleshy and persistent, about 2.5 cm long, corolla campanulate, 5-7 cm long and wide,

purplish; stamens 5, exserted (Bose et al., 1998).

Fruits: A large conspicuous, 2-valved flat woody capsule, 35-60 cm long and 6 to 7 cm wide, containing large number of seeds (Bose et al., 1998).

Fruit type: Capsule.

Seeds: Flat, surrounded by a thin transparent white papery wing, 5-6 cm long (Bose et al., 1998).

Seed dimension:

Seed length:

Seed width:

Seed thickness:

Seed weight:

Seed dispersal: Wind and bats

Seed collection:

Transportation of seeds:

Seed processing:

Seed storage:

Viability period:

Seed emptiness:

Seed pre treatment:

Germination type: Epigeous

Germination percentage:

Germination period:

Nursery technique:

Propagation:

Method of propagation: By seeds and vegetative method

Vegetative propagation:

Pests:

Diseases:

Medicinal properties: The roots are used for inflammation, dropsy, dysentery, vomiting, wounds and fever. The leaves are used for ulcers and vitiated conditions of vata. The extract from the stem bark is tonic and also used as remedy for rheumatic swellings (Bose et al., 1998). Aqueous solutions of *Oroxylum indicum* bark show antibacterial activity against *Streptococcus* sp. and *Staphylococcus* sp. (Choudhury and Sanjib-Shil, 2005). The extracts of *Oroxylum indicum* is a potential source of anticancer compounds (Costa-Lotufo et al., 2005). Used for the treatment of diabetes

(Wahab and Yousuf, 2004). Root bark of *Oroxylum indicum* has antiulcer activity against gastric ulcers (Maitreyi-Khandhar et al., 2006). Bark extracts of *Oroxylum indicum* possess antibacterial activities against Gram positive and Gram negative bacteria (*Staphylococcus aureus*, *Klebsiella pneumoniae*, *Proteus vulgaris* and *Pseudomonas aeruginosa*) (Goswami and Singh, 2006). Stem bark is used for dysentery (Raju and Reddy, 2005). The dichloromethane extracts of *Oroxylum indicum* possess antifungal activity against dermatophytes and wood rot fungi (Ali et al., 1998).

Uses: Bark is used for tanning and dyeing. Stem bark and fruit are employed as mordents in tanning and dyeing industries. Wood is suitable for light packing cases, picture frames, mouldings etc.

Wood properties: The wood is pale yellow, turning brownish with age. It is a soft and light wood with coarse texture and straight grain. No heart wood (Gamble, 1922).

References:

Ali, R.M., Houghton, P.J. and Hoo, T.S. 1998. Antifungal activity of some Bignoniaceae found in Malaysia. *Phytotherapy Research*. 12(5): 331-334.

Bose, T.K., Das, P. and Maiti, G.G. 1998. *Trees of the world*, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 342.

Choudhury, M.D. and Sanjib Shil. 2005. Antibacterial activity of some ethnomedicinal plants. *Annals of Biology*. 21(2): 187-192.

Costa Lotufo, L.V., Khan, M.T.H., Arjumand Ather, Wilke, D.V., Jimenez, P.C., Pessoa, C., Moraes, M.E.A.de. and Moraes, M.O.de. 2005. Studies of the anticancer potential of plants used in Bangladeshi folk medicine. *Journal of Ethnopharmacology*. 99(1): 21-30.

Gamble, J.S. 1922. A manual of Indian timbers. London Sampson Low, Marton and Company Ltd, Calcutta, India.

Goswami, S. and Singh, L.S. 2006. Antibacterial potential of some indigenous plants against human pathogenic bacteria. *Environment and Ecology*. 24S(Special 2): 403-405.

Maitreyi Khandhar, Mamta Shah, Devdas Santani and Sunita Jain. 2006. Antiulcer activity of the root bark of Oroxylum indicum against experimental gastric ulcers. *Pharmaceutical Biology*. 44(5): 363-370.

Nair, K.K.N. 2001. Manual of non-wood forest produce plants of Kerala. KFRI, Peechi.

Narayan Das Prajapati, Purohit, S.S., Arun K. Sharma and Tarun Kumar. 2003. A Hand Book of medicinal plants. A complete source book. Agrobios. Jodhpur, India.

Raju, V.S. and Reddy, K.N. 2005. Ethnomedicine for dysentery and diarrhoea from Khammam district of Andhra Pradesh. *Indian Journal of Traditional Knowledge*. 4(4): 443-447.

Sasidharan, N. 2004. Forest Trees of Kerala. Kerala Forest Research Institute, Peechi, Kerala, India

Wahab, M.A. and Yousuf, M. 2004. Ethno-medical uses of some medicinally active plants for treating diabetes in Chittagong Hill Tracts, Bangladesh. *Hamdard Medicus*. 47(1):

Palaquium ellipticum

Nomenclature:

Scientific name: *Palaquium ellipticum* (Dalz.) Engl.

Vernacular name: Choppala, Kattullupa, Pachenthi, Pala, Pali (Malayalam) (Sasidharan, 2004).

Common name:

Synonyms: *Bassia ellipticum*, *Bassia elliptica* Dalz., *Dichopsis elliptica* (Dalz.) Benth. (Sasidharan, 2004).

Family: Sapotaceae

Subfamily:

Origin:

Distribution: Peninsular India in the Western Ghats from North Karnataka southwards. Occurs all down the Western Ghats from Bombay southwards, absent in Sri Lanka (Bourdillon, 1908).

Description: Trees up to 30 m high, branches angular, terete or obscurely terete (Bourdillon, 1908). Lofty trees forming a prominent component of the top canopy, mostly in the evergreen forests.

Flowering season: December to April (Bourdillon, 1908).

Fruiting season: May to August, August to September (Bourdillon, 1908).

Flowers: Flowers are white, fragrant in axillary fascicles, pedicels are 2 to 4 cm long, calyx consists of 6 sepals, corolla are 5

to 6 lobed. About 12 to 18 stamens present in two whorls (Bourdillon, 1908).

Fruits: Fleshy oblong or ellipsoid berries, and are 1 seeded.

Fruit type: Berry.

Seeds: Seeds are light brown, acute at both ends.

Seed dimension:

Seed length:

Seed width:

Seed thickness:

Seed weight: 251 to 420 seeds/kg.

Seed dispersal: Wind and bats

Seed collection:

Transportation of seeds:

Seed processing:

Seed storage:

Viability period:

Seed emptiness:

Seed pre treatment: Soaking in cold water can enhance germination percentage of seeds.

Germination type:

Germination percentage: 61 to 79

Germination period:

Nursery technique:

Propagation:

Method of propagation:By seeds.

Vegetative propagation:

Pests:

Diseases:

Medicinal properties:

Uses: Seeds yield an oil which is used as an illuminant and in soap manufacture. Trunk yield a gum and it is useful as a coating of

ropes, soled shoes and in the manufacture of ground sheets.

Wood properties: Sapwood white, 5 cm thick; heartwood reddish-brown, straight grained, even, moderately hard and durable. Pores are medium-sized to large, arranged in short, wavy, radial lines. Rays are fine, numerous, crossed by frequent concentric bands of light tissue. Annual rings are indistinct, but marked by darker lines (Bourdillon, 1908).

References:

Bourdillon, T.F. 1908. Forest trees of Travancore. International Book Distributors, Dehradun.

Nair, K.K.N. 2001. Manual of non-wood forest produce plants of Kerala. KFRI, Peechi.

Sasidharan, N. 2004. Forest Trees of Kerala. Kerala Forest Research Institute, Peechi, Kerala, India.

Paraserianthes falcataria

Nomenclature:

Scientific name: *Paraserianthes falcataria* (L.) Nielson

Vernacular name: Peelivaka, Alpashi (Malayalam), Kattamaram (Tamil), Batai (English) (Chacko *et al.*, 2002).

Common name: Albizia, Indonesia Albizia, White Albizia.

Synonyms: *Albizia falcataria* (L.) Fosberg, *Falcataria moluccana* Miq., *Adenanthera falcataria* L. (Chacko *et al.*, 2002).

Family: Leguminosae

Subfamily: Mimosoideae

Origin: Indonesia

Distribution: Native to Indonesia and is extensively planted in Andamans, Assam, Kerala and Tamil Nadu in plantations and sometimes grown in homesteads (Chacko *et al.*, 2002).

Description: Fast growing, large evergreen tree reaching a height of 45 m and a breast height diameter of 67 cm with a straight cylindrical bole (FRI, 1983; Chacko *et al.*, 2002).

Flowering season: March to June and October to December.

Fruiting season: January to May (Chacko *et al.*, 2002).

Flowers: Small, faintly fragrant, in axillary panicle, singly, not in heads.

Fruits: Fruit is a pod, 10-15 cm long, 1.8-2 cm wide, brownish, covered with reticulate markings, thinly woody and many seeded (Chacko *et al.*, 2002).

Fruit type: Pod.

Seeds: Olive green, bean shaped, oblong, flattened and remain attached to the split pods (Chacko *et al.*, 2002).

Seed dimension:

Seed length: 0.8 cm (Chacko *et al.*, 2002).

Seed width: 0.4 cm (Chacko *et al.*, 2002).

Seed thickness: 0.2 cm (Chacko *et al.*, 2002).

Seed weight: 40,000 to 50,000 seeds/kg (Kindt *et al.*, 1997; Chacko *et al.*, 2002).

Seed dispersal: Wind.

Seed collection: Ripe pods are collected from the trees by lopping the branches (FRI, 1983). Freshly fallen ripe pods are collected (Chacko *et al.*, 2002).

Transportation of seeds: Pods are collected in cotton / gunny bags and are transported to the processing centre as quickly as possible (Chacko *et al.*, 2002).

Seed processing: The pods are spread out in the sun until they dehisce and release the seeds. If they do not split open, beating with a stick will help release of seeds, which are then cleaned by winnowing (Chacko *et al.*, 2002).

Seed storage: Orthodox. Seeds can be stored well in gunny bags in a dry place for more than one year (Chacko *et al.*, 2002).

Viability period: Seeds viable up to one year (Chacko *et al.*, 2002).

Seed emptiness: Low (Chacko *et al.*, 2002).

Seed pre treatment: Dormancy is due to a water soluble inhibitor present in the seed coat, in addition to the presence of an impermeable seed coat and micropylar plug. This can be effectively overcome by physical scarification followed by soaking in flowing water for 24 hrs, manual nicking and acid scarification (Sajeevukumar *et al.*, 1995; Kannan *et al.*, 1996). Hot water soaking for 10 minutes followed by cold water soaking for 24 hrs (Chacko *et al.*, 2002).

Germination type: Epigeal (Chacko *et al.*, 2002).

Germination percentage: 70 (FRI 1983; Chacko *et al.*, 2002); 60 to 90 (Carlowitz, 1991).

Germination period: 3 to 10 days (Chacko *et al.*, 2002).

Nursery technique: Pre treated seeds are either sown in seed beds or germination trays containing vermiculite and pricked out to polybags of size 20 cm x 10 cm filled with soil or compost based potting mixture. Seeds can also be directly sown in polythene bags and thinned out to retain the best seedling, which attain plantable size of 30 cm in 3 to 4 months (Chacko *et al.*, 2002). Fertimel (slow release compound fertilizer containing N, P, K, Ca, Mg, S and the minor elements Fe, B, Cu, Mo, Zn and Mn) at 4 g per seedling increase height growth and diameter growth of seedlings (Masano and Mawazin, 1997).

Propagation:

Method of propagation: Seed. *Albizia falcataria* has good coppicing power. In general, coppicing ability is found to be more when pruning is done at a height of 60 cm (Gopikumar *et al.*, 2002).

Vegetative propagation:

Pests: Moderate. Grubs of *Bruchidius bilineatopygus* cause damage to developing pods and seeds by feeding on the endosperm and single grub feeds on 3-4 seeds in succession. Pupation takes place in the seeds and the adults escape through circular holes drilled on the pods. Field infestation of the developing pods showed a progressive increase on storage. *Eurema blanda* cause heavy defoliation in nursery (Varma *et al.*, 1996). This can be controlled by chemicals such as quinalphos, phorate or carbofuran.

Diseases: Moderate (22 to 48.5%) (Chacko *et al.*, 2002). Web blight (caused by *Rhizoctonia solani*) and seedling wilt (*Fusarium solani*) are observed in nurseries (Sankaran and Sharma, 1996).

Medicinal properties:

Uses: The tree is planted as a shade tree in coffee and tea plantations (FRI, 1983; Chacko *et al.*, 2002). Stem bark of marine mangrove plant *Barringtonia racemosa* has two triterpenoids, olean-18-en-3 beta -O-E-coumaroyl ester (1) and olean-18-en-3 beta -O-Z-coumaroyl ester (2), along with compounds like germanicol, germanicone, betulinic acid, lupeol, and taraxerol (Yang Yi *et al.*, 2006).

Wood properties: Soft and light wood. Texture is coarse and uneven, with deeply interlocked grains, sapwood and heartwood are generally indistinguishable. Timber is classified as moderately heavy, weak, not tough, moderately steady and very soft (Ananthanarayana and Kumar, 2004). Wood is used for paper, board making and kattamarans. It is a good fuel wood (Yang Yi *et al.*, 2006).

References:

- Ananthanarayana, A.K. and Kumar, P. 2004. Physical and mechanical properties of *Albizia falcataria* from Tamil Nadu. *Journal of the Indian Academy of Wood Science*. 1(1/2): 1-6.
- Carlowitz, P.G.V. 1991. *Multipurpose Trees and Shrubs: Source of Seeds and Inoculants*. International council for research in Agroforestry, Nairobi, Kenya.
- Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. *Manual of Seeds of Forest Trees, Bamboos and Rattans*. Kerala Forest Research Institute, Peechi, Kerala. pp. 186-187.
- FRI. 1983. *Troup's The Silviculture of Indian Trees*. Vol. IV. The Controller of Publications, Delhi.
- Gopikumar, K., Vidyasagaran, K., Mini Chandran and Lakshmi Nandakumar. 2002. Coppicing behaviour of selected forest tree species. *Indian Forester*. 128(9): 971-975.
- Kannan, C.S., Sudhakara, K., Augustine, A. and Ashokan, P.K. 1996. Seed dormancy and pre-treatments to enhance germination in selected *Albizia* species. *Journal of Tropical Forest Science*. 8(3): 369-380.
- Kindt, R., Mausya, S., Kimotho, J. and Waruhiu. 1997. *Tree seed suppliers Directory: Sources of Seeds and Microsymbionts*. International Centre for Research in Agro Forestry (ICRAF), Nairobi, Kenya.
- Masano and Mawazin. 1997. Effect of Fertimel on the growth of *Paraserianthes falcataria* seedlings. *Buletin Penelitian Hutan*. (605): 1-11.
- Sajeevukumar, B., Sudhakara, K., Ashokan, P.K. and Gopikumar, K. 1995. Seed dormancy and germination in *Albizia falcataria* and *Albizia procera*. *Journal of Tropical Forest Science*. 7(3): 371-382.
- Sankaran, K.V. and Sharma, J.K. 1996. Diseases of *Paraserianthes falcataria* in Kerala and their possible control measures. Impact of diseases and insect pests in tropical forests. Proceedings of the IUFRO Symposium 23-26 November 1993, Peechi, India. pp. 134-142.
- Varma, B.A., Sudhakara, K. and Beena Bhaskar. 1996. Insect pests associated with nurseries of selected tree crops in Kerala. Impact of diseases and insect pests in tropical forests. Proceedings of the IUFRO Symposium 23-26 November 1993, Peechi, India. pp. 468-473.
- Yang Yi, Deng ZhiWei, Proksch, P., and Lin WenHan. 2006. Two new 18-en-oleane derivatives from marine mangrove plant, *Barringtonia racemosa*. *Pharmazie*. 61(4): 365-366.

Peltophorum pterocarpum

Nomenclature:

Scientific name: *Peltophorum pterocarpum* (DC.) Baker ex Heyne

Vernacular name: Ivalvagai, Ivavakai, Peringondrai (Tamil), Poomaram (Malayalam) (Chacko *et al.*, 2002), Kodachinta (Telugu).

Common name: Rusty shield bearer (Bose *et al.*, 1998), braziletto wood, sagabark peltophorum, Yellow gold mohur, Copper pod (Chacko *et al.*, 2002).

Synonyms: *Peltophorum ferrugineum* Benth. (Sasidharan, 2004), *Inga pterocarpa* DC., (Chacko *et al.*, 2002; Bose *et al.*, 1998). *Caesalpinia ferruginea*, *Baryxylum inerme*, *Caesalpinia inermis*, *Peltophorum inermis*

Family: Leguminosae

Subfamily: Caesalpinioideae

Origin:

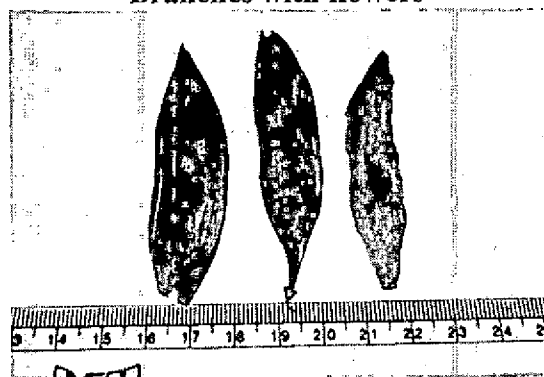
Distribution: Native of Indo-Malayan region and N. Australia and is found as a littoral species in the coastal forests of many islands in the Andamans. It is largely cultivated throughout India in gardens and as avenue tree on account of its beautiful flowers (FRI, 1983; Chacko *et al.*, 2002). Distributed in the Andamans; Sri Lanka; Malaysia and Australia. One of the most popular flowering trees in almost all tropical countries of the world (Bose *et al.*, 1998).

Description: A large magnificent fast growing evergreen tree attaining a height of 12-24 m and a breast height diameter of 32-63 cm with spreading crown of elegant dark green foliage (FRI, 1983; Chacko *et al.*

et al., 2002). It resembles and is easily mistaken for *Albizia chinensis*. Young branches, petioles, rachis and midrib are brown ferruginose-pubescent (Bose *et al.*, 1998).



Branches with flowers



Fruits



Seeds

Flowering season: March - May and September to October; February to April.

Fruiting season: January to March and September to November (FRI, 1983; Chacko *et al.*, 2002).

Flowers: Bright yellow in large rusty terminal panicle. Fragrant flowers, 1.5 inches across (4 cm), with wrinkled petals, each with a brown spot. They are born on upright racemes about 18 inches long (45 cm).

Fruits: Pods are oblong, 5-10 cm long and 2.5 cm broad, compressed, indehiscent, thin, flat, brownish and winged towards both sutures (Chacko *et al.*, 2002).

Fruit type: Pod.

Seeds: 1-4, usually brown, oblong, 1 cm long. Oblong seed pods, 2 to 4.5 inches long (5-11.5 cm), 0.8 to 1.1 inches wide (2-2.7 cm).

Seed dimension:

Seed length: 1 cm (Chacko *et al.*, 2002).

Seed width:

Seed thickness:

Seed weight: 20,000 to 21,000 seeds/kg (Chacko *et al.*, 2002).

Seed dispersal:

Seed collection: Pods are collected from the tree by lopping off the branches (Chacko *et al.*, 2002).

Transportation of seeds: Pods collected in cotton / polythene bags are transported to the processing centre (Chacko *et al.*, 2002).

Seed processing: Pods are dried in cloth bags under the sun. Seeds can be separated by using seed scarifier (Chacko *et al.*, 2002).

Seed storage: Most probably orthodox. Seeds are stored in airtight containers for

more than one year in dry place under cold conditions (Chacko *et al.*, 2002).

Viability period: Seeds are viable up to one year in sealed tins (Chacko *et al.*, 2002).

Seed emptiness: Low (Chacko *et al.*, 2002).

Seed pre treatment: Soak the seeds in hot water and allow the contents to cool for 24 hrs.

Germination type: Epigeal (Chacko *et al.*, 2002).

Germination percentage: Up to 10 (Kumar and Bhanja, 1992; Chacko *et al.*, 2002).

Germination period: 7 to 30 days (Chacko *et al.*, 2002).

Nursery technique: Freshly collected seeds are pretreated and sown in germination trays containing vermiculite and watered regularly. The seedlings are pricked out and potted in polythene bags of 20 x 10 cm in size and maintained under shade (Chacko *et al.*, 2002).

Propagation:

Method of propagation: From seeds.

Vegetative propagation:

Pests: Low (Chacko *et al.*, 2002).

Diseases: Moderate (34.6 %). Eleven fungi and actinomycetes are recorded. *Penicillium* sp., *Aspergillus reserictus*, *A. flavus*, *A. niger*, *Trichoderma* sp., *Thielavia* sp. are the important storage moulds (Mohan and Anil Chandran, 2001; Chacko *et al.*, 2002).

Medicinal properties: Bark is used for dysentery and is a constituent of tooth powders and gargles in Ayurveda. Bark lotions are used for sores, muscular pains and eye troubles.

Uses: Valued as an avenue species, Wood used for cabinet making and fuelwood. The tree is ornamental and suitable for gardens (FRI, 1983; Chacko *et al.*, 2002). Bark is rich in tannin and used for tanning leather, fish nets and tarpaulines. It makes a good home for the lac insect. The wood is used for making furniture and boundary fences in rural areas.

Wood properties: Sapwood is greyish white, turning light greyish-brown on

ageing. The heartwood is light reddish brown or black and is moderately hard and heavy, somewhat lustrous, straight interlocked grained and medium coarse textured. Wood is light reddish brown, soft. Pores are moderate sized, often subdivided, scanty; enclosed, singly or in groups of 2 and 3 in patches of loose tissue which often join together concentrically. Medullary rays are very fine, very numerous and closely packed (Gamble, 1922).

References:

- Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 352.
- Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 188-189.
- FRI. 1983. Troup's The Silviculture of Indian Trees. Vol. IV. The Controller of Publications, Delhi.
- Gamble, J.S. 1922. A manual of Indian timbers. London Sampson Low, Marton and Company Ltd, Calcutta, India.
- Kumar, S.V. and Bhanja, M. 1992. Forestry Seed Manual of Andhra Pradesh. Andhra Pradesh Forest Department, Hyderabad, India.
- Mohanan, C. and Anil Chandran. 2001. Microorganisms associated with seeds of tropical forest species and their management for improving the storability and seedling production. Seed Science and Technology (in press).
- Sasidharan, N. 2004. Forest Trees of Kerala. Kerala Forest Research Institute, Peechi, Kerala, India.

Persea macrantha

Nomenclature:

Scientific name: *Persea macrantha* (Nees) Kosterm.

Vernacular name: Ooravu, Kula mavu (Malayalam) (Sasidharan, 2004), Kolamavu, Kolarmavu (Tamil) (Chacko *et al.*, 2002).

Common name: Machilus (Chacko *et al.*, 2002).

Synonyms: *Machilus macrantha* Nees (Bose *et al.*, 1998; Chacko *et al.*, 2002; Sasidharan, 2004).

Family: Lauraceae

Subfamily:

Origin:

Distribution: Occurs in peninsular India and Sri Lanka (Rai, 1999). In Kerala, it is fairly common in evergreen, semi evergreen and moist deciduous forest up to 2100 m (Chacko *et al.*, 2002). In Western Ghats and Sri Lanka; grown up to 1100 m in the hills of Indian Peninsula (Bose *et al.*, 1998).

Description: Large, evergreen tree reaching a height of 30 m and 127 cm breast height diameter (Bose *et al.*, 1998; Chacko *et al.*, 2002).

Flowering season: November to January. February to March (Bose *et al.*, 1998).

Fruiting season: May to June (Bose *et al.*, 1998). February to March (Rai, 1999; Chacko *et al.*, 2002).

Flowers: Perianth greenish yellow, pubescent without stamens hairy and flowers are borne near the end of the branches, in panicles. Flowers greenish white, 3-4 merous, 1 cm across, in

subterminal panicles; tepals 6, 3+3, equal or the outer whorls smaller, puberulous, acute; fertile stamens 9; staminodes 3 (Bose *et al.*, 1998).

Fruits: Fruit is a berry, globose, green, 1.5 cm contain the globose seed. (Chacko *et al.*, 2002).

Fruit type: Berry.

Seeds: Seed globose with thin testa.

Seed dimension:

Seed length:

Seed width: 1.3-1.9 cm (Chacko *et al.*, 2002).

Seed thickness:

Seed weight: 2,000 seeds/kg (Rai, 1999; Chacko *et al.*, 2002).

Seed dispersal:

Seed collection: Collect the fruits from the ground soon after fall or from the tree by shaking the branches manually (Chacko *et al.*, 2002).

Transportation of seeds: Fruits collected in ventilated polythene bags and transported to the processing centre as quickly as possible (Chacko *et al.*, 2002).

Seed processing: Depulp the fruits and wash them thoroughly in water and dry under shade (Chacko *et al.*, 2002).

Seed storage: Intermediate (CABI, 1998). Seeds can not be stored for long (Chacko *et al.*, 2002).

Viability period: Seeds retain viability for one month under ambient conditions (Rai, 1999; Chacko *et al.*, 2002).

Seed emptiness: Low (Chacko *et al.*, 2002).

Seed pre treatment: Not necessary (Chacko *et al.*, 2002).

Germination type: Epigeal (Chacko *et al.*, 2002).

Germination percentage: Up to 80 (Rai, 1999; Chacko *et al.*, 2002).

Germination period: 15 to 25 days (Rai, 1999; Chacko *et al.*, 2002).

Nursery technique: Freshly collected seeds are sown in germination trays filled with vermiculite and watered regularly. After completion of germination, the seedlings are pricked out to polythene bags of size 22.5 x 17.5 cm filled with soil and maintained under shade (Chacko *et al.*, 2002).

Propagation:

Method of propagation: By seeds.

Vegetative propagation:

Pests: No information (Chacko *et al.*, 2002).

Diseases: Low (Chacko *et al.*, 2002).

Medicinal properties: Bark and leaves of this tree are medicinal. Powdered bark is mainly used in the treatment of tuberculosis, asthma, and rheumatism and leaves are curative for ulcers.

Uses: Wood is used for rough planking and packing case, canoes, but is liable to be attacked by insects. The bark yields one of the highly sought after materials for agarbathi manufacture, which is used as a binder (Chacko *et al.*, 2002).

Wood properties: The wood is even and medium textured, moderately hard, smooth, lustrous and light weight. It is a light reddish brown in colour without a distinct heartwood.

References:

- Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 354.
- CABI. 1998. The Forestry Compendium – A Silvicultural Reference. Module 1. CABI Publishing, CAB International, Wallingford, Oxon, OX108DE, UK.
- Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 190-191.
- Rai, S.N. 1999. Nursery and Planting Techniques of Forest Trees in Tropical South-Asia. Eastern Press, Bangalore, India.
- Sasidharan, N. 2004. Forest Trees of Kerala. Kerala Forest Research Institute, Peechi, Kerala, India.

Phyllanthus emblica

Nomenclature:

Scientific name: *Phyllanthus emblica* L.

Vernacular name: Nellikaram, Nelli (Malayalam), Nelli (Tamil), Nelli (Kannada), Amla, Amlika (Hindi) (Chacko *et al.*, 2002).

Common name: Indian Gooseberry (Chacko *et al.*, 2002), Malacca tree.

Synonyms: *Emblica officinalis* Gaertn., *Cicca emblica* (L.) Kurz, (Chacko *et al.*, 2002; Sasidharan, 2004). *Dichelastina nodicaulis* Hance.

Family: Euphorbiaceae

Subfamily:

Origin:

Distribution: Common in deciduous forests in most parts of India, Myanmar, Malaysia, Sri Lanka and China. Cultivated widely in gardens and homesteads for its fruits (Luna, 1996). It is grown in marginal soils and various kinds of degraded lands such as salt affected soils, ravines and dry and semi dry regions (Singh, 1998). In Kerala mostly found in deciduous forests (Chacko *et al.*, 2002).

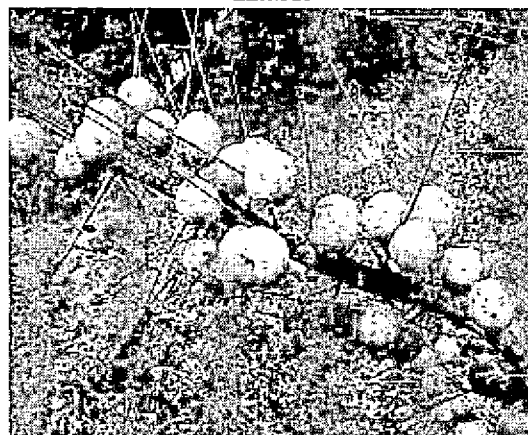
Description: Moderately fast growing, medium sized deciduous tree reaching up to a height of 25 m and a breast height diameter of 80 cm (Chacko *et al.*, 2002).

Flowering season: March to May (Troup, 1921).

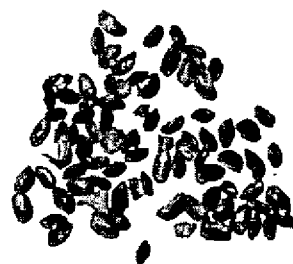
Fruiting season: October to April (Kumar and Bhanja, 1992; Sen Gupta, 1937; Chacko *et al.*, 2002). November to February (Troup, 1921).



Habit



Branch with fruits



Seeds

Flowers: Minute yellowish, densely, fascicled in the axils of young leaves.

Fruits: Fruit is a berry, 3-celled globose, fleshy, almost sessile, 2-3 cm diameter, greenish yellow, firm and bitter (Chacko *et al.*, 2002). Smooth, fleshy and very astringent with a 6 ridged bony endocarp.

Fruit type: Berry.

Seeds: Seeds 6, reniform, trigonius, shiny and reddish brown (Troup, 1921; Kumar and Banja 1992; Luna, 1996; Chacko *et al.*, 2002). Seeds with chestnut brown colour have values for recovery (60%), 100-seed weight (2.188 g), germination percentage (70.63%), seedling length (12.6 cm) and vigour index (1064). Seed coat colour can be used as a parameter to assess the seed quality of *E. officinalis* (Karivarhadaraaju *et al.*, 2001).

Seed dimension:

Seed length: 0.5 cm (Chacko *et al.*, 2002).

Seed width:

Seed thickness:

Seed weight: 65,000 seeds/kg (Kumar and Bhanja 1992) to 1,23,500 seeds/kg (Sen Gupta, 1937; Chacko *et al.*, 2002).

Seed dispersal: Animals.

Seed collection: The fruits are either collected from the tree by shaking the branches manually or from the ground (Chacko *et al.*, 2002). Seeds extracted from ripe fruits collected in Tamil Nadu, were dried and divided into sinkers or floaters using water flotation (Murugesh *et al.*, 1998). Fruits collected from the posterior end of the branch is superior in seed and seedling quality characters in terms of germination, root length, shoot length, dry matter production, vigour index, per cent seed filling and 100 seed weight (Malarkodi *et al.*, 2001).

Transportation of seeds: Fruits are collected in cotton/plastic bags. No special care is needed during transport (Chacko *et al.*, 2002).

Seed processing: Ripe fruits are dried in the sun until the hard putamen dehisces with a cracking sound to release the seeds (Troup, 1921, Kumar and Bhanja, 1992; Chacko *et al.*, 2002).

Seed storage: Seeds are orthodox in nature and could be stored well at 5°C until 24 months with 61% germination by packing them in 700 gauge polyethylene bag (Srimathi *et al.*, 1999). Seedlings from large seeds have greater survival than those from smaller seeds under intense water stress (Ekta Khurana and Singh, 2004; Dent, 1948, Kumar and Bhanja, 1992).

Viability period: Seeds do not keep viability for long (Dent, 1948, Kumar and Bhanja, 1992) and fail to germinate after a year (Troup, 1921; Chacko *et al.*, 2002). Seed is viable for about two months under ambient temperatures (Chacko *et al.*, 2002).

Seed emptiness: Low (Chacko *et al.*, 2002).

Seed pre treatment: No pretreatment is necessary (Kumar and Bhanja, 1992). However soaking the seeds in water for about 12 hrs before sowing improve germination (Singh, 1998; Chacko *et al.*, 2002). Seeds are soaked in Gibberellic Acid 500 ppm solution for 24 hrs. Fresh seeds treated with 0.5% KNO₃ and one-year-old seeds treated with 200 ppm GA3 for 8 h give germination percentage of 69.33 and 46.00%, respectively. Seeds treated with 250 ppm GA3 have 75.98% germination in the laboratory. Seeds of *Embllica officinalis* soaked with 400 ppm GA3 give 87.25% germination. Seeds soaked for 12 h in 400 ppm gibberellic acid give 87.25% germination, and those soaked in water give 56% (Dhankhar, Santosh Kumar

1996; Dhankhar *et al.*, 1997; Pawshe *et al.*, 1997; Wagh *et al.*, 1998; Rajamanickam *et al.*, 2002). Hot water soaking at 60°C for 5 minutes was found to be beneficial (Pawshe *et al.*, 1997). Seeds treated with 1% KNO₃ for 18 h give seed germination of 93.33% (Purbey and Meghwal, 2005).

Germination type: Epigeal (Chacko *et al.*, 2002).

Germination percentage: 40 (Luna, 1996; Chacko *et al.*, 2002). 78% germination (Srimathi and Sujatha, 2007). Seeds soaked for 12 h in 400 ppm gibberellic acid give 87.25% germination, and those soaked in water give 56% (Wagh *et al.*, 1998).

Germination period: 24 to 50 days (Chacko *et al.*, 2002).

Nursery technique: Pre-treated or pre-germinated seeds are sown in polythene bags filled with potting mixture (Kumar and Bhanja, 1992) or in open beds provided with overhead shade (Troup, 1921) during March. Germination takes place in 24 to 27 days. The plants become ready for planting in four to five months (Kumar and Bhanja, 1992; Chacko *et al.*, 2002). Seeds are soaked in Gibberellic Acid 500 ppm solution for 24 hrs. Seeds sown in the middle of July have higher germination and seedling survival compared to those sown on other dates. Percentage budding success and growth of buds are maximum when budding is on the last week of June (Srivastava *et al.*, 2002). The percentage of seedling survival is maximum in seeds sown in July, followed by those sown in August and June (Singh *et al.*, 2002). Spraying of seedling rootstocks raised in polyethylene bags once or twice (with the second spray applied one month after the first spray) with GA3 (100 ppm) increase plant height and diameter and length of the primary and tap root. Application of GA3 at 50 ppm + urea at 0.5% also significantly increase various

vegetative and root growth characteristics. Second spray further increase the effectiveness (Virendra Singh and Shafaat Mohammed, 1996). Treating seeds with 200 ppm GA3 have effect on shoot elongation irrespective of age of seeds. Treating fresh seeds with 0.5% KNO₃ have a positive influence on dry matter production and also give good vigour index (Rajamanickam *et al.*, 2004). Treatment with 750 ppm thiourea give good root development (Dhankhar, and Santosh Kumar 1996; Dhankhar *et al.*, 1997). Seedling development in terms of plant height, number of leaves/plant and root development is also good with 400 ppm GA3 (Wagh *et al.*, 1998). Fresh seeds treated with Azospirillum+Phosphobacteria+0.5% KNO₃ for 8 h give germination percentage of 52.08, and one-year-old seeds treated with Azospirillum+Phosphobacteria+200 ppm GA3 for 8 h give 49.17% germination (Rajamanickam and Anbu, 2001). The application of AM fungi and PSB (phosphate-solubilizing bacteria) in combination produce maximum plant height, maximum diameter of seedlings. The application of AM fungi along with companion fungus or *Azospirillum* and companion fungus boost the growth of Aonla in nursery (Verma *et al.*, 2008).

Propagation:

Method of propagation: The natural regeneration is satisfactory. Natural reproduction of this species is by seeds and it also coppices through root suckers. Budding, ring grafting and shoot cutting are also effective. Girth of rootstock matrix should be more than 0.50 cm during budding for better success. The seeds sown in perforated polybags will be ready for budding in July. Through patch budding, more than 90% success can be obtained by the use of perforated polybags for raising

rootstocks under irrigated hot arid ecosystem (Saroj *et al.*, 2000). Rootstocks raised in polyethylene bags sprayed once or twice (with the second spray applied one month after the first spray) with GA3 at 100 ppm or GA3 at 50 ppm + urea at 0.5% increase plant height and diameter and length of the primary and tap root significantly (Virendra Singh and Shafaat Mohammed, 1996).

Vegetative propagation:

Pests: Low (Chacko *et al.*, 2002).

Diseases: Low (Chacko *et al.*, 2002). Stored fruits of *E. officinalis* are associated with *Aspergillus* spp. (Nisha Misra, 1988). *Fusarium acuminatum* [*Gibberella acuminata*], *Fusarium moniliforme* [*G. fujikuroi*] var. *subglutinans*, *F. equiseti* and *Alternaria alternata* (Geeta Sumbali and Kusum Badyal, 1990).

Medicinal properties: The fruits are edible and used in diarrhoea, dysentery, anaemia. The leaves and root bark are medicinal. In Ayurveda, Chyawanprash is prepared by incorporating around 50 herbs including Amla (*Emblica officinalis* [*Phyllanthus emblica*]), the richest source of vitamin C (Milind Parle and Nitin Bansal, 2006). Ayurvedic formulations derived from *Emblica officinalis* is used in the prevention and the treatment of the respiratory tract ailments related to flu (Badmaev and Majeed, 2004). Aqueous fruit extracts of *Emblica officinalis* [*Phyllanthus emblica*]

References:

Aseeva, T.A., Chekhirova, G.V., Dashinamzhilov, Zh.B., Buraeva, L.B., Ledneva, I.P. and Khamaev, B.I. 2005. Possibility of using alternatives for some plant species used in Tibetan medicine. *Rastitel' nye Resursy*. 41(3): 139-154.

Badmaev, V. and Majeed, M. 2004. Ayurveda vs. flu season. *NutraCos*. 3(1): 2-3.

and chyawanaprash, a non-toxic herbal preparation with 50% *E. officinalis*, has antitumour activity due to its interaction with cell cycle regulation (Jose *et al.*, 1997). The fruit has antibacterial activity also (Sabita Pal *et al.*, 2002).

Uses: Its fruit is very rich in vitamin C and rich in pectin, therefore regarded as very important for medicinal value for ayurvedic. Its wood is used for agricultural implements and well construction. *Emblica officinalis* is one of the most important plants of Ayurveda, the traditional Indian medicine. In this ancient medicine, the fruit of *Emblica officinalis* is processed according to a method named "Svaras Bhavana", whereby the therapeutic potential of the plant is enhanced by treating the main herb with its own juice. *Emblica* fruit contains ascorbic acid (0.40%, w/w), and that the Ayurvedic method of processing increases the healthy characteristics of the fruit and has a higher antioxidant activity content of ascorbic acid (1.28%, w/w). Vitamin C accounts for approximately 45-70% of the antioxidant activity (Scartezzini *et al.*, 2006). Water floatation technique can be used for removal of empty and infertile seeds in amla (Srimathi and Sujatha, 2007). *Malus baccata* fruits are substituted for *Emblica officinalis* [*Phyllanthus emblica*] fruits (Aseeva *et al.*, 2005).

Wood properties: Wood is red, hard and close grained, warps and splits occur in seasoning. There is no heartwood; annual rings are not distinct (Gamble, 1922).

Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 192-193.

Dhankhar, D.S. and Santosh Kumar. 1996. Effect of bio-regulators on seed germination and seedling growth in aonla (*Phyllanthus emblica* Linn.) cv. Anand-2. *Recent Horticulture*. 3(1): 45-48.

Dhankhar, D.S., Santosh Kumar and Bhalla, R. 1997. Effects of GA₃ and thiourea on protein, peroxidase activity and chlorophyll status in seedlings of aonla. *Madras Agricultural Journal*. 84(9): 529-531.

Dent, T.V. 1948. Seed storage with particular reference to the storage of seed of Indian forest plants. *Indian Forest Records (New Series) Silviculture*, 7: 134 pp. Manager of Publications, Delhi.

Ekta Khurana and Singh, J.S. 2004. Germination and seedling growth of five tree species from tropical dry forest in relation to water stress: impact of seed size. *Journal of Tropical Ecology*. 20(4): 385-396.

Gamble, J.S. 1922. A manual of Indian timbers. London Sampson Low, Marton and Company Ltd, Calcutta, India.

Geeta Sumbali, Kusum Badyal. 1990. New records of fungal species associated with fruit rot of *Phyllanthus emblica* Linn. *Indian Journal of Mycology and Plant Pathology*. 20(2): 202-203.

Jose, J.K., Kuttan, G., George, J. and Kuttan, R. 1997. Antimutagenic and anticarcinogenic activity of *Emblica officinalis* Gaertn. *Journal of Clinical Biochemistry and Nutrition*. 22(3): 171-176.

Karivarhadaraaju, T.V., Srimathi, P. and Malarkodi, K. 2001. Seed coat colour as a parameter for seedling quality of amla (*Emblica officinalis* L. Gaertn.). *Advances in Plant Sciences*. 14(1): 271-273.

Kumar, S.V. and Bhanja, M. 1992. Forestry Seed Manual of Andhra Pradesh. Andhra Pradesh Forest Department, Hyderabad, India.

Luna, R.K. 1996. Plantation Trees. International Book Distributors, Dehra Dun, India.

Malarkodi, K., Srimathi, P., Sasthri, G. and Vanangamudi, K. 2001. Seed vigour characteristics of amla as influenced by fruit position. *Madras Agricultural Journal*. 88(4/6): 243-245.

Milind Parle and Nitin Bansal. 2006. Traditional medicinal formulation, Chyawanprash - a review. *Indian Journal of Traditional Knowledge*. 5(4): 484-488.

Muruges, M., Vanangamudi, K., Parthiban, K.T., Bhavanisankar, K., Umarani, R. and Balaji, B. 1998. Effect of growth regulators on germination and seedling vigour of *Emblica officinalis*. *Van Vigyan*. 36(1): 12-14.

- Nisha Misra. 1988. Studies on fungi deteriorating stored fruits of *Emblica officinalis* Gaertn. *International Journal of Tropical Plant Diseases*. 6(1): 95-97.
- Pawshe, Y.H., Patil, B.N. and Patil, L.P. 1997. Effect of pregermination seed treatments on germination and vigour of seedlings in Aonla (*Emblica officinalis* Gaertn.). *PKV Research Journal*. 21(2): 152-154.
- Purbey, S.K. and Meghwal, P.R. 2005. Effect of pre-sowing seed treatment on seed germination and vigour of aonla seedlings. *Research on Crops*. 6(3): 560-561.
- Rajamanickam, C. and Anbu, S. 2001. Effect of bio-fertilizers and growth regulators on seed germination and seedling vigor in amla. *Madras Agricultural Journal*. 88(4/6): 295-297.
- Rajamanickam, C., Anbu, S. and Balakrishnan, K. 2002. Effect of chemicals and growth regulators on seed germination in Aonla (*Emblica officinalis* G.). *South Indian Horticulture*. 50(1/3): 211-214.
- Sabita Pal, Biplab De, Mandal, S.C. and Bhattacharjee, P.R. 2002. Antibacterial herbs. *Indian Journal of Natural Products*. 18(1): 3-9.
- Saroj, P.L., Vishal Nath and Vashishtha, B.B. 2000. Effect of polycontainers on germination, seedling vigour, root characters and budding success in aonla. *Indian Journal of Horticulture*. 57(4): 300-304.
- Sasidharan, N. 2004. *Forest Trees of Kerala*. Kerala Forest Research Institute, Peechi, Kerala, India.
- Scartezzini, P., Antognoni, F., Raggi, M.A., Poli, F., and Sabbioni, C. 2006. Vitamin C content and antioxidant activity of the fruit and of the Ayurvedic preparation of *Emblica officinalis* Gaertn. *Journal of Ethnopharmacology*. 104(1/2): 113-118.
- Sen Gupta, J.N. 1937. Seed weights, plant percents, etc. for forest plants in India. *Indian Forest Records (New Series) Silviculture*, 2:221 pp. Manager of Publications, Delhi.
- Singh, I.S. 1998. *Aonla: Production technology*. Department of Horticulture, N.D. University of Agriculture and Technology, Kumarganj, Faizabad, India.
- Singh, A.K. and Gaur, G.S. 2002. Effect of gypsum and distillery effluent on the chemical composition of aonla (*Emblica officinalis* Gaertn.) shoots in the alkaline soil. *Orissa Journal of Horticulture*. 30(1): 23-26.
- Srimathi, P., Sastri, G., Malarkodi, K., and Parameswari, K. 1999. Influence of storage container and temperature on the shelf life of seeds of amla (*Emblica officinalis* Gaertn.). *Progressive Horticulture*. 31(1/2): 9-13.
- Srimathi, P. and Sujatha, K. 2007. Germination improvement by floatation technique in amla (*Emblica officinalis* Gaertn.). *Advances in Plant Sciences*. 20(1): 101-102.
- Srivastava, A.L., Singh, H.K. and Singh, I.S. 2002. Studies on propagation of aonla (*Emblica officinalis*). *Haryana Journal of Horticultural Sciences*. 31(3/4): 156-158.

Troup, R.S. 1921. The Silviculture of Indian Trees Vol. III. Clarendon Press, Oxford.

Verma, R.K., Khatri, P.K., Kunhikannan, C., Verma, R.K. and Totey, N.G. 1998. Advantageous effects of the tree plantation on the rehabilitation of bhata land ecosystem. Indian Journal of Forestry. 21(3): 197-203.

Virendra Singh and Shafaat Mohammed. 1996. Effect of gibberellic acid and urea on growth and development of seedling rootstock of aonla (Emblica officinalis Gaertn). Journal of Applied Horticulture Navsari. 2(1/2): 116-121.

Wagh, A.P., Choudhary, M.H., Kulwal, L.V., Jadhav, B.J. and Joshi, P.S. 1998. Effect of seed treatment on germination of seed and initial growth of aonla seedling in polybag. PKV Research Journal. 22(2): 176-177.

Pongamia pinnata

Nomenclature:

Scientific name: *Pongamia pinnata* (L.)
Pierre

Vernacular name: Pongu, Ungu (Malayalam), Pungam, Punga (Tamil), Honge, Uggemara (Kannada), Pappar kanji, Karanji (Hindi), Poonga oil plant, Indian Beech (English) (Chacko *et al.*, 2002).

Common name: Indian beech (Chacko *et al.*, 2002), Karanj.

Synonyms: *Pongamia glabra* Vent., *Cytisus pinnatus* L., (Sasidharan, 2004). *P. mitis* Kurz, *Derris indica* (Lam.) Bennet (Chacko *et al.*, 2002).

Family: Fabaceae (Leguminosae)

Subfamily: Faboideae

Origin:

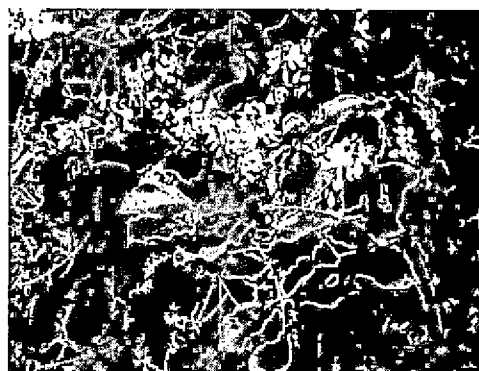
Distribution: Occurs throughout India in plains and in the tidal and beach forests of Sundarbans and along stream banks as well as in the dunes along the sea shore. It is also grown along canal banks, roadside avenues and bunds. In Kerala, it occurs in evergreen and semi evergreen forests up to 900 m, but mostly confined to banks of streams (FRI, 1983; Chacko *et al.*, 2002).

Description: A very handsome moderate sized evergreen tree reaching a height of 18 m and a breast height diameter of 48 cm (FRI, 1983; Chacko *et al.*, 2002).

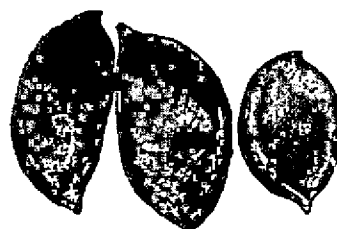
Flowering season: April to June, March to April (Bourdillon, 1908).

Fruiting season: May to June (Chacko *et al.*, 2002). June to July (Bourdillon, 1908).

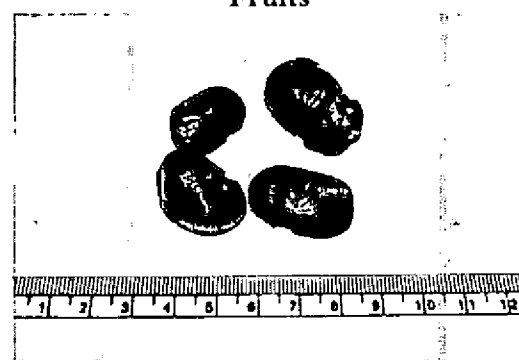
Flowers: Flowers white tinged with pink or violet or in the varying combinations, in axillary racemes, shorter than the leaves, pedicels up to one cm long.



Branch with flowers



Fruits



Seeds

Fruits: Fruit is a pod, 4 to 6 cm x 2.5 to 3 cm, woody, indehiscent, obliquely-oblong and compressed (Chacko *et al.*, 2002).

Fruit type: Pod.

Seeds: Seeds 1-2 per pod, elliptic to reniform shaped, compressed, wrinkled and reddish brown coloured (Chacko *et al.*,2002).

Seed dimension:

Seed length: 1.68 cm (Chacko *et al.*, 2002).

Seed width: 2.16 cm (Chacko *et al.*, 2002).

Seed thickness:

Seed weight: 150-470 pods/kg (Kindt *et al.*,1997); 810-1,410 seeds/kg (Chacko *et al.*,2002).

Seed dispersal: Wind dispersal.

Seed collection: Pods are collected from the tree when it is leafless by shaking the branches manually (Chacko *et al.*, 2002).

Transportation of seeds: Pods collected in plastic / cotton / gunny bags are packed and transported; no special care is needed (Chacko *et al.*,2002).

Seed processing: The pods are thrashed to separate the seeds and sun-dried before storage (Chacko *et al.*, 2002).

Seed storage: Probably Recalcitrant. The pods are stored without breaking (Chacko *et al.*,2002).

Viability period: Seeds remain viable for about one year under ambient room temperature (Chacko *et al.*,2002).

Seed emptiness: Low (Chacko *et al.*, 2002).

Seed pre treatment: Soak the seeds in cold water for 24 hrs (Kindt *et al.*,1997; Chacko *et al.*,2002). Soak in cold water for 24 hrs prior to sowing (Edwards and Naithani, 1999).

Germination type: Hypogeal (Chacko *et al.*, 2002).

Germination percentage: 35 to 70 (Carlowitz, 1991); fresh seeds give up to 89% germination (Chacko *et al.*,2002).

Germination period: 10 to 60 days (Chacko *et al.*, 2002).

Nursery technique: The pre-treated seeds are sown in germination trays filled with vermiculite and watered regularly. The seedlings are pricked out to polythene bags of size 22.5 x 17.5 cm filled with potting mixture and maintained under shade (Chacko *et al.*,2002).

Propagation:

Method of propagation: Seeds and root suckers.

Vegetative propagation:

Pests: No information (Chacko *et al.*, 2002).

Diseases: Moderate (38-52%). Fourteen fungi belonging to 11 genera including *Aspergillus*, *Trichoderma*, *Fusarium* sp., etc. were recorded. *Aspergillus* spp. cause seed rot (Mohanan and Sharma, 1991; Chacko *et al.*, 2002).

Medicinal properties: The oil obtained from the seeds antiseptic, useful in skin diseases. The bark is astringent, carminative, cooling and stimulant.

Uses: *Pongamia pinnata* is an important non edible minor oil seed tree that grows in semi-arid regions. Oil is used for tanning leather. Wood is used locally for agricultural implements, tool handles, cotton reels and combs. It is mainly used as fire wood. The oil obtained from the seeds and leaves is used in indigenous medicine, soap making and illuminating purposes. The oil cake is a

good fertilizer (FRI, 1983). The seeds are a source of biodiesel (Chacko *et al.*, 2002).

Wood properties: The wood is white or pale grey without any distinct heartwood. It is moderately hard and moderately heavy wood with coarse texture and interlocked

grain. Air dry weight about 755 kg/m³. Pores scanty, of medium size. Rays very fine, even, white and equidistant, crossed by broad, wavy bands of soft, white tissue, giving the wood a mottled appearance (Bourdillon, 1908). Annual rings indistinct (Gamble, 1922).

References:

- Bourdillon, T.F. 1908. Forest trees of Travancore. International Book Distributors, Dehradun. pp. 136-137.
- Carlowitz, P.G.V. 1991. Multipurpose Trees and Shrubs: Source of Seeds and Inoculants. International council for research in Agroforestry, Nairobi, Kenya.
- Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 194-195.
- Edwards, D.G. and Naithani, S.C. 1999. Seed and Nursery Technology of forest trees. New Age, New Delhi.
- FRI. 1983. Troup's The Silviculture of Indian Trees. Vol. IV. The Controller of Publications, Delhi.
- Gamble, J.S. 1922. A manual of Indian timbers. London Sampson Low, Marton and Company Ltd, Calcutta, India.
- Kindt, R., Mausya, S., Kimotho, J. and Waruhiu. 1997. Tree seed suppliers Directory: Sources of Seeds and Microsymbionts. International Centre for Research in Agro Forestry (ICRAF), Nairobi, Kenya.
- Mohanan, C. and Sharma, J.K. 1991. Seed pathology of forest tree species in India- Present status, practical problems and future prospects. Commonwealth Forestry Review, 70: 113-151.
- Sasidharan, N. 2004. Forest Trees of Kerala. Kerala Forest Research Institute, Peechi, Kerala, India.

Prosopis juliflora

Nomenclature:

Scientific name: *Prosopis juliflora* (Swartz) DC.

Vernacular name: Vilayti babul (Hindi) (Bose *et al.*, 1998). Ganda babool (Gujarati)

Common name: Vanni, The mesquite (Bose *et al.*, 1998).

Synonyms: *P. chilensis* (Mol.) Stuntz., *Mimosa juliflora* Swartz

Family: Leguminosae

Subfamily: Mimosoideae

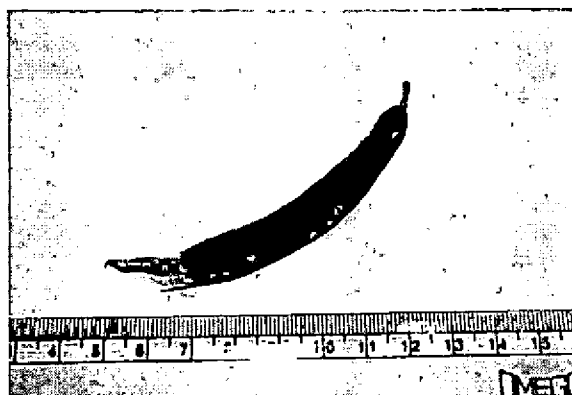
Origin: Native of tropical America.

Distribution: The tree is found in many parts of India, chiefly in Andhra Pradesh, Haryana, Tamil Nadu and Uttar Pradesh. Native from Mexico through Central America to Panama, Colombia, Venezuela, Northern South America and Ecuador to the Galapagos Islands. It has been introduced extensively in most tropical regions of Africa and Asia, brought to India about 100 years ago (Bose *et al.*, 1998).

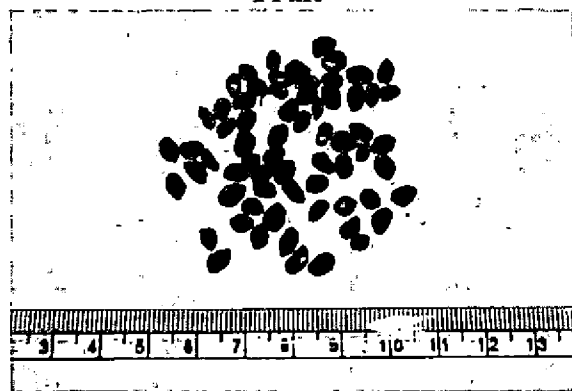
Description: Small to medium-sized evergreen spiny tree, distinguished by the wavy, drooping branches, 8-12 m high, with short crooked trunk and open flat-topped, or rounded canopy with spreading branches; twigs with paired or single straight spreading spines, sometimes none (Bose *et al.*, 1998).

Flowering season: First flowering commence from September-October and may continue to the end of February. Second flowering season is February-March when flowering is profuse (Ram Parkash *et al.*, 1998).

Fruiting season: Once in November-January and again in April-June (Ram Parkash *et al.*, 1998).



Fruit



Seeds

Flowers: Flowers are creamy white in axillary spikes 4 to 10 cm long. Flowers many, short stalked, greenish white to light yellow, 6-8 mm long, in spike-like raceme at leaf base, 7-12 cm long, cylindrical; calyx cup-like, 1 mm long; corolla of 5 petals, 3 mm long, hairy within; stamens 10, thread-like (Bose *et al.*, 1998).

Fruits: Pods develop in bunches of 8 to 10, long narrow, straight to slightly curved, 9-15 cm long, green at first turning light yellow to brown at maturity (Bose *et al.*, 1998).

Fruit type: Pod.

Seeds: Each pod contains 12 to 35 seeds, light brown, hard and shiny, ovate, flattened, 8 to 14 mm long. Seeds many, bean-shaped, oblong, about 5 mm long (Bose *et al.*, 1998).

Seed dimension:

Seed length:

Seed width:

Seed thickness:

Seed weight: 3,201 to 3,500 seeds/kg

Seed dispersal: Wildlife

Seed collection: Ripe pods are collected from the trees by lopping branches or from the ground, during November to December, dried and seeds are extracted, cleaned and stored (Ram Parkash *et al.*, 1998; Vanangamudi and Natarajan, 2006).

Transportation of seeds:

Seed processing: Pods are spread out in sun to dry. Dry pods are beaten to break them into segments and winnowed to remove the impurities. Seed extraction from the pods is difficult because of hard endocarp. This can be done by long soaking in water, drying and then beating the pods to get clean single segmented seeds (Ram Parkash *et al.*, 1998).

Seed storage: Dried seeds can be stored for about two years (Ram Parkash *et al.*, 1998).

Viability period:

Seed emptiness:

Seed pre treatment: Putting the seeds into boiling water and then allowing to cool and soak for 24 hrs. Soak seeds in concentrated sulphuric acid for 15 to 30 minutes or place in boiling water and allow to cool as they soak for 24 hrs. Average time lapse before germination for untreated seeds is 11 days.

Pre treated seeds germinated very quickly, and germination concludes in 5 to 6 days (Edwards and Naithani, 1999). Sulphuric acid (at 95% for 14-30 min or 60% sulphuric acid for 30 min), and manual scarification by cutting or abrasion give germination >94% (Pasicznik *et al.*, 1998). Goat fed seeds show a germination of 82.5% and termite fed seeds give 65% germination (Masilamani and Vadivelu, 1997). *Prosopis juliflora* shows 48% germination after being exposed to 90°C (Usha Sacheti, 1996).

Germination type: Epigeous.

Germination percentage: 75 to 95. Germination and seedling growth of *Prosopis juliflora* decreases and gets delayed with increasing alkalinity (Srinivasu and Toky, 1996).

Germination period: When cleaned (by removing the septum), uninfested and unaborted seeds are treated with hot water, 77% of seeds germinate within one week (Agrawal, 1996).

Nursery technique: The seedlings will be transplanted within a month into containers. Six months old seedlings will be ready for planting during rains (Vanangamudi and Natarajan, 2006).

Propagation:

Method of propagation: Direct sowing and stump planting (Ram Parkash *et al.*, 1998).

Vegetative propagation:

Pests: Termites damage the seedlings. Larvae of *Celosterna scabrator* bore in living stems and roots, *Brachus uberatus* and *Pachymerus gonagra* bore in seeds (Ram Parkash *et al.*, 1998).

Diseases: Gummosis is sometimes observed (Ram Parkash *et al.*, 1998).

Medicinal properties:

Uses: This species is valued as a fire wood crop. In Americas, the pods are used for making flour for human consumption. Wood is suitable for farm implements, constructions, posts and poles, furniture, railway ties, tool handles, and any application demanding strength and hardness. Timber is known as "Loyal timber of poor". It is an excellent fire wood and

used to make superior quality charcoal. Flowers are a source of superior quality honey. Bark is a source of tannin (Ram Parkash *et al.*, 1998).

Wood properties: The sapwood is usually narrow, yellowish white, sharply demarcated from heartwood which is purplish brown. The wood is rather hard and heavy with medium coarse texture and straight to shallowly interlocked grain.

References:

- Agrawal, A.A. 1996. Natural history, seed predation, and germination of *Prosopis juliflora* relative to a reforestation project in southwestern Ecuador. *Tropical Ecology*. 37(2): 193-201.
- Bose, T.K., Das, P. and Maiti, G.G. 1998. *Trees of the world*, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 379.
- Edwards, D.G. and Naithani, S.C. 1999. *Seed and Nursery Technology of forest trees*. New Age, New Delhi.
- Masilamani, P. and Vadivelu, K.K. 1997. Seed development and maturation in honey mesquite (*Prosopis juliflora* Swartz. DC.). *Bangladesh Journal of Forest Science*. 26(1): 68-73.
- Pasiecznik, N.M., Harris, P.J.C., Tavares, J.de.P. and Cassama, M. 1998. Pretreatment of *Prosopis* seeds to break dormancy. *International Tree Crops Journal*. 9(3): 187-193.
- Ram Parkash, M.A., Chaudhri, D.C. and Negi, S.S. 1998. *Plantation and nursery technique of forest trees*. International Book distributors. Dehra Dun, India.
- Srinivasu, V. and Toky, O.P. 1996. Effect of alkalinities on seed germination and seedling growth of important arid trees. *Indian Journal of Forestry*. 19(3): 227-233.
- Usha Sacheti. 1996. Effect of extremely high temperature on the germination of seeds of some leguminous species of arid and semi-arid areas of Oman. *Indian Journal of Ecology*. 23(1): 29-33.
- Vanangamudi, K. and Natarajan. 2006. *Advances in Seed science and technology (Vol I): recent trends in seed technology and management*.

Pseudoxytenanthera ritcheyi

Nomenclature:

Scientific name: *Pseudoxytenanthera ritcheyi* (Munro) Naithani

Vernacular name: Uyie, Erankol (Malayalam), Huda, Udhe, Manga, Tandali (Hindi), Choomaree, Choua, Chiwa (Kannada) (Chacko *et al.*, 2002).

Common name:

Synonyms: *Bambusa ritchiei* Munro, *Oxytenanthera monostigma* Bedd., *O.ritchiei* (Munro) Blatter & Mc Cann (Chacko *et al.*, 2002).

Family: Poaceae (Graminae)

Subfamily:

Origin:

Distribution: Generally found on top of ridges and hills in Karnataka, Maharashtra, Kerala and Tamil Nadu (Chacko *et al.*, 2002).

Description: Fast growing small sized strong bamboo, nearly solid, culms about 3-4.5 m tall and 2.5-3.5 cm in diameter (Chacko *et al.*, 2002).

Flowering season:

Fruiting season: April -May (Chacko *et al.*, 2002).

Flowers: Inflorescence a large terminal panicle or spicate.

Fruits: Fruit is a caryopsis, narrow linear oblong, grooved, ending in a conical mucro formed by the persistent base of the style (Chacko *et al.*, 2002).

Fruit type: Caryopsis.

Seeds:

Seed dimension:

Seed length:

Seed width:

Seed thickness:

Seed weight: 75,000 -78,000 seeds/kg (Chacko *et al.*, 2002).

Seed dispersal:

Seed collection: Seeds are collected by sweeping the ground under flowered clumps and cleaned by winnowing. It is advisable to spread a cloth or tarpaulin sheet under the clumps prior to seed collection (Chacko *et al.*, 2002).

Transportation of seeds: Seeds are transported as early as possible to the processing centre (Chacko *et al.*, 2002).

Seed processing: Seeds are cleaned by winnowing, and dried (Chacko *et al.*, 2002).

Seed storage: Orthodox. Not recommended (Chacko *et al.*, 2002).

Viability period: No information (Chacko *et al.*, 2002).

Seed emptiness: Low (Chacko *et al.*, 2002).

Seed pre treatment: Soaking in cold water for 24 hrs before sowing (Chacko *et al.*, 2002).

Germination type: Epigeal (Chacko *et al.*, 2002).

Germination percentage: Up to 70 (Chacko *et al.*, 2002).

Germination period: 12 to 18 days (Chacko *et al.*, 2002).

Nursery technique:Seeds are sown directly in nursery beds during March-May and covered with soil. Partial shade is necessary up to two months for initial establishment of the seedlings. Seedlings (5 to 6 cm high) are potted in polythene bags of 22.5cm x 17.5 cm size filled with 3 parts forest topsoil 1 part sand and 1 part powdered farmyard manure. One year-old polypotted seedlings are transplanted to the field (Chacko *et al.*, 2002).

Propagation:

Method of propagation: Vegetative propagation (Chacko *et al.*, 2002).

Vegetative propagation:Vegetative propagation is done using 2-noded culm

cuttings from one to two year old culms treated with a solution of NAA 100 ppm. The culm cuttings are planted horizontally in the nursery beds during April-May (Chacko *et al.*, 2002).

Pests: No information (Chacko *et al.*, 2002).

Diseases: No information (Chacko *et al.*, 2002).

Medicinal properties:

Uses:The culms are suitable for fencing, and for making basket and umbrella handles (Chacko *et al.*,2002).

Wood properties:

References:

Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 196-197.

Pterocarpus dalbergioides

Nomenclature:

Scientific name: *Pterocarpus dalbergioides* Roxb.

Vernacular name: Vengai (Tamil), Yerravegisa (Tel.) (Bose *et al.*, 1998).

Common name: Andaman redwood, Andaman padauk (Bose *et al.*, 1998).

Synonyms: *Pterocarpus indicus* Baker non Willd. (Bose *et al.*, 1998).

Family: Leguminosae

Subfamily: Faboideae

Origin:

Distribution: Found throughout the Andaman. Common in deciduous or semideciduous forests in the Andaman and grown in warm humid climate for the timber (Bose *et al.*, 1998).

Description: A very large semi-deciduous or partially evergreen tree up to 40 m high with stout ascending and spreading branches, often with large buttresses; juice blood-red (Bose *et al.*, 1998).

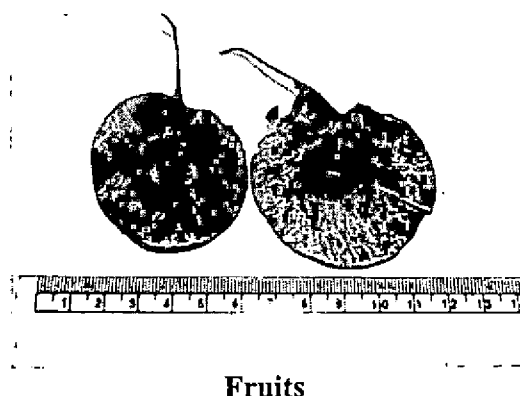
Flowering season: Rainy season, i.e., June. The flowering season is short and the green samaras soon appear. May - July (Bose *et al.*, 1998).

Fruiting season: Ripens in the following January - March.

Flowers: Yellow flowers in large panicle. Flowers are pea shaped, golden yellow, about 8 mm long; in terminal and axillary panicles (Bose *et al.*, 1998).

Fruits: Pods nearly glabrous, flat, orbicular, winged 5-6 cm in diameter, often two seeded (Bose *et al.*, 1998).

Fruit type: Pod.



Seeds: 1-1.25 cm long, dolabriform flattened, reddish brown, smooth, shiny testa and brittle.

Seed dimension:

Seed length: 1-1.25 cm.

Seed width:

Seed thickness:

Seed weight: 1,935 seeds/kg.

Seed dispersal: Wind (Ram Parkash *et al.*, 1998).

Seed collection: Collected from ground (Ram Parkash *et al.*, 1998).

Transportation of seeds:

Seed processing: Seeds are dried in sun for few days (Ram Parkash *et al.*, 1998).

Seed storage: Stored in gunny bags in a dry well ventilated place (Ram Parkash *et al.*, 1998).

Viability period: Retain viability for atleast two years (Ram Parkash *et al.*, 1998).

Seed emptiness:

Seed pre treatment: Soaked in cold water for 24 hrs. Seed is dried alternatively for about 10 days for direct field sowing and soaked continuously for 72 hrs for sowing in the nursery (Ram Parkash *et al.*, 1998).

Germination type: Epigeous.

Germination percentage: 50 - 60

Germination period:

Nursery technique: Planting out of nursery raised entire seedling gives the best result in terms of survival and rate of growth. 1.2-1.5 m tall seedlings will be planted out from the nursery before rainy season at 2.4 x 2.4 m spacing (Ram Parkash *et al.*, 1998).

Propagation:

Method of propagation: By seeds, large cuttings.

Vegetative propagation:

Pests: *Trigonocolus brachmenae* (Weevil) girdles leading shoots. Larvae of *Zeuzera coffeae* bore the shoots of young seedlings (Ram Parkash *et al.*, 1998).

Diseases: Heartwood is attacked by *Fomes fastuosus* causing white pocket rot (Ram Parkash *et al.*, 1998).

Medicinal properties: The kernel of the fruit is emetic. The wood is considered as diuretic and antidiysenteric.

Uses: Wood is very strong, moderately very tough; easy to saw and machine, very durable; resistant to insect attack. It is first class cabinet wood and fine, strong constructional timber; especially suitable for heavy carpentry such as billiard tables, railway carriages, ship cabins, high class furniture, decorative paneling and flooring. It frequently produces large burrs, wood of which is extremely handsome (Bose *et al.*, 1998; Ram Parkash *et al.*, 1998).

Wood properties: The sapwood is pale yellow or grey. Heartwood is light yellowish pink to brick red or deep purple often with darker streaks. The wood is moderately hard and moderately heavy. Pores are moderate sized to large, often subdivided in patches of pale tissue, joined by irregular, pale, wavy, interrupted bands of varying breadth (Gamble, 1922).

References:

Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 382.

Gamble, J.S. 1922. A manual of Indian timbers. London Sampson Low, Marton and Company Ltd, Calcutta, India.

Ram Parkash, M.A., Chaudhri, D.C. and Negi, S.S. 1998. Plantation and nursery technique of forest trees. International Book distributors. Dehra Dun, India.

Pterocarpus marsupium

Nomenclature:

Scientific name: *Pterocarpus marsupium* Roxb.

Vernacular name: Venga (Malayalam), Vengai (Tamil), Benga, Honne (Kannada), Bijasal, Murgasal (Chacko *et al.*, 2002), Bija, Bijasar, Bijasal (Hindi) (Bose *et al.*, 1998)

Common name: Malabar kino tree (Bose *et al.*, 1998), Indian kino tree, Andaman redwood (Chacko *et al.*, 2002), Bijasal, Kino tree.

Synonyms: *Lingoum marsupium* (Roxb.) Kuntze, *Pterocarpus biliobus* Roxb. ex G.Don (Chacko *et al.*, 2002).

Family: Leguminosae

Subfamily: Faboideae

Origin:

Distribution: Throughout the Indian Peninsula in Gujarat, Rajasthan, UP, MP, Orissa, Bihar, W. Bengal and S. Indian states. Occurs in the greater parts of Peninsular India, extending from Gujarat up to West Bengal (FRI, 1983). In Kerala, it occurs in moist, dry deciduous and semi-evergreen forests up to 1,300 m (Chacko *et al.*, 2002). In West Bengal it is seen in Sal forests of laterite zone (Ram Parkash *et al.*, 1998).

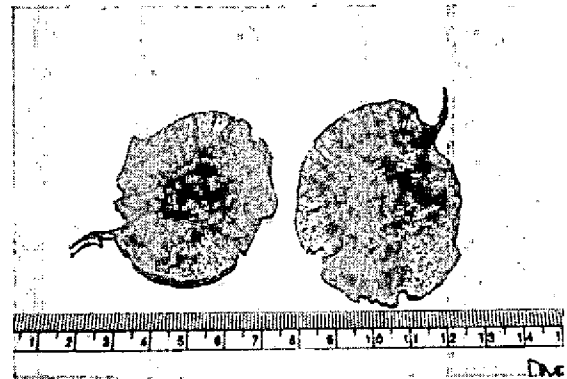
Description: A lofty deciduous tree with spreading branches, forming a fairly large and rounded crown. A medium sized to large tree, up to 20 m high (Bose *et al.*, 1998). Slow growing tree attaining a height of 30 m and breast height diameter of 96 cm (Chacko *et al.*, 2002).

Flowering season: May-August / June-September, July to October (Bose *et al.*, 1998).

Fruiting season: Ripens in December-March (Bourdillon, 1908), February to May (FRI, 1983; Luna, 1996; Chacko *et al.*, 2002).



Branch with fruits



Fruits

Flowers: Flowers are scented, fragrant, yellow, 10-13 mm long, appear in large dense bunches in lateral and terminal racemes; branches thinly-clothed with

brown pubescence; calyx 5-6 mm long, finely brown down; the two upper teeth larger; corolla twice the length of the calyx (Bose *et al.*, 1998).

Fruits: Fruit is a pod, orbicular, compressed, winged, indehiscent, 5-6 cm across contains 1 or 2 true seeds (Chacko *et al.*, 2002). Pods 2.5-4 cm broad (Bose *et al.*, 1998).

Fruit type: Pod.

Seeds: Dolabriform, 1-1.3cm long reddish brown, fairly hard with a smooth shiny leathery testa. Seeds smaller and the wing broader than other species (Bose *et al.*, 1998).

Seed dimension:

Seed length: 10-12 mm (Chacko *et al.*, 2002).

Seed width: 5-6 mm (Chacko *et al.*, 2002).

Seed thickness:

Seed weight: 1587 to 1940 fruits/kg (Sen Gupta, 1937; Luna, 1996; Chacko *et al.*, 2002).

Seed dispersal: By wind.

Seed collection: The pods are collected by lopping off the branches or from the ground (Chacko *et al.*, 2002).

Transportation of seeds: Fruits collected in cotton or gunny bags are transported to the processing centre as quickly as possible. No special care is needed (Chacko *et al.*, 2002).

Seed processing: The pods are dried properly. Inadequately dried pods become susceptible to insect and fungal attack (Rai, 1999; Chacko *et al.*, 2002).

Seed storage: Probably orthodox. The seeds can be stored up to 9 months, sometimes up to a year in gunny bags (Dent, 1948; Chacko *et al.*, 2002).

Viability period: Seeds keep well for about one year (Dent, 1948; Chacko *et al.*, 2002).

Seed emptiness: Low (Chacko *et al.*, 2002).

Seed pre treatment: Cutting across and soaking the pods in water for a few days. Soaking the pods for 72 hrs in cold water or in cowdung slurry for 48 hrs. Pods are tied up in a cloth or gunny bag and soaked in water for 24 hrs and the excess water is allowed to drain off. After 2 to 3 days, the germinating seeds are taken out and used for sowing (FRI, 1983; Chacko *et al.*, 2002).

Germination type: Epigeous (FRI, 1983; Chacko *et al.*, 2002).

Germination percentage: Up to 97 (Sen Gupta, 1937; Chacko *et al.*, 2002).

Germination period: 7 days (FRI, 1983) to 60 days (Sen Gupta, 1937; Chacko *et al.*, 2002).

Nursery technique: The fruits are dibbled in germination trays containing vermiculite and watered regularly. The young seedlings can be pricked out and planted in polythene bags of size 22.5 x 17.5 cm. Seedlings reach a height of about 15 to 20 cm in 4 to 5 months. One year-old seedling can be transplanted with a ball of earth or can be made in to stumps (Chacko *et al.*, 2002).

Propagation:

Method of propagation: By seeds and vegetative method.

Vegetative propagation:

Pests: High infestation due to *Eucosma* sp., (Lepidoptera: Eucosmidae), the caterpillars

of which bore in to the developing fruits and feed on the seed (Chacko *et al.*, 2002).

Diseases: Moderate (37-74%). Seeds are harboured by 36 fungi, a bacterium and a few actinomycetes. Storage moulds like *Aspergillus* sp., and *Penicillium* sp., occur in low frequency. Field fungi like *Alternaria* sp., *Bipolaris* sp., *Corynespora* sp., *Cylindrocladium* sp., *Myrothecium* sp., *Phomopsis* sp., and *Fusarium* sp., are associated with discolouration and seed rot. *Phaeoisaria* sp., *Torula herbarum*, *Cylindrocladium parvum* are the most frequently encountered ones (Mohan and Anil Chandran, 2001; Chacko *et al.*, 2002).

Medicinal properties: Leaves, flowers and gum constitute the drug. It is useful in treating diabetic patients. Bruised leaves are applied on skin diseases, sores and boils. It is used in the treatment of diarrhoea and dysentery. It is locally applied in

leucorrhoea and in passive haemorrhages. An aqueous infusion of the wood is said to be of use in diabetes (Bose *et al.*, 1998).

Uses: Timber used for constructional, furniture, ship building, etc. Blood red or ruby coloured gum called Kino or Malabar Kino. Leaves make an excellent fodder.

Wood properties: The sapwood and heartwood are sharply demarcated from each other. The sapwood is yellowish white and heartwood is golden brown to occasionally reddish brown, with darker streaks. It is moderately hard to hard and moderately heavy to heavy wood with interlocked grain and medium coarse texture. Pores are moderate sized and large, often subdivided, scanty, resinous, uniformly distributed in pale patches, which are joined by, white, fine, wavy, often interrupted concentric line; marked on a vertical section (Gamble, 1922).

References:

- Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 382, 387.
- Bourdillon, T.F. 1908. Forest trees of Travancore. International Book Distributors, Dehradun. pp. 135-136.
- Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 198-199.
- Dent, T.V. 1948. Seed storage with particular reference to the storage of seed of Indian forest plants. Indian Forest Records (New Series) Silviculture, 7: 134 pp. Manager of Publications, Delhi.
- FRI. 1983. Troup's The Silviculture of Indian Trees. Vol. IV. The Controller of Publications, Delhi.
- Gamble, J.S. 1922. A manual of Indian timbers. London Sampson Low, Marton and Company Ltd, Calcutta, India.
- Luna, R.K. 1996. Plantation Trees. International Book Distributors, Dehra Dun, India.

Mohanan, C. and Anil Chandran. 2001. Microorganisms associated with seeds of tropical forest species and their management for improving the storability and seedling production. Seed Science and Technology (in press).

Rai, S.N. 1999. Nursery and Planting Techniques of Forest Trees in Tropical South-Asia. Eastern Press, Bangalore, India.

Ram Parkash, M.A., Chaudhri, D.C. and Negi, S.S. 1998. Plantation and nursery technique of forest trees. International Book distributors. Dehra Dun, India.

Sen Gupta, J.N. 1937. Seed weights, plant percents, etc. for forest plants in India. Indian Forest Records (New Series) Silviculture, 2:221 pp. Manager of Publications, Delhi.

Pterygota alata

Nomenclature:

Scientific name: *Pterygota alata* (Roxb.) R. Br.

Vernacular name: Anathondi, Pothondi (Malayalam), (Sasidharan, 2004). Aneithondi, Kodaittondi (Bose *et al.*, 1998) (Tamil), Talbe-mara (Kannada), Narikel (Hindi) (Chacko *et al.*, 2002), Tula (Bengali).

Common name: The Buddha's coconut tree (Bose *et al.*, 1998; Chacko *et al.*, 2002).

Synonyms: *Stercuila alata* Roxb. (Bose *et al.*, 1998; Chacko *et al.*, 2002; Sasidharan, 2004). *Sterculia haynii* Bedd.

Family: Sterculiaceae.

Subfamily:

Origin:

Distribution: Common in the forests of West Bengal, Assam, and Andamans. Usually, it grows sporadically in moist localities. Cultivated as ornamental and avenue tree (FRI, 1981). In Kerala, it is found in semi evergreen forests (Chacko *et al.*, 2002). The tree is found in the Andamans, Sikkim, Assam and Western Peninsula in India; Bangladesh; Myanmar and Malaysia (Bose *et al.*, 1998). It is found sporadically in moist situations in tropical evergreen forests in Sikkim, Assam, Western Ghats (South of North Kanara), Andamans.

Description: A slow growing, very large evergreen tree with a straight cylindrical bole reaching up to 40 m height and 95 cm breast height diameter and often buttressed

(FRI, 1981; Bose *et al.*, 1998; Chacko *et al.*, 2002).

Flowering season: January to February (Bourdillon, 1908); February to March.

Fruiting season: February to April (Sen Gupta, 1937; Chacko *et al.*, 2002). Ripens in the cold season, November to December (Bourdillon, 1908)..



Twig with flowers



Seeds

Flowers: Flowers are polygamous in short rusty tomentose racemes, staminal column cylindrical, bearing 5 phalages of 5 anthers and ovary is sessile. Flowers in short axillary cymes, purplish or rusty brown outside, red veins within, with unpleasant smell; calyx campanulate, deeply 5 lobed, densely tomentose, about 2 cm long; 5 anthers in male flowers (Bose *et al.*, 1998).

Fruits: Fruits subglobose, woody follicle, pubescent, 10-12 cm in diameter; seeds many, oblong, about 5 cm long, with a spatulate wing. Follicles are as large as

man's fist or larger, obliquely globose, shortly beaked, on stout stalks of 5 to 7.5 cm long, woody, minutely brown felted out side and corky within. About 40 seeds in two rows are tightly packed in a follicle (Bourdillon, 1908; FRI, 1981; Bose *et al.*, 1998; Chacko *et al.*, 2002).

Fruit type: Follicle.

Seeds: Winged, 6.25 cm long, some 20-30 being packed closely in each follicle.

Seed dimension:

Seed length: 2.5 cm (Chacko *et al.*, 2002).

Seed width:

Seed thickness:

Seed weight: 1,060 - 1,660 seeds/kg (FRI, 1981; Chacko *et al.*, 2002).

Seed dispersal:

Seed collection: Fruits are collected from the trees before they shed the seeds. As the trees are very tall, seed collection is often difficult. Hence, fruits are collected by lopping off the branches (FRI, 1981). Seeds are also collected from the floor, under the mother trees, but care should be taken to collect only fresh and fertile seeds (Chacko *et al.*, 2002).

Transportation of seeds: Fruits collected in cotton / plastic / polythene bags are transported quickly to the processing centre (Chacko *et al.*, 2002).

Seed processing: The fruits are dried in the sun and seeds are extracted by hand. The seeds are dried again in the sun for a few days (FRI, 1981; Chacko *et al.*, 2002).

Seed storage: Intermediate / Orthodox (CABI, 1998). Seeds can be stored for a couple of months in a dry, well-ventilated

shed. Care should be taken to protect them against damage by rats and ants (FRI, 1981; Chacko *et al.*, 2002).

Viability period: A few months (Chacko *et al.*, 2002).

Seed emptiness: No information (Chacko *et al.*, 2002).

Seed pre treatment: Not required (Chacko *et al.*, 2002).

Germination type: No information (Chacko *et al.*, 2002).

Germination percentage: Up to 90 (FRI, 1981; Chacko *et al.*, 2002).

Germination period: 14 to 90 days (FRI, 1981; Chacko *et al.*, 2002).

Nursery technique: Seeds are directly sown in polythene bags filled with soil based potting mixture and maintained under irrigation. Seedlings become plantable in about 4 to 5 months (Chacko *et al.*, 2002).

Propagation:

Method of propagation: By seeds.

Vegetative propagation:

Pests: No information (Chacko *et al.*, 2002).

Diseases: No information (Chacko *et al.*, 2002).

Medicinal properties:

Uses: This is a popular tree in tropical gardens. Wood is used for light packing cases and in the veneer and plywood industries. It is a good avenue tree (FRI, 1981; Chacko *et al.*, 2002).

Wood properties: The heartwood is not distinct from the sapwood in colour, the wood is greyish or pale yellowish white, moderately hard and moderately heavy with

straight grain and coarse texture. The air dry weight approximately is 590 kg/m³.

Wood white, soft, but harder than that of other species of the genus.

References:

Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 388-389.

Bourdillon, T.F. 1908. Forest trees of Travancore. International Book Distributors, Dehradun. pp. 50-51.

CABI. 1998. The Forestry Compendium – A Silvicultural Reference. Module 1. CABI Publishing, CAB International, Wallingford, Oxon, OX108DE, UK.

Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 200-201.

FRI. 1981. Troup's The Silviculture of Indian Trees. Vol. III. The Controller of Publications, Delhi.

Sasidharan, N. 2004. Forest Trees of Kerala. Kerala Forest Research Institute, Peechi, Kerala, India.

Sen Gupta, J.N. 1937. Seed weights, plant percents, etc. for forest plants in India. Indian Forest Records (New Series) Silviculture, 2:221 pp. Manager of Publications, Delhi.

Santalum album

Nomenclature:

Scientific name: *Santalum album* Linn.

Vernacular name: Chandanam (Malayalam) (Sasidharan, 2004), Srigandam (Bose *et al.*, 1998), Santhanam (Tamil), Chandan, Chandal, Sandal (Chacko *et al.*, 2002), Chandan (Hindi) (Bose *et al.*, 1998).

Common name: Sandal wood (Bose *et al.*, 1998), White sandal tree.

Synonyms: *Sirium myrtifolium*

Family: Santalaceae

Subfamily:

Origin:

Distribution: Indigenous to Indian peninsula, growing chiefly in rain shadow regions on undulating ground up to 420-1050 m elevation. It is found scattered in Peninsular India, Rajasthan, Uttar Pradesh, Bihar and Manipur. In Kerala, it is fairly common at Marayur; sporadically in the deciduous forests up to 900 m elevation (Luna, 1996; Chacko *et al.*, 2002).

Description: A small evergreen slow growing glabrous tree attaining 10 m height and 60 cm breast height diameter, with slender drooping branches. It is a semi root parasite (Bose *et al.*, 1998; Chacko *et al.*, 2002).

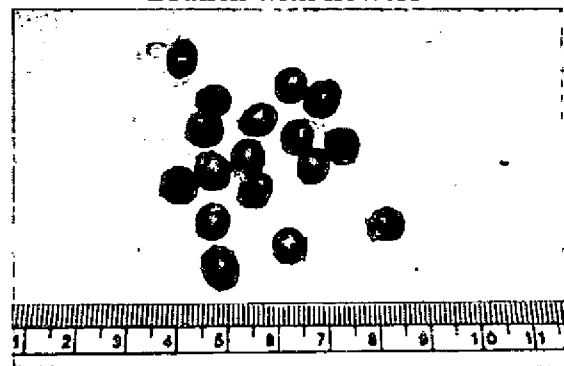
Flowering season: February - April (Coorg), At the end of hot weather or early in the rains (Mysore), May (Ciombatore).

Fruiting season: Ripens in May & June (Coorg), inclose rain (Mysore), May to August and November to December (Sen Gupta, 1937; Chacko *et al.*, 2002).

Flowers: Purplish brown-unscented in axillary or terminal cyme, 4 to 5 mm diameter perianth campanulate, lines 5 of valvate-triangular segments; disc scales 5, fleshy; stamens 5, exserted, alternate with rounded scales. Flowers are self-incompatible and strictly adapted for cross-pollination by insects. The commonest pollinators include flies and bees, seeking nectar in the cup-like disc. The freshly opened dull green flowers and the 1-day-old pale pink flowers are receptive to pollination, while 2-day-old red and dark-red flowers show fertilization stages (Bhaskar, 1992; Bose *et al.*, 1998).



Branch with flowers



Seeds

Fruits: Purplish black globose succulent drupe, 1.25 cm diameter, brown endocarp, which is moderately hard and brittle (Luna, 1996; Chacko *et al.*, 2002).

Fruit type: Drupe.

Seeds: Globose or obovoid, with white albumen and a straight embryo, characterized by a false seed coat, dormancy and high fat content (28%). The embryo is well developed and embedded in the endosperm (Mahdi, 1986; Bose *et al.*, 1998). Red seeds are used for direct sowing and black seeds for storage, and that sown seed should not be deeply buried (Mahdi, 1986). Seeds grouped into 3 classes based on size and weight: Small (up to 0.1 g), 10-13%; medium (0.1-0.2 g), 82-87%; and large (0.2 g), 3-5%. Small seeds germinate more quickly (starting after 15 days and reaching a maximum at 70 days) than the medium and large seeds which start germination after 30 days and reach a maximum at 90 days. However, seedling growth and survival increase with seed size: survival of seedlings from small seeds is only 55-60%, that from medium seeds 70-75%, and from large seeds 90-95%. The seeds of weight >0.1 g is ideal (Nagaveni and Ananthapadmanabha, 1986) 68% and 66% germinations respectively (Nagaveni *et al.*, 1989).

Seed dimension:**Seed length:**

Seed width: 0.2-1.2 cm diameter (Chacko *et al.*, 2002).

Seed thickness:

Seed weight: 6,000 to 7,055 seeds/kg (Sen Gupta, 1937; Kumar and Bhanja, 1992; Chacko *et al.*, 2002). 7,000-10,000 seeds/kg (Srivastava *et al.*, 2006).

Seed dispersal: Birds. Dispersal efficiency (measured by the preference by birds for fruits with seeds of varying sizes and by the distance to which they were dispersed) decrease with seed size. Small-seeded fruits

are preferred to those with large seeds. Small seeds are predominantly passed through faecal matter whereas large seeds were generally regurgitated; consequently small seeds are dispersed farther than large seeds. Thus, selection based on dispersal efficiency favours small seeds while that based on seedling establishment favours larger seeds (Hedge *et al.*, 1991).

Seed collection: Fresh seeds (Black) are collected from the tree or from the floor beneath the tree (Chacko *et al.*, 2002).

Transportation of seeds: Fruits collected in polythene or cotton bags are transported to the processing centre with sufficient ventilation (Chacko *et al.*, 2002).

Seed processing: Fruits are de-pulped by soaking in water and then rubbed between hands. The seeds are washed and air-dried under shade for a day (Srimathy *et al.*, 1995). The white seeds are further dried for a day or two in shade (Chacko *et al.*, 2002).

Seed storage: Probably orthodox/intermediate. Seeds can be stored in sealed tins and gunny bags up to 2 years. But in Andhra Pradesh, the seeds do not store well. For short storage up to 9 months, storing in gunny bags at room temperature is recommended and for longer period, dry cold storage in sealed polythene bags at 4-5°C is preferred (Dent, 1948; Kumar and Bhanja, 1992; Srimathy *et al.*, 1995; Chacko *et al.*, 2002). Seeds can also be dried for storage in sunlight for 1-3 days or in a seed drier at 40°C for 8-24 h; and seeds of low m.c. (3-10%) can be stored safely at about 4°C and 40% RH for up to 16 months (Dayanto Indro Utomo *et al.*, 1990).

Viability period: Seeds stored in polybags are viable up to 9 months (Luna, 1996; Chacko *et al.*, 2002).

Seed emptiness: Low (Chacko *et al.*, 2002).

Seed pre treatment: Acid sacri-fication with concentrated sulphuric acid for 30 min or soaking the seeds in 500 ppm gibberellic acid overnight gives better germination (Srimathy et al., 1995; Luna, 1996; Chacko *et al.*, 2002). Seeds without seed coat and treated with sulphuric acid for 60 minute give 80% germination after 70 days (Nagaveni and Srimathi, 1985). Pretreatments increase speed of germination compared to untreated, reducing the time for first germinants to appear from 60 to 15-45 days. Treatment with H₂O₂, methanol extract thiourea and IAA give 75%, 70%, 68% and 66% germinations respectively (Nagaveni *et al.*, 1989). Seed coat dormancy can be broken by treatment with 0.05% GA₃ or by placing the seeds in hot water (60°C) which is then allowed to cool for 24 h (Dayanto Indro Utomo *et al.*, 1990).

Germination type: Germination is epigeal, and usually photosynthetic. Viability is strongly affected by stages of maturity and the dormancy period (Mahdi, 1986). Both epigeal and hypogeal are reported (Chacko *et al.*, 2002).

Germination percentage: 8 to 85% (Sen Gupta, 1937; Kumar and Bhanja, 1992; Srimathy et al., 1995; Chacko *et al.*, 2002). Red seeds, which are physiologically mature, germinate better (81.5%) than black seeds (39.5%), which are in a resting period (post-mature). Germination of seeds from the bird droppings is higher (at 85%) than that from the fruits (70%) (Masano, 1986). Treatment with H₂O₂, methanol extract, thiourea and IAA give 75%, 70%, 8 to 85 % germination (Sen Gupta, 1937; Kumar and Bhanja, 1992; Srimathy et al., 1995; Chacko *et al.*, 2002).

Germination period: Germination begin 11 days after sowing and continue for 2 months (Dayal, 1986).

Nursery technique: Conventional sowing density for sandal is 500 g/m² of seed in a seedbed containing a mixture of sand and red earth (Annapurna et al., 2005). There is a linear relationship between seedling height and dry weight over ratio of sand:soil potting mixtures (Fox *et al.*, 1990). Seedling establishment (measured by leaf area) is positively associated with seed-size (Hedge *et al.*, 1991). Seedling survival (as a proportion of original seeds) range from 31.0 to 58.0% (av. 42.4%) 62 days after sowing (Bagchi and Kulkarni, 1985). Host plant has no effect on growth but type of growth media has a highly significant effect on height and diameter growth, root development and shoot/root ratio. Seedlings grow best in ash of burned rice chaff, and least in a soil and sawdust mixture (1:3) (Widiarti, 1989).

Propagation:

Method of propagation: Vegetative propagation, transplanting of seedlings.

Vegetative propagation:

Pests: Nil (Chacko *et al.*, 2002). Two species of mealybugs, *Saissetia nigra* [*Parasaissetia nigra*] and *S. coffeae* damage immature fruits of sandal which are shed and will not germinate. Spraying of 0.5% Ekalux [quinalphos] followed by BHC 50% WP [HCH] is used to control the bugs (Sivaramakrishnan *et al.*, 1987).

Diseases: Twenty fungi, a bacterium and after actinomycetes are recorded. *Torula herbarum*, *Phomopsis* sp., *Phoma* sp., *Curvularia eragrostidis*, *Periconia*, *Fusarium*, etc. are the important fungi (Mohanan and Anil Chandran, 2001; Chacko *et al.*, 2002). Sandal seedlings suffer 100% mortality in nurseries caused by a combination of pathogenic fungi (mainly *Fusarium oxysporum*) and nematodes. Using Ekalux [quinalphos] or Thimet [phorate] as

nematicides into nursery beds and soil in polyethylene bags used for transplanting, and application of Dithane-78 [zineb] or Blitox [Cu] as fungicidal drenches, are effective in controlling diseases (Sivaramakrishnan *et al.*, 1987). Pathogenic fungi (mainly *Fusarium* and *Phytophthora*) and nematodes cause wilting in sandal seedlings (Nayar, 1980).

Medicinal properties: The oil extracted from the heartwood is used in medicine; promote urination, inflammation of bladder and cough. Both wood and oil are diuretic, diaphoretic, refrigerant and expectorant, finding several applications in household remedies (Bose *et al.*, 1998).

Uses: The oil extracted from the heartwood is used in perfumery and medicine. Wood is used for carving and other fancy work.

References:

Ananthapadmanabha, H.S., Sivaramakrishnan, V.R. and Sarma, C.R. 1989. Control of spike disease of sandal - an integrated approach. *Myforest*. 25: 377-380.

Annapurna, D., Rathore, T. S. and Somashekhar, P. V. 2005. Impact of Clones in a Clonal Seed Orchard on the Variation of Seed Traits. *Silvae Genetica* 54: pp 4-5.

Germination and Seedling Growth in Santalum album L

Bagchi, S.K. and Kulkarni, H.D. 1985. Germination of open-pollinated seeds and survival of seedlings from the selected trees of Santalum album. *Myforest*. 21: 221-224.

Bhaskar, V. 1992. Pollination biology and fertilization in Santalum album L. (Santalaceae). *Flora Jena*. 187: 73-78.

Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 405.

Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 202-203.

Dayal, R.M. 1986. An assessment of propagation of sandal Santalum album by bush sowing technique. *Journal of Tropical Forestry*. 2: 44-46.

Dayanto Indro Utomo, Sugiharti, Erizal, Komar, T. and Turnbull, J.W. 1990. Seed technology problems of sandalwood in Indonesia. *Tropical tree seed research. Proceedings of an*

Wood and oil are used incense and are of great commercial importance (Chacko *et al.*, 2002). Sandal wood oil from hard wood and roots is useful for the synthesis of powder, soap, perfumes and other cosmetic items. The protein content of deoiled seed meal is 60.0% in viable seeds and 41.0% in non-viable seeds. Fatty oil contents of viable and non-viable seeds are 60.0 and 63.5%, respectively while the corresponding acid values are 8.21 and 4.57. Both percentage unsaponifiable matter and iodine values increase on storage (78 to 12.3% and 147.0 to 161.0, respectively) (Ananthapadmanabha *et al.*, 1989).

Wood properties: Hard, very closely grained and oily; sapwood is white and scentless; heartwood is yellowish brown and strongly scented (Gamble, 1922). Air dry weight is 945 kg/m³.

international workshop held at the Forestry Training Centre, Gympie, Qld, Australia, 21-24 August 1989. ACIAR Proceedings Series. 28: 51-54.

Dent, T.V. 1948. Seed storage with particular reference to the storage of seed of Indian forest plants. Indian Forest Records (New Series) Silviculture, 7: 134 pp. Manager of Publications, Delhi.

Fox, J.E.D., Surata, I.K. and Suriamidhardja, S. 1990. Nursery potting mixture for Santalum album L. in Timor. Mulga Research Centre Journal. 10: 38-44.

Gamble, J.S. 1922. A manual of Indian timbers. London Sampson Low, Marton and Company Ltd, Calcutta, India.

Hedge, S.G., Shaanker, R.U. and Ganeshaiyah, K.N. 1991. Evolution of seed size in the bird-dispersed tree Santalum album L.: a trade off between seedling establishment and dispersal efficiency. Evolutionary Trends in Plants. 5: 131-135.

Kumar, S.V. and Bhanja, M. 1992. Forestry Seed Manual of Andhra Pradesh. Andhra Pradesh Forest Department, Hyderabad, India.

Luna, R.K. 1996. Plantation Trees. International Book Distributors, Dehra Dun, India.

Mahdi, A. 1986. The biology of Santalum album seed with special emphasis on its germination characteristics. BIOTROP Technical Bulletin. 1: 1-9.

Mohanani, C. and Anil Chandran. 2001. Microorganisms associated with seeds of tropical forest species and their management for improving the storability and seedling production. Seed Science and Technology (in press).

Nagaveni, H.C. and Srimathi, R.A. 1985. Germinative capacity of floating and sinking sandal seeds. Indian Forester. 111: 615-618.

Nagaveni, H.C. and Ananthapadmanabha, H.S. 1986. Seed polymorphism and germination in Santalum album. Van Vigyan. 24: 25-28.

Nagaveni, H.C., Ananthapadmanabha, H.S. and Rai, S.N. 1989. Effect of different chemicals on germination of sandal seeds (Santalum album Linn.). Myforest. 25: 311-313.

Nayar, R. 1980. Control of spike disease of sandal. A literature review. European Journal of Forest Pathology. 10: 236-242.

Sasidharan, N. 2004. Forest Trees of Kerala. Kerala Forest Research Institute, Peechi, Kerala, India.

Sen Gupta, J.N. 1937. Seed weights, plant percents, etc. for forest plants in India. Indian Forest Records (New Series) Silviculture, 2:221 pp. Manager of Publications, Delhi.

Sivaramakrishnan, V.R., Nagaveni, H.C. and Rajamuthukrishnan. 1987. Poor seed setting in sandal (Santalum album L.). Myforest. 23: 101-103;243-244.

Srimathy, R. A., Kulkarni, H. D. and Venkatesan, K. R. 1995. Recent advances in Research and Management of Sandal (Santalum album L.) in India. Associated Publishing Company, New Delhi. 416p.

Srivastava, R.K., Manisha Thapliyal, Ombir Singh and Nawa Bahar. 2006. Forest seeds, Information Booklet. Forest Research Institute, Dehra Dun.

Widiarti, A. 1989. Effect of host plants and potting media on the growth of sandal (Santalum album) seedlings in the nursery. Buletin Penelitian Hutan. 507; 1-11.

Sapindus trifoliata

Nomenclature:

Scientific name: *Sapindus trifoliata* Linn.

Vernacular name: Chuvappu kaimaram, Chavakkai, Urunci, Pasakotta (Malayalam) (Sasidharan, 2004), Ritha (Marathi), Pungam Kottei, Nithavanji, Pevam kottai (Tamil), Ritha (Hindi) (Bose *et al.*, 1998).

Common name: Soap nut tree of South India (Bose *et al.*, 1998).

Synonyms: *Sapindus laurifolia* Vahl (Sasidharan, 2004).

Family: Sapindaceae

Subfamily:

Origin:

Distribution: In the S. India common in the open forests of low elevation. Found in the evergreen forests of the W. Ghats. In Kerala, it occurs in Wyanad, Calicut, Malappuram, Palghat, Thrissur, Ernakulam, Idukki, Kottayam, Pathanamthitta and Trivandrum districts.

Description: A large, deciduous tree with spreading branches and dense crown, attaining a height up to 20 m (Bourdillon, 1908; Bose *et al.*, 1998).

Flowering season: October to December (Bose *et al.*, 1998). December to April. November to December (Bourdillon, 1908).

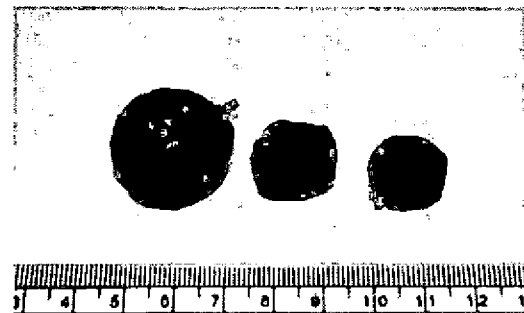
Fruiting season: Ripen from February - April. Fruits ripen in hot months (Bose *et al.*, 1998). March, April and May (Bourdillon, 1908).

Flowers: Flowers are pale white or greenish, yellow in rusty pubescent terminal panicles with numerous male flowers and a

few bisexual ones. Flowers small, white, male or bisexual, on rusty-pubescent terminal paniculate cymes; sepals 4 or 5; petals 4 or 5, with tufts of white hairs; disk concave; ovary 3-lobed, ferruginous-tomentose (Bose *et al.*, 1998).



Habit



Fruits



Seeds

Fruits: Consisting of 2/3 indehiscent carpels 1.25-1.88 cm long, with a saponaceous flesh. Fruits are usually 3 or 2 fleshy, rounded berries, partially joined, covered with reddish hairs when young, hairless when ripe (Bose *et al.*, 1998). Fruit 2-3 lobed, fleshy, fulvous-hairy when young, glabrous and wrinkled when mature.

Fruit type: Berry.

Seeds: Seeds are black, one in each lobe of the fruit, hard and smooth (Purkayastha, 1996; Bose *et al.*, 1998).

Seed dimension:

Seed length:

Seed width:

Seed thickness:

Seed weight: 2,000 - 25,000 seeds/kg (Purkayastha, 1996).

Seed dispersal:

Seed collection:

Transportation of seeds:

Seed processing:

Seed storage:

Viability period:

Seed emptiness:

Seed pre treatment: The seeds should be soaked in water or in cow dung slurry for 24 hrs. Sowing of seeds with or without pericarp.

Germination type:

Germination percentage:

Germination period:

Nursery technique:

Propagation:

Method of propagation: By seeds, root suckers.

Vegetative propagation:

Pests:

Diseases:

Medicinal properties: The pericarp of the fruit is used as a hair wash. Root and bark is used for medicinal purpose. The roots are good for hemicrania, hysteria, and epilepsy. The fruits are acrid, bitter, astringent, and tonic; are good for asthma, diarrhoea, cholera, verminosis and gastralgia due to dyspepsia. The fruit is applied externally as a remedy for bites of poisonous insects and even snake-bite. Remedy for scorpion sting suggested by inhaling the smoke from burning fruits (Bose *et al.*, 1998).

Uses: Fruits are widely used as a detergent. Soap nut is also used by jewellers to restore brightness to tarnished ornaments. The seeds yield oil and it is used for soap industry. Seed shell yields a dye used to colour cloth, leather and wood.

Wood properties: The wood is yellowish white to pale brown without any distinct heartwood. It is a very hard and very heavy wood (Air dry weight about 950 kg/m³) with straight to wavy grain and medium texture. The pores are scanty and moderate sized, and the rays are very fine and numerous (Bourdillon, 1908; Purkayastha, 1996).

References:

Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 406.

Bourdillon, T.F. 1908. Forest trees of Travancore. International Book Distributors, Dehradun. pp. 110-111.

Purkayastha, S.K. 1996. A manual of Indian timbers. Sri Bhumi Publishing Company, Calcutta.

Sasidharan, N. 2004. Forest Trees of Kerala. Kerala Forest Research Institute, Peechi, Kerala, India.

Saraca asoca

Nomenclature:

Scientific name: *Saraca asoca* (Roxb.) de Wilde

Vernacular name: Asokam, Hema pushpam (Malayalam), Asoka, Asogam (Tamil) (Chacko *et al.*, 2002). Ashok (Hindi) (Bose *et al.*, 1998).

Common name: Ashoka (Chacko *et al.*, 2002).

Synonyms: *Jonesia asoca* Roxb., *Saraca indica* auct. non L. (Chacko *et al.*, 2002; Sasidharan, 2004).

Family: Leguminosae

Subfamily: Caesalpinioideae

Origin:

Distribution: Commonly found throughout the country generally along streams and the shades of evergreen forests. The tree is distributed in the central and eastern Himalaya, Western Peninsula of India; Sri Lanka, Myanmar; Malaysia; often grown in gardens for the beautiful flowers (FRI, 1983; Bose *et al.*, 1998; Chacko *et al.*, 2002). In Kerala, it occurs sporadically in the evergreen forests. It is frequently planted in gardens and near Hindu temples (Chacko *et al.*, 2002).

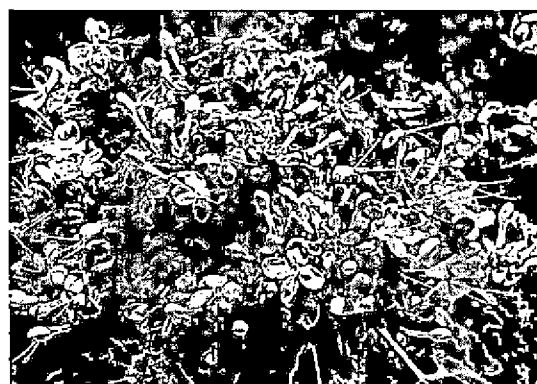
Description: A low branched handsome evergreen tree (6-9 m) with a dense crown of horizontally spreading branches (Bose *et al.*, 1998).

Flowering season: February to June (Bose *et al.*, 1998).

Fruiting season: Ripens in August to September.

Flowers: Flowers yellow or orange, turning red, scented, 2-3 cm long, in dense corymb, mostly on woody branches, sometimes on the trunk; bracteoles coloured; calyx tube 1 cm long, perfect stamens 7-8, scarlet (Bose *et al.*, 1998).

Fruits: Pods are black, compressed, tapering at both ends, coriaceous or almost woody glabrous, veined. Pods 10-20 cm long, slightly curved, young pods purplish, turn brown when ripe (Bose *et al.*, 1998).



Inflorescence



Seeds

Fruit type: Pod.

Seeds: 4-8, ellipsoid oblong, 3.8 cm long, slightly compressed. Seeds 4-8, flat (Bose *et al.*, 1998).

Seed dimension:

Seed length: 4.9 cm (Chacko *et al.*, 2002).

Seed width: 2.6 cm (Chacko *et al.*, 2002).

Seed thickness:

Seed weight: 20 (Kindt *et al.*, 1997) to 97 seeds / kg (Chacko *et al.*, 2002).

Seed dispersal:

Seed collection: Ripe pods are collected from the tree by shaking off the branches. Mature fruits falling on ground can also be collected (Chacko *et al.*, 2002).

Transportation of seeds: Fruits are transported to the processing centre at the earliest (Chacko *et al.*, 2002).

Seed processing: The pods are dried under shade to release the seeds. Insect attacked seeds should be discarded (Chacko *et al.*, 2002).

Seed storage: Orthodox (CABI, 1998; Chacko *et al.*, 2002).

Viability period: Seeds retain viability up to six months in sealed tins when stored under cold conditions (Chacko *et al.*, 2002).

Seed emptiness: Low (Chacko *et al.*, 2002).

Seed pre treatment: Not required (Chacko *et al.*, 2002).

Germination type: Hypogeal (Chacko *et al.*, 2002).

Germination percentage: 58% in shaded beds and 84% in unshaded beds (Ram Parkash *et al.*, 1998).

Germination period: 15 to 24 days (Chacko *et al.*, 2002).

Nursery technique: Seeds are sown in germination trays filled with vermiculite or in nursery beds and watered regularly. The seedlings are potted into polythene bags of size 22.5x17.5 cm filled with potting mixture. The seedlings are most often damaged by rodents and hence needs protection (Chacko *et al.*, 2002).

Propagation:

Method of propagation: By seeds.

Vegetative propagation:

Pests: Moderate (Chacko *et al.*, 2002).

Diseases: Low (Chacko *et al.*, 2002).

Medicinal properties: Flowers, bark, and seeds are medicinally important. Bark is used to cure internal haemorrhage and seeds are used to cure urinary discharge. The bark is used to cure internal haemorrhages and to improve the complexion. The water extract of flower is said to cure dysentery (Bose *et al.*, 1998).

Uses: This is one of the most sacred trees of the Hindus. In the northern parts of Sri Lanka the timber is used for common house building purposes. The wood is used for ploughs and shafts (Chacko *et al.*, 2002). Hindus use the flowers and leaves in religious ceremonies and Buddhists consider this tree sacred as Lord Buddha was born under its shade. It is frequently cultivated as an ornamental tree throughout tropical India. The wood is used in making implements and for house building in Sri Lanka (Bose *et al.*, 1998).

Wood properties: The wood is yellowish brown, moderately hard and moderately heavy. It is diffuse porous wood with growth rings delimited by fine interrupted lines of soft tissues. The pores are moderately large to small. The wood is light

reddish-brown, soft; occasional faint brown concentric belts of soft tissue. Pores are moderate sized, in radial, and frequently oblique, lines. Medullary rays fine, scanty and indistinct (Bourdillon, 1908).

References:

Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 412.

Bourdillon, T.F. 1908. Forest trees of Travancore. International Book Distributors, Dehradun. pp. 145-146.

CABI. 1998. The Forestry Compendium – A Silvicultural Reference. Module 1. CABI Publishing, CAB International, Wallingford, Oxon, OX108DE, UK.

Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 204-205.

FRI. 1983. Troup's The Silviculture of Indian Trees. Vol. IV. The Controller of Publications, Delhi.

Kindt, R., Mausya, S., Kimotho, J. and Waruhiu. 1997. Tree seed suppliers Directory: Sources of Seeds and Microsymbionts. International Centre for Research in Agro Forestry (ICRAF), Nairobi, Kenya.

Ram Parkash, M.A., Chaudhri, D.C. and Negi, S.S. 1998. Plantation and nursery technique of forest trees. International Book distributors. Dehra Dun, India.

Sasidharan, N. 2004. Forest Trees of Kerala. Kerala Forest Research Institute, Peechi, Kerala, India.

Schleichera oleosa

Nomenclature:

Scientific name: *Schleichera oleosa* (Lour.) Oken

Vernacular name: Dhoothalam, Poovanam (Sasidharan, 2004), Poovam, Kusam (Malayalam), Pumaratha, Puvattipuvam, Puvam (Tamil), Kosum, Gosum (Hindi) (Chacko *et al.*, 2002).

Common name: Kusum, Gum lac tree, The lac tree, Honey tree (Bose *et al.*, 1998), Macassar oil tree, Sri Lanka oak (Chacko *et al.*, 2002).

Synonyms: *S. aculeata* Kostel., *Schleichera trijuga* Willd., *Pistacia oleosa* Lour. (Chacko *et al.*, 2002; Sasidharan, 2004).

Family: Sapindaceae

Subfamily:

Origin:

Distribution: Throughout Indian sub continent. Also in Burma, Sri Lanka, Java. In India found in Bihar, W. Bengal, Central and S. India, Chota Nagpur, Rajasthan, Assam and Andamans. In India, it occurs sporadically on the low hills of the Himalayas up to 900 m from the Sutlej eastwards up to Bihar, West Bengal, Central and Southern India. It is also found in Myanmar, Sri-Lanka and Java Indonesia (FRI, 1981). In Kerala, it occurs in semi evergreen and moist deciduous forests up to 900 m (Chacko *et al.*, 2002).

Description: Slow to moderately fast growing, medium-sized to large deciduous tree attaining a height of 20 m and a breast height diameter of 64 cm, with dense and spreading shady crown. Trunk is short and

fluted (FRI, 1981; Bose *et al.*, 1998; Chacko *et al.*, 2002).

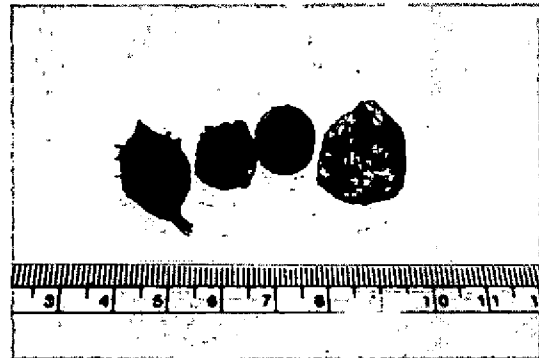
Flowering season: March - April. February to March (Bose *et al.*, 1998)

Fruiting season: Ripens in June - July (Bose *et al.*, 1998); August to November (FRI, 1981; Chacko *et al.*, 2002).

Flowers: Minute, yellowish green, stalkless and borne in short dense clusters. Flowers small, yellowish green, polygamo-dioecious, apetalous, in short dense clusters, arranged in numerous spikes arising from the branches among the leaves; stamens 6-8; styles 3- to 4- cleft (Bose *et al.*, 1998).

Fruits: Smooth or slightly prickly, globose or ovoid, hard skinned berry dry, indehiscent, 1-2 seeded. Fruit drupe, globose, with scattered warty spines, 1-1.5 cm across, contains 1-2 seeds enclosed by a pulpy aril (Chacko *et al.*, 2002).

Fruit type: Drupe.



Fruits

Seeds: Up to 1.5 cm long smooth brown enclosed in a succulent aril, which is edible and has a pleasant acid taste. Seed one or two, brownish, compressed, enclosed in a succulent aril of pleasantly acid taste (Bose *et al.*, 1998).

Seed dimension:

Seed length: 1.5 cm (Chacko *et al.*, 2002).

Seed width:

Seed thickness:

Seed weight: 1,517 (Sen Gupta, 1937) to 2,200 seeds/kg (FRI, 1981; Kumar and Bhanja, 1992; Luna, 1996; Chacko *et al.*, 2002).

Seed dispersal:

Seed collection: Ripe fruits are collected from the ground as soon after fall. The fruits may also be collected from the tree (Chacko *et al.*, 2002).

Transportation of seeds: Fruits collected in cotton or plastic bags are transported as early as possible (Chacko *et al.*, 2002).

Seed processing: The fruits are thrashed to separate the seeds (Chacko *et al.*, 2002).

Seed storage: Orthodox / intermediate. Seeds, smeared with wood ash, can be stored in gunny bags or in air-tight tins for about 6 months without any deterioration. (FRI, 1981). Seeds remain viable for one year in gunny bags and for two years in sealed tin (Chacko *et al.*, 2002).

Viability period: Seeds remain viable about an year of storage in both gunny bags and sealed tins (Dent, 1948; Chacko *et al.*, 2002).

Seed emptiness: Moderate (Chacko *et al.*, 2002).

Seed pre treatment: Although pre treatments are not needed (Kumar and Bhanja, 1992), soaking in hot water is beneficial (Kindt *et al.*, 1997; Chacko *et al.*, 2002).

Germination type: Epigeous (Kumar and Bhanja, 1992; Chacko *et al.*, 2002).

Germination percentage: 6 to 58 (Sen Gupta, 1937); 50 to 80 (FRI, 1998; Luna, 1996; Chacko *et al.*, 2002).

Germination period: 8 to 94 days (Sen Gupta, 1937; FRI, 1981; Luna, 1996; Chacko *et al.*, 2002).

Nursery technique: Seeds are sown in polybags of size 22.5x17.5 cm filled with potting mixture during July to August directly since seeds do not withstand the transplanting shock because of the very fast growth of the taproot (Kumar and Bhanja, 1992; Chacko *et al.*, 2002).

Propagation:

Method of propagation: By seeds and root suckers; stump planting is also practised (Ram Parkash *et al.*, 1998).

Vegetative propagation:

Pests: Low infestation due to an unidentified beetle (Chacko *et al.*, 2002).

Diseases: High (64%). More than 23 fungi, actinomycetes and bacteria are recorded on seeds. *Chlamydomyces palmarum* and *Botryodiplodia theobromae* are the most frequently encountered fungi. *Cylindrocladium* sp., and *Phoma* sp., are found associated with seed rot (Chacko *et al.*, 2002).

Medicinal properties: The seed oil is bitter, sour, sweet, purgative and tonic. It is used in ulcers, pruritus, acne, and leg swelling. Inflammation oil is used for massage in rheumatism. The bark cures inflammation and skin diseases. The oil cake has good manurial value (Bose *et al.*, 1998).

Uses: Wood is used for making wheels, shafts and agricultural implements. It is a

prized host tree of the lac insect. The tree yields an oil that for cleaning and promoting the growth of hair and for making soaps and perfumes. It is an important forest tree and the best lac is obtained when the insects are grown in these trees. The timber is used for the oil and sugar mills, rice pounders, cart wheels, shafts, mortars and hammers. Oil is extracted from seeds and used for cooking, lubricating, hair dressing and burning in lamps (Bose *et al.*, 1998).

Wood properties: Sapwood is pale grey and heartwood is light reddish brown. It is a very hard and very heavy wood with medium straight texture and straight to shallowly interlocked grain (Air dry weight about 100 kg/m³). Pores are scanty, moderate-sized, often oval and subdivided, often joined by pale, interrupted, wavy, uniform and equidistant, closely packed; the distance between the rays less than the transverse diameter of the pores (Gamble, 1922).

References:

- Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa, India. pp. 412.
- Bourdillon, T.F. 1908. Forest trees of Travancore. International Book Distributors, Dehradun. pp. 145-146.
- CABI. 1998. The Forestry Compendium – A Silvicultural Reference. Module 1. CABI Publishing, CAB International, Wallingford, Oxon, OX108DE, UK.
- Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 204-205.
- FRI. 1983. Troup's The Silviculture of Indian Trees. Vol. IV. The Controller of Publications, Delhi.
- Kindt, R., Mausya, S., Kimotho, J. and Waruhiu. 1997. Tree seed suppliers Directory: Sources of Seeds and Microsymbionts. International Centre for Research in Agro Forestry (ICRAF), Nairobi, Kenya.
- Kumar, S.V. and Bhanja, M. 1992. Forestry Seed Manual of Andhra Pradesh. Andhra Pradesh Forest Department, Hyderabad, India.
- Luna, R.K. 1996. Plantation Trees. International Book Distributors, Dehra Dun, India.
- Ram Parkash, M.A., Chaudhri, D.C. and Negi, S.S. 1998. Plantation and nursery technique of forest trees. International Book distributors. Dehra Dun, India.
- Sasidharan, N. 2004. Forest Trees of Kerala. Kerala Forest Research Institute, Peechi, Kerala, India.

Semecarpus anacardium

Nomenclature:

Scientific name: *Semecarpus anacardium* L.f.

Vernacular name: Cherkkuru, Thenkotta, Alakkucheru (Malayalam) (Sasidharan, 2004). Thembarai, Shenkottai (Tamil) Bhilawa, Bhela (Hindi) (Bose *et al.*, 1998) (Chacko *et al.*, 2002).

Common name: Oriental cashew, (Bose *et al.*, 1998). Marking nut tree, Varnish tree, Dhobi nut, (Chacko *et al.*, 2002)

Synonyms: *Anacardium latifolium* Lamk., *A.officinarium* Gaertn.

Family: Anacardiaceae

Subfamily:

Origin:

Distribution: Sub Himalayan tract from the Bias Eastwards-Assam, Meghalaya, and Central India, Western Peninsula and extending to Bangladesh; North Australia; Malaysia (Bose *et al.*, 1998). It is fairly common in Sal forests (FRI, 1981). In Kerala, it occurs in the moist and dry deciduous forests (Chacko *et al.*, 2002).

Description: Moderate sized deciduous tree, 20 m high and breast height diameter of 67 cm (FRI, 1981; Chacko *et al.*, 2002).

Flowering season: May to August (Bose *et al.*, 1998). June to July (Bourdillon, 1908).

Fruiting season: April to May (Chacko *et al.*, 2002). November (Bourdillon, 1908).

Flowers: Flowers greenish yellow, subsessile, 6-8 mm across, fascicled in compressed erect terminal, panicles; sepals small, pilose on the outer surface; petals broad ovate, acute; in male flowers stamens

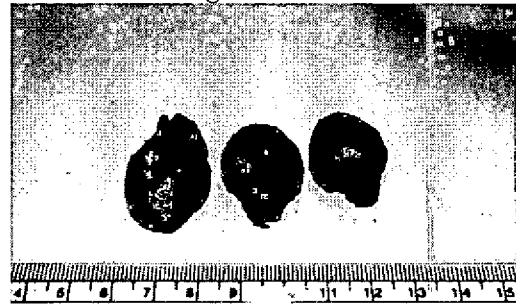
inserted at the base of disc; ovary rudimentary, hairy; in female flowers stamens imperfect; ovary sub globose, densely pilose, 2-celled (Bose *et al.*, 1998). Pollinators include bees (most commonly *Apis florea* and *Ceratina similima* (84%), wasps (14%) and butterflies (2%) (Solomon Raju *et al.*, 1999).

Fruits: A compressed, oblong drupe about 3 cm long, obliquely ovoid or oblong, smooth, shining, purplish black when ripe, seated on a fleshy, orange receptacle or hypocarp; pericarp full of acrid resinous juice (FRI, 1981; Bose *et al.*, 1998; Chacko *et al.*, 2002).

Fruit type: Drupe.



Twig with fruits



Seeds

Seeds: Black drupaceous fruit is referred to as seed (FRI, 1981; Chacko *et al.*, 2002).

Seed dimension:

Seed length: 2.5-3.8 cm (Chacko *et al.*, 2002).

Seed width:

Seed thickness:

Seed weight: 460 to 880 (FRI, 1991; Chacko *et al.*, 2002).

Seed dispersal:

Seed collection: The fruits are collected from the tree or from the ground (Chacko *et al.*, 2002).

Transportation of seeds: Drupes are collected in cotton/ plastic/ polythene bags and transported to the processing centre as quickly as possible (Chacko *et al.*, 2002).

Seed processing:

Seed storage: Orthodox (CABI, 1998; Chacko *et al.*, 2002).

Viability period: Seeds are viable for about few months under ambient room temperature (Sen Gupta, 1937; Chacko *et al.*, 2002).

Seed emptiness: No information (Chacko *et al.*, 2002).

Seed pre treatment: The seeds are soaked in cold water for 48 hrs. Acid scarification in 50% sulphuric acid for 5 and 10 min increase the percentage germination and reduce mean germination time (Subodh Airi *et al.*, 1998).

Germination type: Epigeal (Chacko *et al.*, 2002).

Germination percentage: Up to 21 (Sen Gupta, 1937; Chacko *et al.*, 2002).

Germination period: 27 to 53 days (Sen Gupta, 1937; Chacko *et al.*, 2002).

Nursery technique: Seeds are sown with the stalk end upwards and in slanting position in polythene bags of 22.5x17.5 cm size filled with potting mixture and watered (Rai, 1999). Seedlings do not stand transplanting well (FRI, 1981) and hence direct sowing is preferred (Chacko *et al.*, 2002).

Propagation:

Method of propagation: By seeds.

Vegetative propagation:

Pests: No information (Chacko *et al.*, 2002).

Diseases: No information (Chacko *et al.*, 2002).

Medicinal properties: The gum, ripe fruits and its oil are medicinal. The fruits are bitter, acrid and digestive carminative. They are useful in cancer, cough, asthma and ulcers. The tree exudes a gum-resin used in leprosy and nervous debility (Bose *et al.*, 1998). It is used for the treatment of rheumatoid arthritis and other inflammatory disorders (Selvam and Jachak, 2004).

Uses: The fruit, wall is rich in black, oily, bitter and highly resicant juice which produces blisters on the skin and is used traditionally for marking ink with lime as a mordant; also is used in varnish. Fleshy receptacle is often roasted and eaten. The oil is used also as a preservative against white ants and as a lubricant for wooden axles of carts (FRI, 1981; Chacko *et al.*, 2002). Wood is suitable for packing cases (Bose *et al.*, 1998; Rai, 1999; Chacko *et al.*, 2002).

Wood properties: The wood is greyish white when fresh, turning pale greyish brown with age, without any distinct heartwood. It is a soft to moderately hard and moderately heavy wood. Pores are evenly distributed, well marked on a longitudinal section, of medium size, scanty.

Rays numerous, rather fine and close (Bourdillon, 1908).

References:

Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 417.

Bourdillon, T.F. 1908. Forest trees of Travancore. International Book Distributors, Dehradun. pp. 120.

CABI. 1998. The Forestry Compendium – A Silvicultural Reference. Module 1. CABI Publishing, CAB International, Wallingford, Oxon, OX108DE, UK.

Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 208-209.

FRI. 1981. Troup's The Silviculture of Indian Trees. Vol. III. The Controller of Publications, Delhi.

Rai, S.N. 1999. Nursery and Planting Techniques of Forest Trees in Tropical South-Asia. Eastern Press, Bangalore, India.

Sasidharan, N. 2004. Forest Trees of Kerala. Kerala Forest Research Institute, Peechi, Kerala, India.

Selvam, C. and Jachak, S.M. 2004. A cyclooxygenase (COX) inhibitory biflavonoid from the seeds of Semecarpus anacardium. Journal of Ethnopharmacology. 95(2/3): 209-212.

Sen Gupta, J.N. 1937. Seed weights, plant percents, etc. for forest plants in India. Indian Forest Records (New Series) Silviculture, 2:221 pp. Manager of Publications, Delhi.

Solomon Raju, A.J., Nagalakshmi, S. and Naidu, S.A. 1999. Insect-pollination in marking-nut tree. Insect Environment. 5: 108-109.

Subodh Airi., Rawal R.S., Samant, S.S., Dhar, U. and Airi, S. 1998. Treatments to improve germination of four multipurpose trees of central sub Himalaya. Seed Science and Technology. 26: 347-354.

Spondias pinnata

Nomenclature:

Scientific name: *Spondias pinnata* (Linn. f.) Kurz

Vernacular name: Ambalam, mampali, Pulimayu, Amara, Ambara, Ambazham (Malayalam), Pulicchi (Tamil) (Bourdillon, 1908), Kattumavu, Katambalam (Tamil), Amra (Hindi & Beng.) (Chacko *et al.*, 2002).

Common name: Indian hog plum (Chacko *et al.*, 2002), Bile tree, Wild mango, Traveller's delight

Synonyms: *Spondias mangifera* Willd.; *Mangifera pinnata* Linn. f. (Chacko *et al.*, 2002; Sasidharan, 2004). *Spondias amara* Lamk.

Family: Anacardiaceae

Subfamily:

Origin:

Distribution: Found in greater parts of India either natural or cultivated. From the Sub Himalayan tracts up to Bengal, Assam, Andamans, Indian Peninsula (Bose *et al.*, 1998). In Kerala it occurs in the moist deciduous and semi evergreen forests. (Chacko *et al.*, 2002).

Description: A medium-sized to large deciduous tree with stout branches, attaining a height of 30 m with a breast height diameter of 111 cm (FRI, 1981; Chacko *et al.*, 2002).

Flowering season: December to April (Bourdillon, 1908).

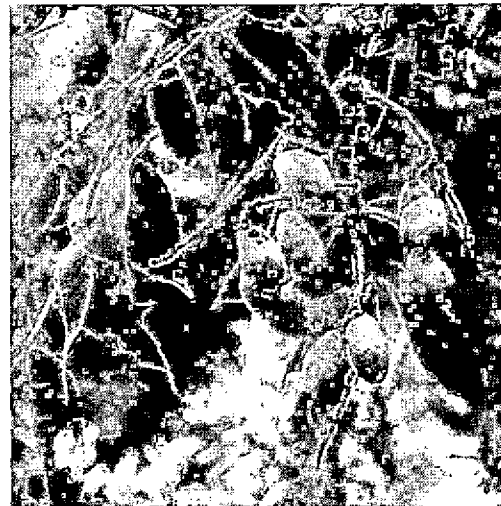
Fruiting season: Ripen in September to October (Bose *et al.*, 1998). December to May (Sen Gupta, 1937; Chacko *et al.*, 2002).

February - March, July to November (Bourdillon, 1908).

Flowers: Flowers are hermaphrodites. White, Polygamous, 0.5 cm across, pentamerous. Pollen grains are dusty. Male and bisexual on stout panicles; sepals 5-toothed; petals 5, oblong; stamens 8-10 (Bourdillon, 1908; Bose *et al.*, 1998; Darshana Nand, 2001).

Fruits: Fruit is a drupe, ovoid or oblong, fleshy, smooth, 3-5 cm long, yellow when ripe. The stone is semi-woody, fibrous outside and pitted with cavity with 2-5 seeds (Kumar and Bhanja, 1992; Chacko *et al.*, 2002).

Fruit type: Drupe.



Twig with fruits



Seeds

Seeds: 1-5, of which not more than 1-3 are perfect. All parts of the tree give characteristic aromatic smell. The seed is 2 to 5 celled, some times 6-celled, with 1 to 3 fertile seeds.

Seed dimension:

Seed length: 2.5 cm (Chacko *et al.*, 2002).

Seed width: 2.1 cm (Chacko *et al.*, 2002).

Seed thickness:

Seed weight: 126 to 290 stones/kg (Kumar and Bhanja, 1992; Rai 1999; Chacko *et al.*, 2002).

Seed dispersal: Deer, pigs, monkeys, squirrels and other animals.

Seed collection: Fruits are collected either from the tree or from the ground (Chacko *et al.*, 2002).

Transportation of seeds: Fruits collected in cotton/ plastic/ polythene bags are transported to the processing centre soon after collection (Chacko *et al.*, 2002).

Seed processing: Fruits are squeezed under water to remove the pulp. The seeds are then dried under partial shade (Chacko *et al.*, 2002).

Seed storage: Intermediate(?). Seeds cannot be stored for long. Germinative power decreases by 50% after one year of storage (Kumar and Bhanja, 1992).

Viability period: The seed has short viability under ambient room temperatures (Chacko *et al.*, 2002).

Seed emptiness: Low (Chacko *et al.*, 2002).

Seed pre treatment: Suitable clippings of seeds increase the germination percentage (Kumar and Bhanja, 1992).

Germination type: Epigeous.

Germination percentage: 25 to 40, 60 (Rai, 1999) to 80 (Kumar and Bhanja, 1992; Chacko *et al.*, 2002).

Germination period: 30 to 229 days (Chacko *et al.*, 2002).

Nursery technique: Seeds (fresh stones) are sown in germination trays filled with vermiculite soon after collection and watered regularly. Germination commences after 30 to 40 days. When the seedlings attain a height of 5 to 7 cm they are pricked out and potted in polybags of size 22.5x17.5 cm filled with soil and maintained under shade (Chacko *et al.*, 2002).

Propagation:

Method of propagation: By seeds.

Vegetative propagation:

Pests: Low, due to nut weevil (Chacko *et al.*, 2002).

Diseases: Negligible. Eight fungi are recorded. *Pestalotia* sp., *Phoma* sp., *Penicillium* spp. are the important fungi (Mohanan and Anil Chandran, 2001; Chacko *et al.*, 2002).

Medicinal properties: The roots are useful in regulating menstruation. The bark is aromatic, astringent, and are useful in dysentery, vomiting and muscular rheumatism. It is said to be a remedy for snake bite. The leaf extract is used to cure ear ache and the fruit relieves dyspepsia (Bose *et al.*, 1998). The extracts possess antibacterial activity against *Salmonella typhi*, *Salmonella paratyphi*, *Staphylococcus aureus*, *Escherichia coli*, *Klebsiella*

pneumoniae, *Proteus mirabilis*, *Pseudomonas* sp. and *Bacillus* sp. (Bibitha Babu *et al.*, 2002).

Uses: Fruits are edible and are used for pickles (Rai, 1999). Wood is suitable for light packing cases, splints and match boxes (Chacko *et al.*, 2002). The tree is extensively lopped for fodder. The tree yields a tasteless gum and the fruits are pickled.

Wood properties: Sapwood white or greyish white and narrow, heartwood, scarcely distinguishable from the sapwood. The wood is very soft and hard (Bose *et al.*, 1998). Wood greyish white, extremely soft and soon perishable. Pores large, numerous, often divided. Rays fine, white, at unequal distances, distinctly marked as long narrow plates in the silver-grain. Annual rings not seen (Bourdillon, 1908).

References:

- Bibitha Babu, Jisha, V.K., Salitha, C.V., Mohan, S., Valsa, A.K., Babu, B. 2002. Antibacterial activity of different plant extracts. *Indian Journal of Microbiology*. 42: 361-363.
- Bose, T.K., Das, P. and Maiti, G.G. 1998. *Trees of the world*, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 426-427.
- Bourdillon, T.F. 1908. *Forest trees of Travancore*. International Book Distributors, Dehradun. pp. 127.
- Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. *Manual of Seeds of Forest Trees, Bamboos and Rattans*. Kerala Forest Research Institute, Peechi, Kerala. pp. 210-211.
- Darshana Nand. 2000. Blossom biology of hog-plum (*Spondais pinnata* Kurz). *Journal of Applied Horticulture Lucknow*. 2: 34-36.
- FRI. 1981. *Troup's The Silviculture of Indian Trees*. Vol. III. The Controller of Publications, Delhi.
- Kumar, S.V. and Bhanja, M. 1992. *Forestry Seed Manual of Andhra Pradesh*. Andhra Pradesh Forest Department, Hyderabad, India.
- Mohanan, C. and Anil Chandran. 2001. Microorganisms associated with seeds of tropical forest species and their management for improving the storability and seedling production. *Seed Science and Technology* (in press).
- Rai, S.N. 1999. *Nursery and Planting Techniques of Forest Trees in Tropical South-Asia*. Eastern Press, Bangalore, India.
- Sasidharan, N. 2004. *Forest Trees of Kerala*. Kerala Forest Research Institute, Peechi, Kerala, India.
- Sen Gupta, J.N. 1937. Seed weights, plant percents, etc. for forest plants in India. *Indian Forest Records (New Series) Silviculture*, 2:221 pp. Manager of Publications, Delhi.

Sterculia urens

Nomenclature:

Scientific name: *Sterculia urens* Roxb.

Vernacular name: Thondi, Theethondi, Paravakka, Annanvazhukki (Malayalam), Kavalam (Tamil), Kullu (Hindi) (Chacko *et al.*, 2002).

Common name: Karaya

Synonyms:

Family: Sterculiaceae

Subfamily:

Origin:

Distribution: It is a native of tropical Himalayas and Southern India. It is found in various areas of central India. Widely distributed over northern, central and peninsular India, usually on stoney or rocky soils; also occurs in Myanmar and Sri Lanka (FRI, 1981). In Kerala, it occurs in moist and dry deciduous forests (Chacko *et al.*, 2002).

Description: A moderate to large sized, deciduous much branched tree reaching a height of 15 m and a breast height diameter of 48 cm. Bole is usually short (Bourdillon, 1908; FRI, 1981; Chacko *et al.*, 2002).

Flowering season: December to January (Bourdillon, 1908).

Fruiting season: April - May (Bourdillon, 1908), May to June (Sen Gupta, 1937; Chacko *et al.*, 2002).

Flowers: Greenish yellow, having unpleasent odour, a few bisexual flowers mixed with large number of male flowers.

Fruits: Follicle long, sessile, coriaceous, spreading, woody 2.5 to 3x2 cm size,

oblong, bright red, spreading in a star-like fashion, covered with stiff stinging bristles, open on the ventral suture, with seeds attached (Chacko *et al.*, 2002).

Fruit type: Follicle.



Twig with fruits



Seeds

Seeds: Seed oblong brown coloured 6 mm long and 3-6 in each follicle (Chacko *et al.*, 2002).

Seed dimension:

Seed length: 6 mm (Chacko *et al.*, 2002).

Seed width:

Seed thickness:

Seed weight: 5,291 (Sen Gupta, 1937; Chacko *et al.*, 2002) to 6,360 seeds/kg (FRI, 1981; Chacko *et al.*, 2002).

Seed dispersal:

Seed collection: Ripe fruits are collected from the tree when they start to dehisce. Seeds can also be collected from the ground soon after fall (Chacko *et al.*, 2002).

Transportation of seeds: Fruits collected in cotton/ plastic/ polythen bags are transported to the processing centre soon after collection (Chacko *et al.*, 2002).

Seed processing: Remove the aril and dry the seed under shade (Chacko *et al.*, 2002).

Seed storage: Recalcitrant (CABI, 1998). Seeds cannot be stored for more than a year (Luna, 1996; Chacko *et al.*, 2002).

Viability period: No information (Chacko *et al.*, 2002).

Seed emptiness: Low (Chacko *et al.*, 2002).

Seed pre treatment: Overnight soaking in ordinary water.

Germination type: No information (Chacko *et al.*, 2002).

Germination percentage: 77 (FRI, 1981; Chacko *et al.*, 2002). 88 (sown within few days of collection).

Germination period: 7 to 53 days (FRI, 1981; Chacko *et al.*, 2002).

Nursery technique: Seeds are sown in plastic trays containing vermiculite soon after collection and watered regularly. When germination is complete the seedlings are potted in polythene bags of 22.5 x 17.5 cm size filled with potting mixture. After 3 to 4 months of potting, the seedlings reach 15 to 20 cm height (Chacko *et al.*, 2002).

Propagation:

Method of propagation: By seeds or cuttings.

Vegetative propagation:

Pests: Low (Chacko *et al.*, 2002).

Diseases: Moderate (55%). Sixteen fungi and actinomycetes are recorded. *Nigrospora* sp., *Botrytis* sp., *Phoma* sp., *Cylindrocladium* sp., *Pestalotiopsis* sp., *Fusarium* sp., *Genicularia* sp., *Alternaria* sp., etc. are the important fungi (Mohan and Anil Chandran, 2001; Chacko *et al.*, 2002).

Medicinal properties: Gum is polysaccharide in nature and is used in throat infection and in dental fixture powders.

Uses: Bark yields fibre suitable for making ropes. Timber is used for making musical instruments, toys, light packing cases and low-grade pencils. The seeds are edible and are generally eaten after roasting (FRI, 1981; Chacko *et al.*, 2002).

Wood properties: The sapwood is greyish and the heartwood is reddish brown. The wood is moderately heavy with straight grain and coarse texture. Air dry weight is about 545 kg/m³. The wood is very soft, with a light coloured sapwood, and rays of moderate breadth (Bourdillon, 1908). Pores large, often oval and subdivided, very scanty, frequently filled with gum. Medullary rays moderately broad, on a radial section prominent as long, dark, undulating bands, giving the wood a mottled silver-grain; the distance between the rays is larger than the transverse diameter of the pores. Alternate dark and light concentric bands across the rays (Gamble, 1922).

References:

Bourdillon, T.F. 1908. Forest trees of Travancore. International Book Distributors, Dehradun. pp. 49.

CABI. 1998. The Forestry Compendium – A Silvicultural Reference. Module 1. CABI Publishing, CAB International, Wallingford, Oxon, OX108DE, UK.

Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 212-213.

FRI. 1981. Troup's The Silviculture of Indian Trees. Vol. III. The Controller of Publications, Delhi.

Gamble, J.S. 1922. A manual of Indian timbers. London Sampson Low, Marton and Company Ltd, Calcutta, India.

Luna, R.K. 1996. Plantation Trees. International Book Distributors, Dehra Dun, India.

Mohanan, C. and Anil Chandran. 2001. Microorganisms associated with seeds of tropical forest species and their management for improving the storability and seedling production. Seed Science and Technology (in press).

Sen Gupta, J.N. 1937. Seed weights, plant percents, etc. for forest plants in India. Indian Forest Records (New Series) Silviculture, 2:221 pp. Manager of Publications, Delhi.

Stereospermum chelonoides

Nomenclature:

Scientific name: *Stereospermum chelonoides* (Roxb.) Benth.

Vernacular name: Padiri, Kariyam, Vedankorna (Malayalam), Padal, Pandri (Hindi)

Common name:

Synonyms: *Bignonia suaveolens* Roxb., *Bignonia chelonoides* L.f., *Stereospermum suaveolens* DC. (Sasidharan, 2004).

Family: Bignoniaceae

Subfamily:

Origin:

Distribution: The tree is found throughout the greater parts of India in mixed deciduous and sal forests. It occurs also in Chota Nagpur, Central India and in many other parts of Indian Peninsula.

Description: A large deciduous tree (Bourdillon, 1908).

Flowering season: March to May (Bourdillon, 1908).

Fruiting season: March to May, November to January (Bourdillon, 1908).

Flowers: Flowers fragrant, in large, lax, trichotomous viscid panicles; corolla dull-crimson, yellow within, 2.5-3 cm long, funnel-shaped; limb oblique, 3 anterior lobes longer and the edges of all curled (Bose et al., 1998).

Fruits: Long cylindrical two valved capsule, dark grey with raised white specks.

Fruit type: Capsule.

Seeds: Seed is pale yellowish brown and consists of a central bony axis with a pair of light delicate papery wings.

Seed dimension:

Seed length:

Seed width:

Seed thickness:

Seed weight:

Seed dispersal: By wind

Seed collection:

Transportation of seeds:

Seed processing:

Seed storage:

Viability period:

Seed emptiness:

Seed pre treatment:

Germination type: Epigeal

Germination percentage:

Germination period:

Nursery technique:

Propagation:

Method of propagation:

Vegetative propagation:

Pests:

Diseases:

Medicinal properties: The roots, leaves and flowers are used in native medicine. The flowers are acrid with a flavour, useful in Kapha and vata, bilious diarrhoea, burning sensations. The root bark is an ingredient in dasamula.

Uses: The leaves are good fodder. Wood is employed for construction work, carriages, wagons, furniture and tool handles

Wood properties: Wood hard with a small yellowish brown handsomely mottled heartwood. Seasons and polishes well. Pores moderate-sized. Rays fine (Bourdillon, 1908).

References:

Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 433.

Bourdillon, T.F. 1908. Forest trees of Travancore. International Book Distributors, Dehradun.

Sasidharan, N. 2004. Forest Trees of Kerala. Kerala Forest Research Institute, Peechi, Kerala, India.

Troup, R. S. 1921. The Silviculture of Indian Trees. (Vol II) International Book Distributors, Dehra Dun.

Strychnos nux-vomica

Nomenclature:

Scientific name: *Strychnos nux-vomica*
Linn.

Vernacular name: Kanjiram (Malayalam) (Sasidharan, 2004), Yetti, Eddi, Kanchurai (Tamil), Kanjira (Kannada), Bailewa, Chibbinge (Chacko *et al.*, 2002), Kuchla, (Hindi) (Bose *et al.*, 1998).

Common name: Strychnine tree, Poison nut (Bose *et al.*, 1998), Nux-vomica, Snake wood tree, Crow-fig (Chacko *et al.*, 2002).

Synonyms:

Family: Loganiaceae

Subfamily:

Origin:

Distribution: Indigenous to India but growing in China and Australia. It is also distributed in Myanmar and Sri Lanka (Bose *et al.*, 1998). Occurs throughout India. In Kerala, it grows in the moist and dry deciduous forests up to 300 m (Chacko *et al.*, 2002).

Description: A moderate sized or large handsome evergreen or deciduous tree up to 25 m high; and a breast height diameter of 108 cm, trunk short and thick (Bourdillon, 1908; Bose *et al.*, 1998; Chacko *et al.*, 2002).

Flowering season: March-May (Bourdillon, 1908), February to April (Bose *et al.*, 1998).

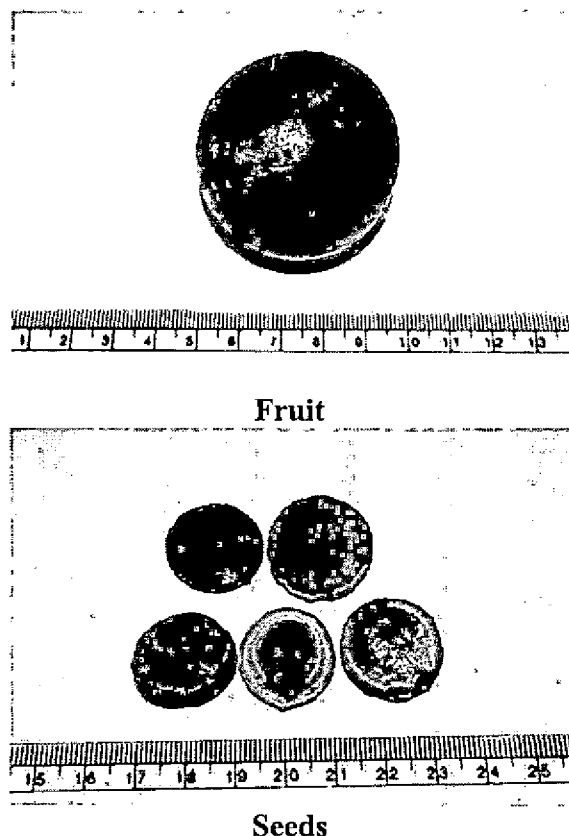
Fruiting season: Ripen in cold and hot season from December to June, November to March (Bourdillon, 1908). December to June (Sen Gupta, 1937; Kumar and Bhanja, 1992; Chacko *et al.*, 2002).

Flowers: Small greenish white, fragrant, about 1.2 cm long, strongly scented in terminal pedunculate compound cymes; calyx lobes acute; petals 5, joined for most of their length to form a slender tube; stamens included; style projects beyond the mouth of corolla (Bose *et al.*, 1998).

Fruits: Berry globose, large, shining, up to 6 cm across about the size and colour of a small orange, with a rather hard coriaceous pericarp and a bitter white pulp (Bose *et al.*, 1998).

Fruit type: Berry.

Seeds: Seeds are poisonous, discoid, compressed, ash grey, with concave and convex sides covered with very fine and pressed silky hairs (FRI, 1985; Bose *et al.*, 1998; Chacko *et al.*, 2002).



Seed dimension:**Seed length:****Seed width:** 2 cm (FRI, 1985).**Seed thickness:** 2.5 mm (FRI, 1985).**Seed weight:** 600 to 846 seeds/kg (FRI, 1985; Chacko *et al.*, 2002).**Seed dispersal:****Seed collection:** Fruits are collected from the tree by shaking the branches or from the ground (Chacko *et al.*, 2002).**Transportation of seeds:** Fruits are transported in jute/ polythene bags. It is better to avoid the cotton bags as the fruit is pulpy and gummy (Chacko *et al.*, 2002).**Seed processing:** The pulp of the fruit is washed or rotted off and the seeds are sun-dried on mats. The seeds are then sorted; the floaters rejected (FRI, 1985; Chacko *et al.*, 2002).**Seed storage:** Orthodox. Seeds are stored in gunny bags for one year or even longer periods (Dent, 1948; Chacko *et al.*, 2002).**Viability period:** Seeds retain viability up to one year in gunny bags (Chacko *et al.*, 2002).**Seed emptiness:** Low (Chacko *et al.*, 2002).**Seed pre treatment:** Mild boiled water treatment and soaking in cold water for 48 hrs; or keeping the seeds in cowdung slurry for 24 hrs (Kumar and Bhanja, 1992; Chacko *et al.*, 2002).**Germination type:** Epigeal (Chacko *et al.*, 2002).**Germination percentage:** 13 to 52 (Chacko *et al.*, 2002).**Germination period:** 45 to 120 days (Chacko *et al.*, 2002).**Nursery technique:** Pretreated seeds are sown in germination trays containing vermiculite and watered. Seed germinates after 45 days. Shoot growth is very slow and the root growth is very fast (Kumar and Bhanja, 1992; Chacko *et al.*, 2002).**Propagation:****Method of propagation:** By seeds.**Vegetative propagation:****Pests:** Low (Chacko *et al.*, 2002).**Diseases:** Nine fungi and a bacterium are recorded. Except *Fusarium* sp., all are storage moulds. *Aspergillus candidus*, *A. niger*, *A. flavus*, *A. restrictus* are the important storage fungi recorded on seeds (Mohanan and Anil Chandran, 2001; Chacko *et al.*, 2002).**Medicinal properties:** Leaves and root bark contain brucine, strychnine and vomocine. It is highly toxic to man and animal, producing stiffness of muscles and convulsions. Leaves are applied as a poultice on sloughing wounds and maggot infested ulcers. Decoction of bark is used in epilepsy. Juice of fresh wood is used in fever, cholera, dysentery and dyspepsia. Nux-vomica possesses intensely and persistently bitter taste; used as a tonic, stimulant and febrifuge, also used in the preparation for the remedy of nervous disorders (Bose *et al.*, 1998). It is traditionally used by tribals of the Maruthamalai hills, Coimbatore District, Tamil Nadu and possesses activity against *Aeromonas hydrophila*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Staphylococcus aureus* and *Salmonella typhi* (Senthilkumaret *et al.*, 2005).

Uses: The wood is not attacked by termites and is used in ploughs, axe handles etc. Seeds are the *Nux vomica* of commerce and yields the alkaloids strychnine and brucine. The wood is used locally for axe and hammer handles, agricultural implements and for ornamental panels. The seeds yield alkaloids, which are used in medicine (Chacko *et al.*, 2002).

Wood properties: Wood is creamy white or yellowish grey, often with reddish brown

lines, smooth, close-grained and durable, but liable to crack marked by numerous strands of included phloem, without any distinct heartwood. No heart-wood nor annual rings. Pores are large and scanty, mixed with others very small and numerous running in radial lines and clusters. Rays white, very conspicuous, fairly broad, crossed by wavy bands of darker tissue (Bourdillon, 1908).

References:

- Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 435.
- Bourdillon, T.F. 1908. Forest trees of Travancore. International Book Distributors, Dehradun. pp. 269-270.
- Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 214-215.
- Dent, T.V. 1948. Seed storage with particular reference to the storage of seed of Indian forest plants. Indian Forest Records (New Series) Silviculture, 7: 134 pp. Manager of Publications, Delhi.
- FRI. 1985. Troup's The Silviculture of Indian Trees. Vol. VI. The Controller of Publications, Delhi.
- Kumar, S.V. and Bhanja, M. 1992. Forestry Seed Manual of Andhra Pradesh. Andhra Pradesh Forest Department, Hyderabad, India.
- Mohanan, C. and Anil Chandran. 2001. Microorganisms associated with seeds of tropical forest species and their management for improving the storability and seedling production. Seed Science and Technology (in press).
- Sasidharan, N. 2004. Forest Trees of Kerala. Kerala Forest Research Institute, Peechi, Kerala, India.
- Sen Gupta, J.N. 1937. Seed weights, plant percents, etc. for forest plants in India. Indian Forest Records (New Series) Silviculture, 2:221 pp. Manager of Publications, Delhi.

Senthilkumar, M., Gurumoorthi, P. and Janardhanan, K. 2005. Antibacterial potential of some plants used by tribals in Maruthamalai hills, Tamil Nadu. New Delhi, India: National Institute of Science Communication and Information Resources.

Strychnos potatorum

Nomenclature:

Scientific name: *Strychnos potatorum*
Linn. f.

Vernacular name: Nirmali (Hindi),
Tettran (Bose *et al.*, 1998), Tettancottia
(Tamil), Tettamaram, Thettanparil
kanjiram (Malayalam).

Common name: Clearing nut tree (Bose
et al., 1998).

Synonyms:

Family: Loganiaceae

Subfamily:

Origin:

Distribution: Within India it is found in the
Central, Eastern and Peninsular regions of
the country. Found also in Central and
Western India, Sri Lanka and Myanmar
(Bourdillon, 1908).

Description: A small to moderate sized
deciduous or evergreen tree up to 15 m high;
trunk often fluted (Bose *et al.*, 1998).

Flowering season: February to March.
February to April (Bourdillon, 1908; Bose *et al.*, 1998).

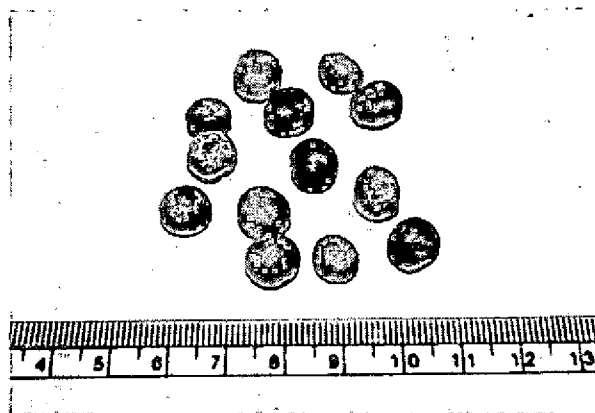
Fruiting season: November to March
(Bourdillon, 1908). Fruits remain on the tree
for several months (Bose *et al.*, 1998).

Flowers: Small, white, fragrant, in axillary
cymes; corolla tube 3-5 mm, hardly twice as
long as broad, hairy within, nearly glabrous
in the throat; anther cells oblong, glabrous;
stigma small, capitate (Bose *et al.*, 1998).

Fruits: Berries edible, sub globose black
when ripe, up to 1.7 cm in diameter,
containing 1 or 2 pale yellow, circular,

compressed seeds immersed in white pulp
(Bourdillon, 1908; Bose *et al.*, 1998).

Fruit type: Berry.



Seeds

Seeds: Seeds not poisonous one or two,
circular, 6-8 mm in diameter, sub-peltate,
hardly discoid with whitish pulp (Bose *et al.*, 1998).

Seed dimension:

Seed length:

Seed width:

Seed thickness:

Seed weight: 1,660 seeds/kg.

Seed dispersal:

Seed collection: Ripe fruits are collected
from the trees during April to May, and the
seeds extracted, cleaned and stored
(Edwards and Naithani, 1999).

Transportation of seeds:

Seed processing:

Seed storage:

Viability period:

Seed emptiness:

Seed pre treatment: Mild boiled water treatment and soaking in water for 48 hrs.

Germination type:

Germination percentage:

Germination period:

Nursery technique: Seeds are put in polybags and continuously watered. The shoot comes up with the cotyledons just like a round cap. The root growth is very fast compared to the shoot growth and so a longer polythene bag is required for raising the seedlings (Edwards and Naithani, 1999).

Propagation:

Method of propagation: By seeds.

Vegetative propagation:

Pests:

Diseases:

References:

Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 435.

Bourdillon, T.F. 1908. Forest trees of Travancore. International Book Distributors, Dehradun. pp. 270.

Edwards, D.G. and Naithani, S.C. 1999. Seed and Nursery Technology of forest trees. New Age, New Delhi.

Medicinal properties: The seeds yield alkaloids, which are used in medicine. The powdered bark is useful in cholera. The seeds possess tonic, stomachic, demulcent and emetic properties and are used in acute diarrhoea, diabetes, gonorrhoea etc. They are used in the treatment of eye diseases, particularly conjunctivitis, in the treatment of dysentery and bronchitis (Bose *et al.*, 1998).

Uses: Used for carts, shaft, agricultural implements, etc. The ripe seeds are used for clearing muddy water and reported to be very effective as a coagulant aid (Bose *et al.*, 1998).

Wood properties: The wood is white when fresh, turning yellow grey on exposure, without any distinct heartwood. It is a hard and heavy wood with medium coarse texture. It is a diffuse porous wood with growth rings delimited by fine lines of soft tissues. Pores some few and large, others very small and numerous, arranged in lines or patches. Rays numerous, white, fine and moderately broad (Bourdillon, 1908).

Swietenia macrophylla

Nomenclature:

Scientific name: *Swietenia macrophylla*
King

Vernacular name: Valia Mahogany,
Mahogany (Malayalam), Mahogany
(Tamil) (Chacko *et al.*, 2002).

Common name: Honduras mahogany,
Large - leaved Mahogany (Chacko *et al.*,
2002).

Synonyms: *Swietenia belizensis* Lundell,
S. candollei Pittier, *S. krukovii* Gleason,
S. tessmanii Harms (Chacko *et al.*, 2002).

Family: Meliaceae

Subfamily:

Origin:

Distribution: The tree is a native to Mexico and South America and it was introduced in India from Honduras in 1872. In India, it is found in W.Bengal, Orissa, Maharashtra, Bihar. It is also grown in most tropical countries for the showy appearance and hard wood of good quality but less valuable than Spanish mahogany (FRI, 1981; Chacko *et al.*, 2002).

Description: Moderately fast growing very large deciduous tree, attaining a height of 40 m and a breast height diameter of 127 cm with stout branches (Chacko *et al.*, 2002).

Flowering season: April to May (Bose *et al.*, 1998).

Fruiting season: December - January, September to October (Bose *et al.*, 1998). February to April (FRI, 1981; Chacko *et al.*, 2002).

Flowers: Inconspicuous white flowers in small open clusters. Flowers greenish white,

about 8 mm across, in axillary paniculate cymes; petals oblong; staminal tube whitish; disc bright red (Bose *et al.*, 1998).

Fruits: Fruit is a woody capsule ovoid - oblong, up to 15 cm long, erect (Bose *et al.*, 1998; Chacko *et al.*, 2002).

Fruit type: Capsule.



Twig with fruit



Seeds

Seeds: Flat winged brown seeds are arranged on the central axis of the bulbous capsule (Chacko *et al.*, 2002).

Seed dimension:

Seed length: 8.3 cm (Chacko *et al.*, 2002).

Seed width: 2.5 cm (Chacko *et al.*, 2002).

Seed thickness:

Seed weight: 1,600 to 2,300 seeds/kg (Mayhew and Newton, 1998; Chacko *et al.*, 2002).

Seed dispersal:

Seed collection: Mature fruits turning grey grain to brown are collected from the trees before they dehisce (Tompsett and Kemp, 1996; Mayhew and Newton, 1998; Chacko *et al.*, 2002).

Transportation of seeds: Capsules are dehisced and seeds are transported in closed containers maintained cool above 2°C. Moist material should be ventilated (Tompsett and Kemp, 1996; Chacko *et al.*, 2002).

Seed processing: The fruits are sun dried until they open and the seeds are extracted by hand (FRI, 1981; Chacko *et al.*, 2002).

Seed storage: Orthodox (Tompsett and Kemp, 1996); Intermediate (Kindt *et al.*, 1997; Hong and Ellis, 1998; Chacko *et al.*, 2002). Seeds possess intermediate seed storage behaviour - the viability of seeds could be maintained for >2 years in the polyethylene bags at 10°C (Pukittayacamee *et al.*, 1995).

Viability period: Under normal conditions, It is viable up to 3 months (Mayhew and Newton, 1998; Chacko *et al.*, 2002).

Seed emptiness: Low (Chacko *et al.*, 2002).

Seed pre treatment: No pretreatment is required. De-winging before sowing is beneficial (Chacko *et al.*, 2002).

Germination type: Hypogeal (FRI, 1981; Chacko *et al.*, 2002).

Germination percentage: 90 (Luna, 1996; Chacko *et al.*, 2002) to 95 (Mayhew and Newton, 1998; Chacko *et al.*, 2002).

Germination period: 10 (Sen Gupta, 1937; FRI, 1981) to 112 days (Mayhew and Newton, 1998; Chacko *et al.*, 2002).

Nursery technique: Seeds are sown horizontally to a depth of 2 cm in germination trays containing vermiculite. The seedlings are transferred when they attain a height of 15 cm to polythene bags of 22.5 x 17.5 cm size filled with soil or root trainers. The seedlings are ready for planting 3 months after potting (Abdul Kader *et al.*, 2001; Chacko *et al.*, 2002).

Propagation:

Method of propagation: By seeds.

Vegetative propagation:

Pests: Low infestation by an unidentified caterpillar in fallen fruits. The shoot and fruit borer, *Hypsipyla robusta* Moore is a serious pest of fruits also (Beeson, 1941; Chacko *et al.*, 2002).

Diseases: Low to high (6.5 to 99.5%). Thirty two fungi belonging to 24 genera, bacteria and actinomycetes are recorded on seeds. *Aspergillus* spp. are the important storage moulds. Species of *Helminthosporium*, *Alternaria*, *Drechslera* and *Curvularia* are the important field fungi recorded on seeds (Chacko *et al.*, 2001).

Uses: Wood is favoured for high-value of furniture and interior fittings. The seed oil is considered to be useful for moderate

drying oil and for soapmaking. It is also grown as an ornamental tree for the showy appearance (Bose *et al.*, 1998).

Wood properties: Wood light, moderately hard. Pores small, scanty. Paler in colour

than that of Mahogany. Not as good too. Medullary rays fine, the distance between them about equal to the diameter of the pores. Occasional concentric bands of light tissue, some of which may be annual rings (Gamble, 1922).

References:

- Abdul Kader, S., Seethalakshmi, K.K. and Chacko, K.C. 2001. Rapid viability tests for fresh and stored seeds of mahogany (*Swietenia macrophylla*, King). In: Kris Connor, Tannis Beardmore, Enrique L. Tolentino, Jr. and Wilfredo M. Carandang (eds.). Proceedings of the IUFRO Joint Symposium on Tree Seed Technology, Physiology and Tropical Silviculture. TREES, College of Forestry and Natural Resources, University of the Philippines Los Banos, Philippines April 30 – May 03, 2001. pp. 46-53.
- Beeson, C.F.C. 1941. The Ecology and Control of the Forest Insects of India and the Neighbouring Countries. Govt of India, New Delhi.
- Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 436.
- Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 216-217.
- FRI. 1981. Troup's The Silviculture of Indian Trees. Vol. III. The Controller of Publications, Delhi.
- Gamble, J.S. 1922. A manual of Indian timbers. London Sampson Low, Marton and Company Ltd, Calcutta, India.
- Hong, T.D. and Ellis, R.H. 1998. Contrasting seed storage behaviour among different species of Meliaceae. Seed Science and Technology, 26: 77-95.
- Kindt, R., Mausya, S., Kimotho, J. and Waruhiu. 1997. Tree seed suppliers Directory: Sources of Seeds and Microsymbionts. International Centre for Research in Agro Forestry (ICRAF), Nairobi, Kenya.
- Luna, R.K. 1996. Plantation Trees. International Book Distributors, Dehra Dun, India.
- Mayhew, J.E. and Newton, A.C. 1998. The Silviculture of Mahogany. Commonwealth Agriculture Bureau International, UK.
- Pukittayacamee, P., Saelim, S. and Bhodthipuks, J. 1995. Seed storage of Swietenia macrophylla. Technical Publication – ASEAN Forest Tree Seed Centre Project. 25: 11.
- Sen Gupta, J.N. 1937. Seed weights, plant percents, etc. for forest plants in India. Indian Forest Records (New Series) Silviculture, 2:221 pp. Manager of Publications, Delhi.

Tompsett, P.B. and Kemp, R. 1996. Database of Tropical Tree Seed Research with Special Reference to Dipterocarpaceae, Meliaceae and Araucariaceae. Royal Botanic Garden, Kew, U.K.

Swietenia mahagoni

Nomenclature:

Scientific name: *Swietenia mahagoni* (Linn.) Jacq.

Vernacular name: Mahagani, Cheriamahogony (Malayalam), Cimainukku Mahogany (Tamil) (Chacko *et al.*, 2002), Mahagony (Bengali)

Common name: Spanish mahogany, Small-leaved mahogany (Chacko *et al.*, 2002).

Synonyms: *Cedrus mahagoni* L. (Chacko *et al.*, 2002).

Family: Meliaceae

Subfamily:

Origin: West Indies.

Distribution: Native to West Indies. The mahogany indigenous in Jamaica and Central America. It is now grown in almost all tropical countries of the world because of its magnificent appearance and very valuable timber (Bose *et al.*, 1998).

Description: Moderately fast growing, medium sized to large evergreen tree with stout trunk and uniformly spreading crown, attaining a height of 30 m and a breast height diameter of 143 cm (Chacko *et al.*, 2002).

Flowering season: February to May; April to May (Bose *et al.*, 1998).

Fruiting season: October to December (FRI, 1981; Chacko *et al.*, 2002); August to October (Bose *et al.*, 1998).

Flowers: Greenish yellow, in axillary pendulous panicles, quite glabrous. Petals 5, obovate-oblong, spreading; stamens form a

tube with 10 teeth above, arising from a small disc (Bose *et al.*, 1998).

Fruits: Fruit is a woody capsule, five valved (Chacko *et al.*, 2002) 7-9 cm in diameter (Bose *et al.*, 1998).

Fruit type: Capsule.

Seeds: Seeds many, flat, winged and arranged on the central axis (Chacko *et al.*, 2002).

Seed dimension:

Seed length: 5.4 cm (FRI, 1981).

Seed width: 1.5 cm (FRI, 1981).

Seed thickness:

Seed weight: 3,527 seeds/kg (with wings) (Sen Gupta, 1937) to 9,100 seeds/kg (Tompsett and Kemp, 1996; Chacko *et al.*, 2002).

Seed dispersal:

Seed collection: The capsules are collected from trees just before they start to dehisce. The fruits and seeds can also be collected from the ground soon after fall (FRI, 1981; Chacko *et al.*, 2002).

Transportation of seeds: The capsules or seeds are transported in closed containers. Moist material should be ventilated (Tompsett and Kemp, 1996; Chacko *et al.*, 2002).

Seed processing: Capsules are sun dried and the seeds are taken out when the capsules open (FRI, 1981; Chacko *et al.*, 2002).

Seed storage: Orthodox (Tompsett and Kemp, 1996). Seeds dried in the sun and stored in an airtight tin will remain fairly

viable for over six months (Brandis, 1971). Dried seeds (4% MC or lower) should be retained in hermetic storage at 2°C. For long-term storage, lower moisture contents (down to 2%) and very low temperatures (-13°C or less) are desirable (Tompsett and Kemp, 1996). When stored in open baskets, the viability loses rapidly after six months (Dent, 1948; Chacko *et al.*, 2002).

Viability period: Under normal conditions, seeds are viable up to 6 months (FRI, 1981; Chacko *et al.*, 2002).

Seed emptiness: Low (Chacko *et al.*, 2002).

Seed pre treatment: No pretreatment other than de-winging is required (Chacko *et al.*, 2002).

Germination type: Hypogeal (Chacko *et al.*, 2002).

Germination percentage: 86 (Chacko *et al.*, 2002).

Germination period: 14 to 28 days (Chacko *et al.*, 2002).

Nursery technique: Seeds are sown horizontally to a depth of 2 cm in germination trays containing vermiculite. Germination commences within 14 days of sowing and continues for about 32 days. The seedlings are transferred to polybags of 22.5 x 17.5 cm or root trainers filled with potting mixture, when they attain a 15 cm height. The seedlings are ready for planting after 3 months of potting (Chacko *et al.*, 2002).

Propagation:

Method of propagation:

Vegetative propagation:

Pests: Infestation by unidentified caterpillar is noticed in fallen fruits. Shoot and fruit borer, *Hypsipyla robusta* is a serious pest of fruits (Beeson, 1941; Chacko *et al.*, 2002).

Diseases: Spermoplane microorganisms recorded include 23 fungi and a bacterium. Species of *Aspergillus*, *Penicillium*, *Chaetomium*, *Cladosporium* are the important storage moulds. *Botryodiplodia theobromae*, *Rhizoctonia* sp., *Drechslera* sp., *Fusarium* sp., are the important field fungi (Chacko *et al.*, 2001; Chacko *et al.*, 2002).

Medicinal properties: The bark contains tannin and may serve as an antipyretic, tonic and astringent. The bark of the tree is used as an astringent and as a substitute for cinchona (Bose *et al.*, 1998).

Uses: Wood is used extensively for furniture and also used for ship building. Also, it is a common tree in gardens and on road sides (Bose *et al.*, 1998).

Wood properties: Wood is hard, reddish brown, season and works well. Annual rings marked by a continuous line of pores with few or no pores in the autumn wood. Pores moderate sized, scanty, uniformly distributed, often subdivided, sometimes filled with resin. Medullary rays very short, very numerous, moderately broad, uniform and equidistant, giving a handsome silver grain (Gamble, 1922).

References:

Beeson, C.F.C. 1941. The Ecology and Control of the Forest Insects of India and the Neighbouring Countries. Govt of India, New Delhi.

Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 436, 441.

Brandis, D. 1971. Indian Trees. (reprint edition) Bishen Singh Mahendra Pal Singh, Dehra Dun, India.

Chacko, K.C., Mohanan, C., Seethalakshmi, K.K. and George Mathew. 2001. Seed handling and nursery practices for selected forest trees of Kerala. Final Technical Report of ICFRE – World Bank Forestry Research Education and Extension Project. Kerala Forest Research Institute, Peechi.

Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 218-219.

Dent, T.V. 1948. Seed storage with particular reference to the storage of seed of Indian forest plants. Indian Forest Records (New Series) Silviculture, 7: 134 pp. Manager of Publications, Delhi.

FRI. 1981. Troup's The Silviculture of Indian Trees. Vol. III. The Controller of Publications, Delhi.

Gamble, J.S. 1922. A manual of Indian timbers. London Sampson Low, Marton and Company Ltd, Calcutta, India.

Sen Gupta, J.N. 1937. Seed weights, plant percents, etc. for forest plants in India. Indian Forest Records (New Series) Silviculture, 2:221 pp. Manager of Publications, Delhi.

Tompsett, P.B. and Kemp, R. 1996. Database of Tropical Tree Seed Research with Special Reference to Dipterocarpaceae, Meliaceae and Araucariaceae. Royal Botanic Garden, Kew, U.K.

Syzygium cumini

Nomenclature:

Scientific name: *Syzygium cumini* (L.) Skeels

Vernacular name: Njaval, Njara (Malayalam) (Sasidharan, 2004), Naval, Neredamm (Tamil), Jamun (Bose *et al.*, 1998), Jaman, Jam (Hindi), (Chacko *et al.*, 2002). Kalajam (Bengali), Neredu (Telugu).

Common name: Black plum, Jamun (Chacko *et al.*, 2002), Skeels, Malabar plum, Indian black berry (Bose *et al.*, 1998).

Synonyms: *Eugenia jambolana* Lam., *E. cumini* Druce. (Bose *et al.*, 1998), *Myrtus cumini* L., *Syzygium jambolanum* (Lamk.) DC. (Sasidharan, 2004).

Family: Myrtaceae

Subfamily:

Origin:

Distribution: Widely distributed in tropical and subtropical parts of India and Sri Lanka; Malaysia; Malay archipelago; Myanmar, Thailand, also found in Australia, Philippines. Introduced in West Indies, Florida, California, East and West Africa and Israel. Occurs throughout India, including Andamans and other Union Territories. In Kerala, it is found in evergreen and semi evergreen forests, also in sacred groves up to 1800 m (Bose *et al.*, 1998; Chacko *et al.*, 2002).

Description: A large, evergreen tree, 25 m high, beautiful, dense, well-formed canopy (Bose *et al.*, 1998).

Flowering season: April to May (Bose *et al.*, 1998).

Fruiting season: May to August (Sen Gupta, 1937; Chacko *et al.*, 2002). Fruits ripen between June and August (Bose *et al.*, 1998).

Flowers: Flowers whitish or greenish white, 6-8 mm across, fragrant, crowded, in short racemes arising below the leaves; calyx tube turbinate; petals calyptrate; stamens many (Bose *et al.*, 1998).

Fruits: Fruit is an oblong, ovoid, juicy berry or drupe of 2-3 cm long, deep purple or almost black when fully ripe, pulp acidic or sweet, depending on the type and cultivar, purple or pink in colour (Bose *et al.*, 1998; Chacko *et al.*, 2002).

Fruit type: Berry.



Branch with flowers and fruits

Seeds: One seeded. Large sized seeds perform better in terms of germination and growth of seedlings (Ponnamma *et al.*, 1992).

Seed dimension:

Seed length:

Seed width:

Seed thickness:

Seed weight: 1,129 -1,210 seeds/kg; 3,880 fruits/kg (Sen Gupta, 1937); 1,100 to 1,300 seeds/kg (Kumar and Bhanja, 1992); 1,800 seeds/kg (FRI, 1984; Chacko *et al.*, 2002).

Seed dispersal: Birds.

Seed collection: The fruits are collected from the ground immediately after they have fallen (FRI, 1984). However, it is best to collect the ripe fruits, which are black in colour from the tree by shaking the branches (Chacko *et al.*, 2002).

Transportation of seeds: Fruits collected in cotton or polythene bags are transported as quickly as possible since seeds are susceptible to fungal attack and has a very poor viability (Chacko *et al.*, 2002).

Seed processing: Immediately after collection, the pulp is removed by rubbing with hand, washed and dried under shade before sowing (Chacko *et al.*, 2002).

Seed storage: Recalcitrant (Hong and Ellis, 1996; Srimathi *et al.*, 2003; Mazhar Abbas *et al.*, 2003). The seeds lose their viability on storage and hence storage is not recommended (Dent, 1948); the seeds stored for three weeks have a very low germination (FRI, 1984; Chacko *et al.*, 2002). Seeds lose viability within 5 days after shedding from trees, with a high initial moisture content (52% fresh weight basis), remain viable when stored at low temperatures (5-8°C) (Patil *et al.*, 1997). Seeds are stored mixed with sand in the ratio 1: 4 and moistened up to 2% with water in polythene bags at 10°C (Srimathi *et al.*, 2001). Critical moisture for safer storage of Jamum seed is 45-50% (Srimathi *et al.*, 2003).

Viability period: Under natural conditions, seed loses viability within 15 days (Rai, 1999; Chacko *et al.*, 2002).

Seed emptiness: Low (Chacko *et al.*, 2002).

Seed pre treatment: Except de-pulping, no other treatment is needed (Chacko *et al.*, 2002). Washing seeds with water after one day fermentation (Srimathi *et al.*, 2003).

Germination type: Hypogeal (FRI, 1984; Chacko *et al.*, 2002).

Germination percentage: Up to 90 (Chacko *et al.*, 2002).

Germination period: 12 to 98 days (Sen Gupta, 1937; Chacko *et al.*, 2002).

Nursery technique: Fresh seeds are sown in germination trays containing vermiculite and watered regularly. The seedlings are pricked out within 50 days to polythene bags of size 22.5 x 17.5 cm filled with soil based potting mixture and maintained under shade till the seedlings established (Rai, 1999). The seedlings can be retained in polythene bags for about 2 years (FRI, 1984; Chacko *et al.*, 2002).

Propagation:

Method of propagation: Seeds, grafting, patch budding (Singh *et al.*, 2004).

Vegetative propagation:

Pests: Low. Infestation is due to an unidentified caterpillar, which feeds on the fleshy pericarp often boring into the seed. A weevil, *Sitophilus rugicollis* has been reported to bore in seeds (Beeson, 1941; Chacko *et al.*, 2002).

Diseases: Species of *Trichoderma*, *Aspergillus*, *Mucor*, *Cladosporium* are the storage moulds and *Drechslera* sp. and *Botryodiplodia theobromae* are recorded on seeds (Chacko *et al.*, 2002).

Medicinal properties: The leaves are antibacterial and are used for strengthening the teeth. The fresh bark juice mixed with milk is used in diarrhoea. The bark is an

astringent and remedy for sore throats, bronchitis, asthma, dysentery and several other diseases. The fruit is considered as a tonic and used to strengthen teeth and gum. The seeds are good for diabetes (Bose *et al.*, 1998). The water and methanolic extracts of seeds possess antibacterial and antifungal activity (Chandrasekaran and Venkatesalu, 2004).

Uses: Wood is extensively used for post, beams, door frames and panels. The fruit is

edible (Chacko *et al.*, 2002), used for the manufacture of squashes, juices and jellies. The bark is used for tanning and dyeing.

Wood properties: A strong, hard, durable wood. Pale reddish or brownish grey without any distinct heartwood, though the central portion of the log is usually comparatively darker in colour. Suited for light constructional work and for internal fittings.

References:

- Beeson, C.F.C. 1941. The Ecology and Control of the Forest Insects of India and the Neighbouring Countries. Govt of India, New Delhi.
- Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 444, 449.
- Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 220-221.
- Chandrasekaran, M. and Venkatesalu, V. 2004. Antibacterial and antifungal activity of Syzygium jambolanum seeds. Journal of Ethnopharmacology. 91(1): 105-108.
- Dent, T.V. 1948. Seed storage with particular reference to the storage of seed of Indian forest plants. Indian Forest Records (New Series) Silviculture, 7: 134 pp. Manager of Publications, Delhi.
- FRI. 1984. Troup's The Silviculture of Indian Trees. Vol. V. The Controller of Publications, Delhi.
- Hong, T.D. and Ellis, R.H. 1996. A protocol to Determine Seed Storage Behaviour. IPGRI, Italy.
- Kumar, S.V. and Bhanja, M. 1992. Forestry Seed Manual of Andhra Pradesh. Andhra Pradesh Forest Department, Hyderabad, India.
- Mazhar Abbas, Khan, M.M., Iqbal, M.J. and Fatima, B. 2003. Studies on Jaman (*Syzygium cumini*.L. skeels) seed storage behavior. Pakistan Journal of Agricultural Sciences. 40(3/4):164-169.
- Patil, V.S., Halesh, G.K. and Janardhan, K.V. 1997. Recalcitrant behaviour of Jamun seeds. Plant Physiology and Biochemistry, New Delhi. 24: 106-107.

- Ponnammal, N.R., Antony, K.A. and Arjunan, M.C. 1992. Seed polymorphism, seed germination and seedling biomass in *Syzygium cumini* (L.) Skeels. *Journal of Tropical Forestry*. 8: 155-159.
- Rai, S.N. 1999. *Nursery and Planting Techniques of Forest Trees in Tropical South-Asia*. Eastern Press, Bangalore, India.
- Sasidharan, N. 2004. *Forest Trees of Kerala*. Kerala Forest Research Institute, Peechi, Kerala, India.
- Sen Gupta, J.N. 1937. Seed weights, plant percents, etc. for forest plants in India. *Indian Forest Records (New Series) Silviculture*, 2:221 pp. Manager of Publications, Delhi.
- Singh, V.K., Anand Singh and Singh, I.S. 2004. Vegetative propagation of Jamun (*Syzygium cumini* Skeels). *Advances in Plant Science*. 17 (1): 271-273.
- Srimathi,P., Malarkodi, K. and Karivaradaraaju, T.V. 2001. Storage media and temperature on storability of recalcitrant jamun seeds (*Syzygium cumini*). *Seed Research*. 29: 183-188.
- Srimathi,P., Ramanadne, T., Malarkodi, K. and Natarajan, K. 2003. Seed extraction in Jamun (*Syzygium cumini* Skeels). *Progressive Horticulture*, 35(2):221-223.

Tamarindus indica

Nomenclature:

Scientific name: *Tamarindus indica* Linn.

Vernacular name: Kolpuli, Valanpuli, Puli (Malayalam), Pulia-maram (Tamil) (Chacko *et al.*, 2002), Amlika, Tintiri (Sanskrit), Amlī, Imli (Hindi) (Bose *et al.*, 1998).

Common name: Tamarind tree (Chacko *et al.*, 2002; Bose *et al.*, 1998).

Synonyms: *Tamarindus occidentalis* Gaertn., *Tamarindus officinalis* Hook. (Chacko *et al.*, 2002).

Family: Leguminosae (Fabaceae)

Subfamily: Caesalpinioideae

Origin:

Distribution: This is not a forest species, but is a reforestation species in dry deciduous and thorn forests of the southern state. It is extensively planted along avenues and in open lands for its valuable fruits. The tamarind is believed to be a native of tropical Africa and probably also to some parts of South India, but it is grown in almost all tropical countries, particularly in Asia and Africa (FRI, 1983; Bose *et al.*, 1998; Chacko *et al.*, 2002).

Description: A large, handsome, slow growing tree reaching a height of 30 m and a breast height diameter of 159 cm with short, stout trunk and more or less evergreen in nature (Bose *et al.*, 1998; Chacko *et al.*, 2002).

Flowering season: April - June / Sept - Oct, April to May (Bourdillon, 1908).

Fruiting season: Appears in winter and ripens in spring (February - April) March to

April (Luna, 1996; Chacko *et al.*, 2002), February to March (Bourdillon, 1908).



Branch with flowers



Branch with fruit



Seeds

Flowers: Flowers in small lax racemes from all over the branches, up to 10 cm long, drooping; calyx segments 4; petals 3; unequal, the lower 2 reduced to scales,

yellow, reddish-tinged; perfect stamens 3, united to the middle (Bose *et al.*, 1998).

Fruits: Pods linear-oblong, 7.5 -20 cm by 2.5 cm, cinnamon - brown, plump and slightly curved, subcompressed, indehiscent with constrictions, brittle epicarp, pithy greenish inside white ripe and becomes brown pulpy later (Bose *et al.*, 1998; Chacko *et al.*, 2002).

Fruit type: Pod.

Seeds: 3-10, 1.3 cm in diameter, irregularly shaped, with hard dark brown or black shining smooth testa; embedded in reddish brown edible acid pulp (Luna, 1996; Chacko *et al.*, 2002).

Seed dimension:

Seed length: 1.22 cm (Chacko *et al.*, 2002).

Seed width: 1 cm (Chacko *et al.*, 2002).

Seed thickness:

Seed weight: 1,450/kg; 700 to 2,600 seeds/kg (Kindt *et al.*, 1997; Chacko *et al.*, 2002).

Seed dispersal: Animals (Especially monkeys).

Seed collection: The mature ripe fruits are knocked off the tree (Chacko *et al.*, 2002).

Transportation of seeds: No special care is needed (Chacko *et al.*, 2002).

Seed processing: Break open the fruits with wooden stick and extract the seed by hand (Chacko *et al.*, 2002).

Seed storage: Recalcitrant (Kindt *et al.*, 1997). Seeds are sun-dried and stored for about 4 months (Chacko *et al.*, 2002).

Viability period: Seeds retain viability for about 4 months (Chacko *et al.*, 2002).

Seed emptiness: Low (Chacko *et al.*, 2002).

Seed pre treatment: Soak the seeds in cold water for 24 hrs or seeds are treated with cow's urine (Chacko *et al.*, 2002).

Germination type: Epigeous (Chacko *et al.*, 2002).

Germination percentage: 90 (Chacko *et al.*, 2002).

Germination period: 5 to 30 days (Luna 1996; Chacko *et al.*, 2002).

Nursery technique: Pre treated seeds are sown in germination trays filled with vermiculite and watered regularly. Seedlings are transplanted into polythene bags of size 22.5 x 17.5 cm filled with soil (Chacko *et al.*, 2002).

Propagation:

Method of propagation: By seeds or cuttings.

Vegetative propagation:

Pests: Seeds are damaged by bruchid beetles (Chacko *et al.*, 2002).

Diseases: Low (Chacko *et al.*, 2002).

Medicinal properties: The leaves are applied to reduce inflammatory, swelling and ring worm. The bark is tonic and astringent; the leaves reduce inflammation; the flowers are effective to cure conjunctivitis; the seeds are used to cure dysentery and the pulp has laxative property (Bose *et al.*, 1998).

Uses: Wood used for wheel making and as fire wood. Seeds are fed to cattles and give an amber coloured oil which is made into a varnish to paint idols. Leaves give a red dye.

The acidic pulp is used in curries and pickles. The wood is an excellent firewood. The fruits are chiefly used as souring agent in foods. The seeds are used in the jam, jelly, and confectionery industries. The plant has many medicinal uses (Chacko *et al.*, 2002).

Wood properties: Sapwood yellowish white turning to greyish brown on ageing;

heartwood irregular dark purplish, very small; hard to very hard, heavy to very heavy, moderately straight grained to interlocked and wavy grained and medium coarse textured. Pores moderate sized, uniform, each pore or group of pores surrounded by round patches of soft tissue. Rays very fine and numerous (Bourdillon, 1908).

References:

- Bose, T.K., Das, P. and Maiti, G.G. 1998. Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 458, 459.
- Bourdillon, T.F. 1908. Forest trees of Travancore. International Book Distributors, Dehradun. pp. 146-147.
- Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. Manual of Seeds of Forest Trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Kerala. pp. 222-223.
- FRI. 1983. Troup's The Silviculture of Indian Trees. Vol. IV. The Controller of Publications, Delhi.
- Kindt, R., Mausya, S., Kimotho, J. and Waruhiu. 1997. Tree seed suppliers Directory: Sources of Seeds and Microsymbionts. International Centre for Research in Agro Forestry (ICRAF), Nairobi, Kenya.
- Luna, R.K. 1996. Plantation Trees. International Book Distributors, Dehra Dun, India.

Tectona grandis

Nomenclature:

Scientific name: *Tectona grandis* Linn.f.

Vernacular name: Thekku (Tamil & Malayalam), Sagun (Hindi), Tegu, Tegna (Kannada) (Chacko *et al.*, 2002).

Common name: Teak (Chacko *et al.*, 2002), Sagwan, Indian oak (Bose *et al.*, 1998).

Synonyms: *Tectona theka* Lour., *Theka grandis* (L.f.) Lam., *Jatus grandis* (L.f.) Kuntze (Chacko *et al.*, 2002).

Family: Verbenaceae

Subfamily:

Origin:

Distribution: Indigenous throughout the greater parts of Indian peninsula, Siam, Java and Myanmar. Plantation raised in Assam, Kerala, Tamil Nadu, Bengal, Orissa and Andamans. Occurs naturally in India, Myanmar, Laos and Thailand. It has been planted widely in the tropics (Chacko *et al.*, 2002).

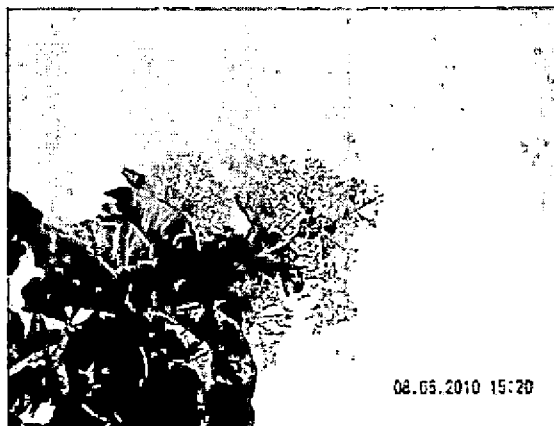
Description: A large moderately fast growing deciduous tree with rounded crown and a tall cylindrical bole, attaining a height of more than 50 m and a breast height diameter of 206 cm (Chacko *et al.*, 2002).

Flowering season: June - Aug/ Sept

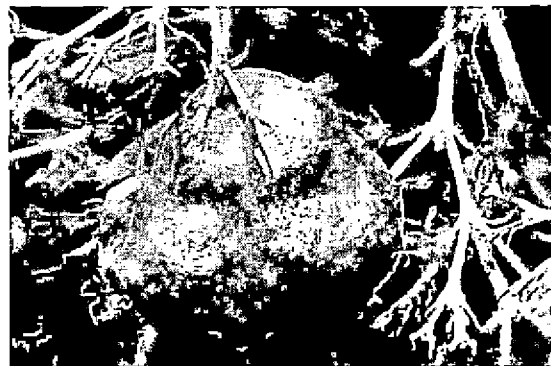
Fruiting season: Ripens in November-January, November to May (Sen Gupta, 1937; Chacko *et al.*, 2002).

Flowers: Small white in large terminal panicles having 15 units of flowers arranged in compound dichasia. The first position flowers in the dichasia show increased fruit set, fruit weight, diameter and

seed fill compared with flowers at other positions (Nagarajan *et al.*, 1996). The flowers are weakly protandrous. The papillate stigma is of the wet type with a hollow style and a short receptive period (1100-1300 hr). The most effective pollination period is between 0900 and 1300 hr (Tangmitcharoen and Owens, 1996). *Graphium sarpedon choredon*, *Papilio polymnestor*, *Apis cerana indica*, *Apis mellifera*, *Oecophylla smaragdina*, *Musca domestica*, *Tabanus atratus*, *Mylabris pustulata* and *Xylocopa* sp. are the flower visitors of teak and 5 of them are nectar and pollen foragers (Thangaraja *et al.*, 2001).



Branch with flowers



Fruit

Fruits: Hard, bony irregular globose nut, somewhat pointed at the apex, enclosed in a thick, felty, light brown covering (Chacko *et*

al., 2002). Most fruits belong to the 9-12 mm grade (Indira *et al.*, 2000).

Fruit type: Drupe.

Seeds: 1-3, rarely 4, marble white, egg shaped, 4-8 mm long. Rate of germination is faster for small seeds than large seeds. Larger seeds produce seedlings with higher NAR and LAI (Agboola, 1995).

Seed dimension:

Seed length: 1-2 cm (Chacko *et al.*, 2002).

Seed width: 1 cm (Chacko *et al.*, 2002).

Seed thickness:

Seed weight: 1,433 to 3,527 fruits/kg (Sen Gupta, 1937; Chacko *et al.*, 2002).

Seed dispersal: By insects.

Seed collection: Seeds are usually collected from the cleaned ground. Seeds are also brought down from trees by manually shaking the branches using long pole fitted with hook (Chacko *et al.*, 2002).

Transportation of seeds: Fruits are packed in cotton or jute bags and transported to the processing centre at the earliest (Chacko *et al.*, 2002).

Seed processing: The bladder like calyx is removed by vigorously rubbing the seeds in gunny bags. The calyx part are separated by winnowing (Tewari, 1992; Chacko *et al.*, 2002). Fruits are soaked in water for 72 h before mixing with equal quantities of sand and small stones (1:1:1) and then placing in a machine having two rotating discs (100 rpm) of slight concave shape and ribbed surface, which remove the pericarp, and produce material which is more geometrically uniform and brittle. This processed material is fed into a second

element, which is composed of two parallel cylinders (35 mm in diameter and speed of 520 rpm) which crush the fruits and release the seeds (Ferraz *et al.*, 1998). The abraded fruits are then removed, washed in water and dried in the sun. The treated fruits can then be stored (Grewal *et al.*, 1993; Bapat and Phulari, 1995). Thereafter, the seeds are size graded using a sieve of 9 mm mesh size and seeds retained on the sieve are used for sowing (Chacko *et al.*, 2002).

Seed storage: Orthodox (Kindt *et al.*, 1997). Seeds can be dry-stored in gunny bags, sealed airtight plastic or aluminum tins for 2 - 3 years (Dent, 1948; Chacko *et al.*, 2002). Storage for one year results in 91% reduction in germination percentage (Sudhakara and Jijeesh, 2008). Seeds retain viability for longer and germinate better when stored in air-tight metal containers rather than in loose bags. Germination increase over the first 6 months of storage (indicating initial dormancy) and then start decreasing. Seeds collected from more moist localities show higher initial germination percentage, but lose viability faster (Parvez Jalil, 1994).

Viability period: Viable for more than a year (Dent, 1948; Chacko *et al.*, 2002).

Seed emptiness: Moderate in moist localities and high in dry localities (Chacko *et al.*, 2002). There exists a positive correlation between drupe weight and seed filling percentage (Sivakumar *et al.*, 2002).

Seed pre treatment: Seed pre-treatment is necessary for enhanced germination of teak seeds with stony seed coat (Mannan, 2000). Allowing the mesocarp of the seeds to be eaten away by termite leaving behind seeds with stony endocarp and soaking the seeds in cowdung solution for 24 hrs improve germination. 'Weathering' is the popular pre-sowing treatment employed. It involves wetting seeds during night and drying them

under sun. The process is repeated for 7 to 21 days (Ngulube, 1988; Chacko *et al.*, 2002). Soaking and drying of drupes for 5 days at intervals of 12 h followed by soaking in 4.5% KNO₃ solution and germinating in the mist chamber give 52% germination (Masilamani and Dharmalingam, 1999a). Acid scarified drupes are soaked in 1% KNO₃ to enhance the germination and seedling vigour (Manonmani and Vanangamudi, 2003). Soaking and drying of drupes for 5 days at an interval of 12 hrs followed by soaking in 1.5% hydrogen peroxide solution also improves germination (Masilamani and Dharmalingam, 1999b). Accelerated ageing of seeds maintained at 100% RH and 40°C for 13 days give 53% germination against 18% in normal open condition after 28 days of sowing. Fruit stones in mist chamber give 39% germination (11 days aging) against 14% in the untreated seeds (Masilamani and Dharmalingam, 2001). Pit method of treating the seed involves placing the seeds in a pit in alternate layers of seeds and straw for 7 days with daily watering (Dhanai *et al.*, 2007; Bapat and Phulari, 1995). Treating seeds with IAA at 100 and 300 ppm and GA₃ at 200 and 300 ppm for 24 hrs are also effective in improving germination (Unnikrishnan and Rajeeve, 1990).

Germination type: Epigeous (Luna, 1996; Chacko *et al.*, 2002).

Germination percentage: Up to 75 to 77 (Sen Gupta, 1937; Chacko *et al.*, 2002). 15-18 mm size grade drupes give 83.4 germination percentage (Sudhakara and Jijeesh, 2008).

Germination period: Mostly 8 to 60 days (Sen Gupta, 1937).

Nursery technique: Conventionally, seeds are sown in raised nursery beds (30 cm height) between summer and rainy season (Chacko *et al.*, 2002). Teak drupes

germinate better in nursery bed compared to root trainers and sand medium (Sudhakara and Jijeesh, 2008). The seeds are sown 5 cm apart in lines 10 cm apart in 20 cm raised nursery beds and covered with 1 cm sand. The beds should have a 5 cm top layer of sand containing well rotted FYM. The seedbeds are irrigated thrice daily until final germination is recorded 75 days after sowing (Saini *et al.*, 1999). Container seedlings have a higher survival (96-100%) than stumps (58-96%). Container seedlings were also characterized by root coiling and multiple shoot formation, the management of which is not cost effective. Hence it favours the use of stumps. The optimal size of stumps is between 1 and 2 cm (obtained at 7 months of age) (Muruges *et al.*, 1997). Stumps with 2.5 cm shoot length, 15 to 20 cm root length, 1 to 2 cm diameter at thickest portion of the root prepared from one year old seedlings are planted in the field. Polybag seedlings (40 to 60 days old) and root trainer seedlings (60 to 90 days old) are also used for planting (Chacko *et al.*, 2002). A combination of cattle or poultry manure and soil mixed at a ratio 1:2 is superior to NPK fertilizer (45 or 90 kg/ha) (Arthur, 1999). The mycorrhiza treated seedlings are tolerant of the sodic soil, surviving better (96 vs. 38%) compared to untreated seeds and exhibit significantly greater growth and chlorophyll content (Vijaya *et al.*, 1996). 6 species of vesicular-arbuscular mycorrhizal (VAM) fungi, *Acaulospora scrobiculata*, *Glomus aggregatum*, *G. deserticola*, *G. multicaulis*, *Sclerocystis microcarpus* are suitable for mass production and inoculation into teak seedling roots (Ramanwong and Sangwanit, 2000). Seedlings growth performance is better in full sunlight than in shade, with height, diameter, leaf area, leaf size, root weight, shoot weight, leaf weight and chlorophyll content all higher under full sunlight (Saju *et al.*, 2000). The application

of IAA as a spray to 1-month-old seedlings increase the growth and dry wt. of shoots and roots, but the use of higher concentrations suppress growth (Kalpana Mishra and Mishra, 1986).

Propagation:

Method of propagation: Bud grafting, rooting of branch cutting and tissue culture.

Vegetative propagation:

Pests: The infestation is due to termites and shot hole borers (Chacko *et al.*, 2002). Two defoliating insects, *Hyblaea puera* (Hyblaeidae: Lepidoptera) and *Eutectona machaeralis* (Pyralidae: Lepidoptera) are the major pests of teak (*Tectona grandis*) plantations (Sudheendrakumar *et al.*, 1993; Basalingappa and Gandhi, 1994; Tilakaratna, 1995; Ali and Chaturvedi, 1996; Katagall, 1996; Varma *et al.*, 1996; Baksha and Islam, 1997; Roychoudhury, 1999; Ali *et al.*, 2002; Javaregowda and Naik, 2007). Chemical control methods using quinalphos, phorate or carbofuran are effective in controlling the pests (Varma *et al.*, 1996) carbaryl, at 200 g/bed is also effective (Meshram *et al.*, 1990). The occurrence of the gall midge, *Asphondylia tectonae* is observed in clonal teak seed orchard (Pillai and Gopi, 1996; Chavan and Prasad Kumar, 1999). Feeding by a cerambycid girdler (*Acanthophorus* sp) result in girdling at the collar region (Gujar *et al.*, 1996). *Alceterogystia cadambae* (*Cossus cadambae*) causes extensive bark injury and riddling of the bole with numerous holes. The infested tree subsequently gets attacked by various pathogenic/saprophytic fungi which results in die-back as well as decay of wood (Mathew and Rugmini, 1996). *Helicoverpa armigera*, a notorious pest in agriculture attacks terminal shoots of young teak (Varma *et al.*, 2007). White grubs of the

scarab beetle damage 14-52% of teak seedlings in the nursery beds (Nitin Kulkarni *et al.*, 2007). Some times root knot nematode (*Meloidogyne* spp) occurs in nurseries (Mehrotra and Sharma, 1990).

Diseases: Collar rot in the seedlings is caused by *Rhizoctonia solani*. Incidence is maximum in the month of July, August and September ranging from 20 to 100% (Ramesh, 2002). *Ralstonia* (syn. *Pseudomonas*) *solanacearum* cause serious wilt disease (Supriadi *et al.*, 2001). Basal canker caused by *Fusarium pallidoroseum* (Dadwal and Jamaluddin, 2001). Stored teak logs in the depots are affected by heart rot incurring 11% loss in wood volume (Harsh and Tiwari, 1996). Teak leaf rust, caused by the fungal pathogen *Olivea tectonae* (Daly *et al.*, 2006). *Uncinula tectonae* cause powdery mildew disease (Harsh *et al.*, 1992). Leaf spot disease caused by *Phyllosticta tectonae* (Harsh *et al.*, 1989). Water blister occurring in teak is caused by radial shake in the stem wood. Loss occurs in terms of log quality, resulting in rejection of affected timber for high quality veneer, boards, or turnery stock. The occurrence of water blisters seems to be related to proximity to a river/canal (Kallarackal *et al.*, 1992). Bacterial wilt disease of teak is caused by *Pseudomonas solanacearum* (Basak, 1992).

Medicinal properties: The roots are useful in diabetes, leprosy and skin diseases. The leaves are used in ulcer, haemorrhages and vitiated condition of pitta.

Uses: Cell suspension cultures of *Tectona grandis* produce 5 antibacterial triterpene acids (Kawazu *et al.*, 1998). Many tribes and Meitei community of Manipur traditionally use teak in combination with other plants for extraction and preparation of dyes utilizing indigenous processes (Lunalisa Potsangbam *et al.*, 2008). Leaves of teak has a novel

pigment, Tectograndone (Aguinaldo *et al.*, 1993).

Wood properties: Moderately hard, sapwood small, whitish; Heartwood dark golden yellow, sometimes with dark streaks, turning brown on ageing, oily, with a

characteristic odour, extremely durable. Most important timber of India; used for ship building, bridge, piles, furnitures, wagon, ordanance work, general carpentry. The timber is versatile and suitable for almost all end uses (Chacko *et al.*, 2002).

References:

- Agboola, D.A. 1995. Effect of seed size on germination, seedling growth and dry matter accumulation in some tropical tree species. *Malaysian Forester*. 56(1/2): 61-71.
- Aguinaldo, A.M., Ocampo, O.P.M., Bowden, B.F., Gray, A.I. and Waterman, P.G. 1993. Tectograndone, an anthraquinone naphthoquinone pigment from the leaves of Tectona grandis. *Phytochemistry*. 33(4): 933-935.
- Ali, M.S. and Chaturvedi, O.P. 1996. Major insect pests of forest trees in north Bihar. Impact of diseases and insect pests in tropical forests Proceedings of the IUFRO Symposium, 23-26 November 1993, Peechi, India. pp. 464-467.
- Ali, M.S., Alam, T., Manoj Kumar and Chatruvedi, O.P. 2002. Studies on seasonal incidence of Eutectona machaeralis Walker on teak seedling stock. *Indian Journal of Agroforestry*. 4(1): 79-80.
- Arthur, M.B. 1999. The effect of compost and NPK fertilizer on growth performance of Tectona grandis Linn. F. seedlings in the nursery. *Ghana Journal of Forestry*. 8: 31-35.
- Baksha, M.W. and Islam, M.R. 1997. Major defoliators of teak in Bangladesh and their management. *Bulletin Forest Entomology Series, Bangladesh Forest Research Institute*. (2): 14 pp.
- Bapat, A.R. and Phulari, M.M. 1995. Teak fruit treatment machine - a prototype - II. *Indian Forester*. 121(6): 545-549.
- Basalingappa, S. and Gandhi, M.R. 1994. Infestation of the seedlings of Tectona grandis by the lepidopteran larvae of Hapalia machaeralis [Eutectona machaeralis] (Pyrilidae) and Hyblaea puera (Hyblaeidae). *Journal of Ecobiology*. 6(1): 67-68.
- Basak, A.C. 1992. Bacterial wilt disease of teak [Tectona grandis] seedlings in the forest nurseries and its control. *Bangladesh Journal of Forest Science*. 21(1/2): 67-68.
- Bose, T.K., Das, P. and Maiti, G.G. 1998. *Trees of the world, Vol. 1. Regional Plant Resource Centre, Orissa, India*. pp. 458, 459.
- Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. *Manual of Seeds of Forest Trees, Bamboos and Rattans*. Kerala Forest Research Institute, Peechi, Kerala. pp. 224-225.

- Chavan, M.R. and Prasad Kumar. 1999. Gall midge, Asphondylia tectonae Mani (Cecidomyiidae: Diptera) threat to teak. Indian Journal of Forestry. 21(4): 366.
- Dadwal, V.S. and Jamaluddin. 2001. A note on basal canker of Teak (Tectona grandis) in plantations. Indian Forester. 127(3): 365-366.
- Daly, A.M., Shivas, R.G., Pegg, G.S. and Mackie, A.E. 2006. First record of teak leaf rust (Olivea tectonae) in Australia. Australasian Plant Disease Notes. 1(1): 25-26.
- Dent, T.V. 1948. Seed storage with particular reference to the storage of seed of Indian forest plants. Indian Forest Records (New Series) Silviculture, 7: 134 pp. Manager of Publications, Delhi.
- Dhanai, C.S., Gupta, G.R., Panwar, G.S., Singh, V.K. and Anil Kumar. 2007. Pre sowing seed treatments effect on germination behaviour of Tectona grandis (L.). Progressive Agriculture. 7(1/2): 12-14.
- Ferraz, A.C.de.O., Dal Fabbro, I.M., Silva, J.M.da., Amaral, R.do., Rodrigues, A.L.G. and Penteadó, S.R. 1998. Design of a processing machine for teak fruits to extract seeds. Engenharia Agricola. 18(1): 52-58.
- Grewal, J.S., Anmol Kumar, Gaikwal, S.R. 1993. Teak fruit treatment machine - a prototype. Indian Forester. 119(3): 252-254.
- Gujar, D.R., Ghude, D.B. and Gogate, M.G. 1996. Incidence of a cerambycid girdler attack in teak seed orchard in Maharashtra, India. Impact of diseases and insect pests in tropical forests. Proceedings of the IUFRO Symposium, 23-26 November 1993, Peechi, India. 498-501.
- Harsh, N.S.K., Tiwari, C.K. and Nath, V. 1989. Foliage diseases in forest nurseries and their control. Journal of Tropical Forestry. 5(1): 66-69.
- Harsh, N.S.K., Tiwari, C.K. and Nath, V. 1992. Some powdery mildews from Madhya Pradesh. Journal of Tropical Forestry. 8(2): 173-178.
- Harsh, N.S.K. and Tiwari, C.K. 1996. Assessment of damage caused by heart rot in teak in Madhya Pradesh. Impact of diseases and insect pests in tropical forests. Proceedings of the IUFRO Symposium, 23-26 November 1993, Peechi, India. pp. 61-65.
- Indira, E.P. and Mohanadas, K. 2002. Intrinsic and extrinsic factors affecting pollination and fruit productivity in teak (Tectona grandis Linn.f.). Indian Journal of Genetics and Plant Breeding. 62(3): 208-214.
- Javaregowda and Naik, L.K. 2007. Seasonal incidence of teak defoliator, Hyblaea puera Cramer (Hyblaeidae: Lepidoptera) in Uttara Kannada District of Karnataka. Karnataka Journal of Agricultural Sciences. 20(1): 153-154.
- Kallarackal, J., Seethalakshmi, K.K. and Bhat, K.V. 1992. Water blisters in teak. KFRI Research Report. (82): iii + 22.

- Kalpna Mishra and Mishra, G.P. 1986. Effect on indole acetic acid on growth and dry matter production of *Dendrocalamus strictus* Nees and *Tectona grandis* Linn. seedlings. *Journal of Tree Sciences*. 5(2): 118-121.
- Katagall, R.D. 1996. Incidence of defoliators in the teak plantation. *Insect Environment*. 2(1): 20.
- Kawazu, K., Marwani, E., Kobayashi, A., Nitoda, T. and Kanzaki, H. 1998. Production of antibacterial triterpene acids not detected in the native plant by cell suspension culture of *Tectona grandis*. *Scientific Reports of the Faculty of Agriculture, Okayama University*. (87): 9-12.
- Kindt, R., Mausya, S., Kimotho, J. and Waruhiu. 1997. *Tree seed suppliers Directory: Sources of Seeds and Microsymbionts*. International Centre for Research in Agro Forestry (ICRAF), Nairobi, Kenya.
- Luna, R.K. 1996. *Plantation Trees*. International Book Distributors, Dehra Dun, India.
- Lunalisa Potsangbam, Swapana Ningombam and Laitonjam, W.S. 2008. Natural dye yielding plants and indigenous knowledge of dyeing in Manipur, Northeast India. *Indian Journal of Traditional Knowledge*. 7(1): 141-147.
- Mannan, M.A. 2000. Studies on seed production, germination and storage of some plantation species in Bangladesh. *Bangladesh Journal of Forest Science*. 29(1): 61-66.
- Manonmani, V. and Vanangamudi, K. 2003. Studies on enhancing seed germination and seedling vigour in teak (*Tectona grandis*). *Journal of Tropical Forest Science*. 15(1): 51-58.
- Masilamani, P. and Dharmalingam, C. 1999a. Influence of seed treatment with potassium nitrate on germination and seedling vigour of teak (*Tectona grandis* Linn. F.). *Indian Journal of Forestry*. 22(1/2): 1-6.
- Masilamani, P. and Dharmalingam, C. 1999b. Germination behaviour of teak (*Tectona grandis* Linn.F.) drupes in flyash incorporated medium. *Advances in Plant Sciences*. 12(1): 57-61.
- Masilamani, P. and Dharmalingam, C. 2001. Effect of accelerated aging on germination and seedling vigour of teak (*Tectona grandis*). *Journal of Tropical Forest Science*. 13(1): 93-98.
- Mathew, G. and Rugmini, P. 1996. Impact of the borer *Alceterogystia cadambae* (Moore) (Lepidoptera: Cossidae) in forest plantations of teak in Kerala, India.
- Mehrotra, M.D. and Sharma, V. 1990. Occurrence of root knot nematodes in forest nurseries. *Indian Forester*. 116(10): 846.
- Meshram, P.B. and Patra, A.K. 2003. Heavy outbreak of parakeet *Psittacula krameri* (Scopoli) in Hi-Tech Teak plantations at Chhindwara. *Indian Forester*. 129(3): 413-414.
- Muruges, M., Srinivasan, V.M., Rai, R.S.V. and Annamalai, R. 1997. Studies on curtailing nursery period in teak (*Tectona grandis*). *Journal of Tropical Forest Science*. 10(1): 66-72.
- Nagarajan, B., Mohan Varghese, Nicodemus, A., Sashidharan, K.R., Bennet, S.S.R. and Kannan, C.S. 1996. Reproductive biology of teak and its implication in tree improvement. *Tree*

improvement for sustainable tropical forestry QFRI IUFRO Conference, 27 October - 1 November 1996, Volume I, Caloundra, Queensland, Australia. pp. 244-248.

Ngulube, M.R. 1988. Effect of seed pretreatment on the germination of teak (Tectona grandis Linn. F.) in the nursery. *Journal of Tropical Forestry*. 4(2): 143-146.

Nitin Kulkarni, Kailash Chandra, Wagh, P.N., Joshi, K.C. and Singh, R.B. 2007. Incidence and management of white grub, *Schizonycha ruficollis* on seedlings of teak (Tectona grandis Linn. f.). *Insect Science*. 14(5): 411-418.

Parvez Jalil. 1994. Effect of storage containers on the viability of *Tectona grandis* seeds from different provenances of Madhya Pradesh. *Vaniki Sandesh*. 18(4): 32-37.

Pillai, S.R. and Gopi, K.C. 1996. Stem gall of teak and its management. Impact of diseases and insect pests in tropical forests. Proceedings of the IUFRO Symposium, 23-26 November 1993, Peechi, India. pp. 427-430.

Ramanwong, K. and Sangwanit, U. 2000. Effect of vesicular-arbuscular mycorrhizal fungi on the growth of teak seedlings. Bio-technology applications for reforestation and biodiversity conservation. Proceedings of the 8th International Workshop of BIO-REFOR, Kathmandu, Nepal, November 28-December 2, 1999. pp. 119-122.

Ramesh, K.R. 2002. Colar rot disease caused by Rhizoctonia solani in Teak (Tectona grandis Linn.f.) - a new record from the nurseries of Tamil Nadu. *Indian Journal of Forestry*. 25(1/2): 87-88.

Roychoudhury, N. 1999. Teak defoliator and host-plants: an ecological relationship. *Advances in Forestry Research in India*. 20: 182-189.

Saini, B.C., Misra, K.K. and Singh, R.V. 1999. Effect of pre-sowing seed treatment on germination of teak (*Tectona grandis* L.) seeds in sand beds. *Indian Journal of Forestry*. 22(3): 245-247.

Saju, P.U., Gopikumar, K., Asokan, P.K. and Ani, J.R. 2000. Effect of shade on seedling growth of Grevillea robusta, *Tectona grandis* and *Ailanthus triphysa* in the nursery. *Indian Forester*. 126(1): 57-61.

Sen Gupta, J.N. 1937. Seed weights, plant percents, etc. for forest plants in India. *Indian Forest Records (New Series) Silviculture*, 2:221 pp. Manager of Publications, Delhi.

Sivakumar, V., Parthiban, K.T., Singh, B.G., Gnanambal, V.S., Anandalakshmi, R. and Geetha, S. 2002. Variability in drupe characters and their relationship on seed germination in teak (Tectona grandis L.f.). *Silvae Genetica*. 51(5/6): 232-237.

Sudhakara, K. and Jijeesh, C.M. 2008. Effect of germination conditions, grading and storage of teak (Tectona grandis Linn. F.) drupes on the germination parameters. *Indian Forester*. 134(2): 241-249.

Sudheendrakumar, V.V., Nair, K.S.S. and Chacko, K.C. 1993. Phenology and seasonal growth trend of teak at Nilambur (Kerala), India. *Annals of Forestry*. 1(1): 42-46.

- Supriadi, Mulya, K. and Sitepu, D. 2001. Bacterial wilt disease of woody trees caused by Ralstonia solanacearum: a review. *Journal Penelitian dan Pengembangan Pertanian*. 20(3): 106-112.
- Tangmitcharoen, S. and Owens, J.N. 1997. Floral biology, pollination, pistil receptivity, and pollen tube growth of teak (Tectona grandis Linn f.). *Annals of Botany*. 79(3): 227-241.
- Tewari, D.N. 1992. A Monograph on Teak (Tectona grandis L.f.). International Book Distributors, Dehra Dun, India.
- Thangaraja, A., Senthilkumar, N. and Ganesan, V. 2001. Foraging dynamics of floral visitors of Tectona grandis L.f. (Verbenaceae). *Insect Environment*. 7(3): 133-134.
- Tilakaratna, D. 1995. Parasites of the teak defoliator, Hyblaea puera. *Sri Lanka Forester*. 20(1/2): 23-25.
- Unnikrishnan, K. and Rajeeve, K.P. 1990. On germination of Indian teak (Tectona grandis L.f.). *Indian Forester*. 116(12): 992-993.
- Varma, B.A., Sudhakara, K. and Beena Bhaskar. 1996. Insect pests associated with nurseries of selected tree crops in Kerala. Impact of diseases and insect pests in tropical forests. Proceedings of the IUFRO Symposium, 23-26 November 1993, Peechi, India. pp. 468-473.
- Varma, R.V., Sajeev, T.V. and Sudheendrakumar, V.V. 2007. Pest susceptibility of Tectona grandis under intensive management practices in India. *Journal of Tropical Forest Science*. 19(1): 46-49.
- Vijaya, T., Srivasuki, K.P. and Sastry, P.S. 1996. Role of gibberellic acid in teak seed germination and the effect of Glomus macrocarpus on growth and sodic soil tolerance. *Annals of Forestry*. 4(2): 211-212.

Terminalia arjuna

Nomenclature:

Scientific name: *Terminalia arjuna*
(Roxb.ex.DC.) Wt. & Arn.

Vernacular name: Neermaruthu, Attumaruthu, Vellamatthi (Malayalam) (Sasidharan, 2004), Arjun, Arjuna, Kahua, Koha (Hindi), Kulamaruthu, Vella marda (Tamil) (Chacko *et al.*, 2002).

Common name: Arjun, Malabar almond (Chacko *et al.*, 2002).

Synonyms: *Terminalia glabra*,
Pentaptera arjuna Roxb.ex DC.,
Terminalia berryi Wight & Arn.
(Chacko *et al.*, 2002).

Family: Combretaceae

Subfamily:

Origin:

Distribution: Common throughout the greater parts of Indian peninsula along rivers, streams, ravines and dry water courses. Found in sub-Himalayan tracts, Chota Nagpur, Central and S. India. It is also found in Sri Lanka (FRI, 1984). In Kerala it grows along river banks in the dry deciduous forests (Chacko *et al.*, 2002).

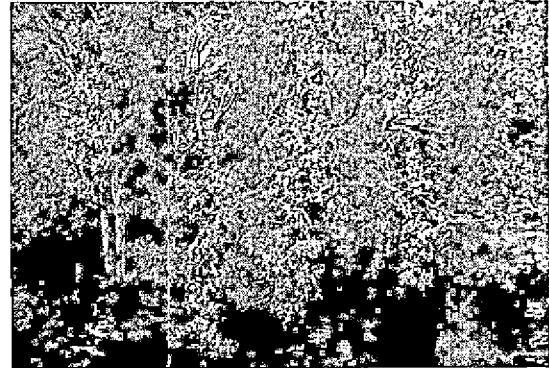
Description: A fast growing large handsome evergreen tree, with a buttressed trunk, large crown and drooping branchlets attaining a height of 40 m and a breast height diameter of 302 cm (FRI, 1984; Chacko *et al.*, 2002).

Flowering season: April to May (Bourdillon, 1908).

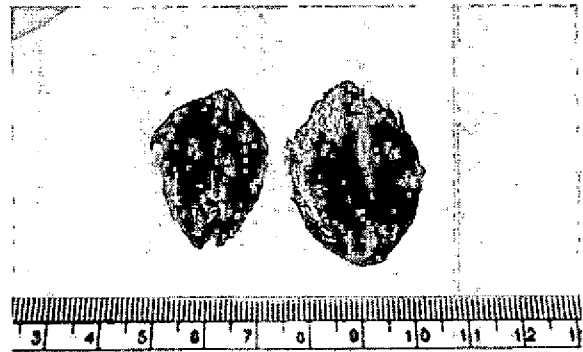
Fruiting season: Ripens at February to May. December to May (Sen Gupta, 1937;

Chacko *et al.*, 2002). November to January (Bourdillon, 1908).

Flowers: Flowers are sessile, small white, honey scented in short, axillary spikes or in terminal panicles. Stamens 10, petals absent (Bourdillon, 1908).



Habit



Fruits

Fruits: Fruit is a drupe, ovoid to obovoid, 5 winged, reddish brown, glabrous, 4-5 cm x 2.5 to 3 cm with a hard bony axis and 5-7 wing (Chacko *et al.*, 2002).

Fruit type: Drupe.

Seeds: One seeded.

Seed dimension:

Seed length: 2.5-5 cm (Chacko *et al.*, 2002).

Seed width: 1.3 cm (Chacko *et al.*, 2002).

Seed thickness:

Seed weight: 176 to 375 fruits/kg (Sen Gupta, 1937); 1,450 fruits/kg (Kumar and Bhanja, 1992; Chacko *et al.*, 2002).

Seed dispersal: The roseringed parakeet (Sushil Kumar and Kumar, 1994).

Seed collection: Seeds are collected from the trees or from the ground (Chacko *et al.*, 2002).

Transportation of seeds: Fruits collected in gunny bags or cotton bags are transported to the processing centre as early as possible (Chacko *et al.*, 2002).

Seed processing: Fruits are dried under shade before storage (Chacko *et al.*, 2002).

Seed storage: Probably orthodox. Seeds are stored in sealed tins and gunny bags for a year without much loss of viability (Dent, 1948; Chacko *et al.*, 2002).

Viability period: Keeps fairly well for an year (Dent, 1948; Chacko *et al.*, 2002).

Seed emptiness: Low (Chacko *et al.*, 2002).

Seed pre treatment: Soaking the seeds in cold water for 24 hr is beneficial (Chacko *et al.*, 2002). Seeds completely soaked in water for approximately 5-6 hrs, and heaped under wet straw at 38-39°C show good germination (Dash *et al.*, 2001). *Terminalia arjuna* seeds treated with 0-400 ppm gibberellic acid show increased seed germination and shoot growth (Ashok and Prasad, 1997).

Germination type: Epigeous (Chacko *et al.*, 2002).

Germination percentage: 61 (Sen Gupta, 1937; Chacko *et al.*, 2002) to 90 (Kumar and

Bhanja, 1992; Chacko *et al.*, 2002). Seeds soaked in water for 24 h show 70% and seeds soaked for 24 h give 33 germination percentages (Mohiuddin and Ara, 1999).

Germination period: 14 to 48 days (Sen Gupta, 1937; Chacko *et al.*, 2002).

Nursery technique: The fruits are sown vertically with the stalk downwards in plastic trays containing vermiculite and watered regularly. The germinated fruits are pricked out into polythene bags of 22.5x17.5 cm filled with potting mixture (Chacko *et al.*, 2002). Otherwise, seeds are sown directly in polyethylene bags, containing a sowing medium of nursery soil and cowdung (3:1) (Mohiuddin and Ara, 1999). In order to produce healthy and vigorous nursery seedlings use N100:P100:K50 (Santosh Kumar *et al.*, 2003). Seedling growth increase with availability of nutrients in the potting mixture (Neeta Srivastava *et al.*, 2002). Seedlings are raised in the nursery by transplanting the best looking germinants to 160 ml root trainers in a medium of FYM/red earth soil/sand (1:1:0.5) and requires about 20-30% culling in order to obtain uniformly good planting stock (Rao *et al.*, 1998).

Propagation:

Method of propagation: By seeds.

Vegetative propagation:

Pests: Not reported (Chacko *et al.*, 2002).

Diseases: 16 fungi, a bacterium and actinomycetes are recorded from the tree. Species of *Aspergillus*, *Nigrospora*, *Mucor*, *Penicillium*, *Colletotrichum* and *Botryodiplodia theobromae* are the important field fungi recorded on seeds (Chacko *et al.*, 2002).

Medicinal properties: Bark is used in medicinal preparations (FRI, 1994; Chacko

et al.,2002). It is used for asthma, dysentery, internal and external haemorrhages, blood pressure, leucorrhoea and ear ache, and acts as an antidote to poisons.

Uses: *T. arjuna* seedlings have a modest potential to tolerate alkalinity (7.6, 8.0, 9.5 and 8.4 pH) and could attain optimum growth even under limiting nutrient availability (Neeta Srivastava *et al.*, 2002). Bark is used for tanning and dyeing. The timber is used for carts, agricultural implements, water troughs, boat building and other domestic purposes (Chacko *et al.*,2002). A sample of the bark contain tannin 15.8, soluble non-tannin 8.2, and H₂O 7.5 percent. Both hydrolysable and

condensed tannins are present. The fruit contain about 8.2 percent tannin (H₂O 10.8 percent.). The bark is easily leached, the resulting solution (analytical strength) having a pH of 4.7. Leather tanned with *T. arjuna*, alone or mixed with myrobalans, is very firm but of inferior colour (Choudhary, 1941).

Wood properties: Sapwood is reddish white, heartwood brown, variegated with darker coloured streaks, very hard. Annual rings doubtful. Pores moderate size and large, sometimes very large, uniformly distributed, more numerous and larger than in *Terminalia tomentosa*, often divided, each pore surrounded by a ring of soft tissue (Bourdillon, 1908).

References:

- Ashok, P. and Prasad, U.S. 1997. Effect of gibberellic acid (GA3) on germination and seedling growth of three host plants of tasar silkworm. *Indian Journal of Sericulture*. 36: 153-154.
- Bourdillon, T.F. 1908. *Forest trees of Travancore*. International Book Distributors, Dehradun. pp. 177.
- Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. *Manual of Seeds of Forest Trees, Bamboos and Rattans*. Kerala Forest Research Institute, Peechi, Kerala. pp. 226-227.
- Choudhary, K.S. 1941. *Terminalia arjuna* as a tanning material. *J. Intern. Soc. Leather Trades' Chem.* 25 (56-8). *Chem. Abs.* 35 (8346). P.R.
- Dash, A.K., Nayak, B.K. and Guru, B.C. 2001. Effect of imbibition on seed germination of *Terminalia arjuna* and *Terminalia alata*, two important food plants of tasar silkworm *Antheraea paphia* Linn. *Bulletin of Indian Academy of Sericulture*. 5: 94-97.
- Dent, T.V. 1948. Seed storage with particular reference to the storage of seed of Indian forest plants. *Indian Forest Records (New Series) Silviculture*, 7: 134 pp. Manager of Publications, Delhi.
- FRI. 1984. *Troup's The Silviculture of Indian Trees*. Vol. V. The Controller of Publications, Delhi.
- Kumar, S.V. and Bhanja, M. 1992. *Forestry Seed Manual of Andhra Pradesh*. Andhra Pradesh Forest Department, Hyderabad, India.

Mohiuddin, M. and Ara, R. 1999. Effect of water soaking period on seed germination of Terminalia belerica Roxb., T. arjuna W&A and Aegle marmelos L. *Corr. Pakistan Journal of Forestry*. 46: 1-4, 45-49.

Neeta Srivastava, Behl, H.M. and Srivastava, N. 2002. Growth and nutrient use efficiency in Terminalia arjuna Bedd. seedlings grown in various potting mixtures. *Indian Forester*. 128: 45-53.

Rao, G.M., Rao, A.R., Acharyulu, M.V.S.N. and Prasad, N.S. 1998. Improvement of planting stock through culling in root trainer nursery. *Indian Forester.*, 124: 739-742.

Santosh Kumar, Siddiqui, M.H. and Kumar, S. 2003. Effect of NPK fertilizers on production of healthy and vigorous seedlings of Terminalia arjuna Bedd. *Journal of Research, Birsa Agricultural University*.15: 159-163.

Sasidharan, N. 2004. *Forest Trees of Kerala*. Kerala Forest Research Institute, Peechi, Kerala, India.

Sen Gupta, J.N. 1937. Seed weights, plant percents, etc. for forest plants in India. *Indian Forest Records (New Series) Silviculture*, 2:221 pp. Manager of Publications, Delhi.

Sushil Kumar and Kumar, S. 1994. Seed damage of tree Terminalia arjuna Bedd. by roseringed parakeet (Psittacula krameri (Scopali)). *Indian Journal of Forestry*. 17: 151-153.

Terminalia bellirica

Nomenclature:

Scientific name: *Terminalia bellirica* Roxb.

Vernacular name: Thani (Malayalam), Behera, Buhura, Bulla (Hindi), Thani, Kattuelupay, Thandi (Tamil) (Chacko *et al.*, 2002).

Common name: Behera (Chacko *et al.*, 2002), Belliric myrobalan (Bose *et al.*, 1998).

Synonyms: *Myrobalanus bellirica* Gaertn. (Sasidharan, 2004).

Family: Combretaceae

Subfamily:

Origin:

Distribution: This species is distributed in the Indo - Malaysian region, Sri Lanka and Indo China. Within India it is found throughout the plains and in the lower hills in the Arunachal Pradesh and in the Western Ghats of Karnataka and Tamil Nadu. Widely distributed throughout India except in the arid regions of Rajasthan. Also found in Pakistan, Myanmar, Sri Lanka, Indo-China and Malaysia (FRI, 1984). In Kerala it occurs in moist deciduous and semi evergreen forests up to 900 m (Chacko *et al.*, 2002).

Description: A moderately fast growing large deciduous tree usually with a straight tall bole; often buttressed, attaining a height of up to 40 m and a breast height diameter of more than 125 cm (Chacko *et al.*, 2002).

Flowering season: February to April (Bourdillon, 1908).

Fruiting season: Ripens in November-February (Bose *et al.*, 1908); in February to

April (Sen Gupta, 1937; Chacko *et al.*, 2002).

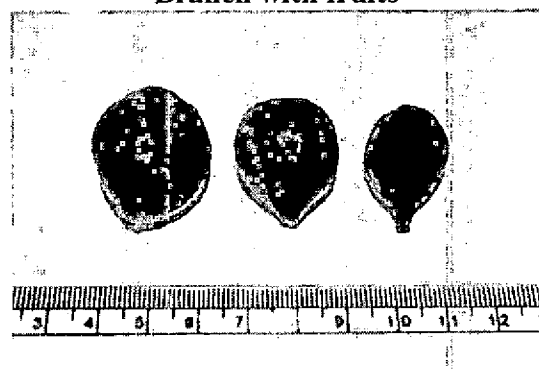
Flowers: Small greenish white with a strong honey smell in spikes 5-7.5 cm long (Bourdillon, 1908).

Fruits: Fruit is a drupe, obovoid or sub globose, pyriform, ellipsoidal, grey velvety tomentose 1.5 to 2.7 cm (Chacko *et al.*, 2002).

Fruit type: Drupe.



Branch with fruits



Fruits

Seeds: Oval shaped light yellow coloured seeds.

Seed dimension:

Seed length: 1.5-2.7 cm (Chacko *et al.*, 2002).

Seed width: 2-2.5 cm (Chacko *et al.*, 2002).

Seed thickness:

Seed weight: 97 to 176 fruits/kg (Sen Gupta, 1937; Chacko *et al.*, 2002).

Seed dispersal: Birds.

Seed collection: Freshly fallen fruits are collected from the ground (Chacko *et al.*, 2002).

Transportation of seeds: Fruits collected in polythene, cotton or gunny bags are transported to the processing centre. No special care is needed (Chacko *et al.*, 2002).

Seed processing: Remove the pulp and sun-dry the seeds (Luna, 1996; Chacko *et al.*, 2002).

Seed storage: Probably Orthodox. The seeds retain viability for about a year, in sealed tin and gunny bags (Dent, 1948; Chacko *et al.*, 2002).

Viability period: The seed is viable up to one year under normal conditions (Dent, 1948; Chacko *et al.*, 2002).

Seed emptiness: Low (Chacko *et al.*, 2002).

Seed pre treatment: Soaking the seeds in cold water for a week is beneficial (Rai, 1999). Scarification with 10% H₂SO₄ for 10 min give 48% germination (where as non-treated seeds give 6%) and a total seedling length of 41.9 cm (16.7 cm in the untreated seeds) (Archana Sharma *et al.*, 1999).

Germination type: Hypogeous. Seed of *Terminalia bellirica* give maximum germination at 25°C (constant) and 30/25°C (alternate temperatures). Germination percent of seeds is influenced by light/dark periods, with maximum germination at 12/12 h light/dark (Shashi Chauhan *et*

al., 2007). Germination takes place at different times and the seeds are successfully established only if they are buried in soil with moisture.

Germination percentage: 86 to 100, 69 (Sen Gupta, 1937); 87 (Rai, 1999; Chacko *et al.*, 2002). The higher dose of 0.3% GA give comparatively less germination percentage and energy. Freshly collected seeds perform better than the 3-month-old seeds (Shivanna *et al.*, 2007). Seeds harvested at 30 days of maturation, exhibit optimum germination and there is a positive correlation between seed maturity period (days) and percent germination (Shashi Chauhan *et al.*, 2002). Seeds kept for germination show improvement in germination by increasing temperature after every 10 d (Negi and Todaria, 1993).

Germination period: 16 to 110 days (Sen Gupta, 1937; Chacko *et al.*, 2002).

Nursery technique: The pretreated seeds are sown in plastic trays filled with vermiculite and watered regularly. The seedlings are pricked out into polythene bags of 22.5 x 17.5 cm filled with potting mixture, when they have 3 to 4 leaves. Deoiled seed cakes of *Brassica latifolia* (mahua [*Bassia latifolia*=*Madhuca longifolia*]), *Pongamia glabra* [*P. pinnata*], *Azadirachta indica* and *Ricinus communis* applied as fertilizer to potted saplings (Naidu and Swamy, 1994).

Propagation:

Method of propagation: By seeds.

Vegetative propagation:

Pests: Moderate. Damage is caused by *Euproctis scintillans* Wlk. (Lepidoptera: Lymantridae), larvae which feed gregariously on leaves, flowers, young fruits. Mature fruits falling on the ground,

particularly the kernels, are eaten by porcupines (Chacko *et al.*,2002).

Diseases: More than 17 spermiophyte microorganisms including 15 fungi, a bacterium and a few actinomycetes are recorded on seeds. *Colletotrichum gloeosporioides*, *Fusarium* spp., and *Phoma* spp. are the important fungal pathogens. Bacterial infection also causes discoloration and seed rot (Chacko *et al.*,2001).

Medicinal properties: Fruit contain tannins, and alpha sitosterol, gallic acid and is used for leprosy, ulcers, fevers, eye troubles and headache.

Uses:Wood used for planking, packing cases, boatmaking and other purposes. The fruits are used for tanning. Cardenolide (cannogenol 3-O- beta -D-galactopyranosyl-(1 -> 4)-O- alpha -L-rhamnopyranoside (1)),

is isolated from the seeds of *Terminalia bellirica* (Yadava and Kavita Rathore, 2001). The seed oils of *Terminalia bellirica* possess phospholipid constituents phosphatidylcholine, phosphatidylethanolamine, phosphatidylinositol and cardiolipin (Khotpal *et al.*,1994). Kernels of *Terminalia bellirica* contain moisture 6.4, protein 33.5, fat 40.9 and ash 4.8% (Rukmini and Rao,1986).

Wood properties: The wood is creamy yellow sometimes with darker streaks, without any distinct heartwood. It is moderately hard and moderately heavy wood with coarse texture and usually straight grain. Pores medium sized and large, often divided, dispersed through narrow, wavy bands of soft tissue. Rays numerous, very fine, uniform and equidistant (Bourdillon, 1908).

References:

- Archana Sharma, Sharma, M.C., Tiwari, K.P. and Sharma, A. 1999. Germination behaviour and seedling growth as influenced by pre-treatments of seeds of *Terminalia bellerica*. *Journal of Tropical Forestry*.15: 103-107.
- Bose, T.K., Das, P. and Maiti, G.G. 1998. *Trees of the world*, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 465-466.
- Bourdillon, T.F. 1908. *Forest trees of Travancore*. International Book Distributors, Dehradun. pp. 173-174.
- Chacko, K.C., Mohanan, C., Seethalakshmi, K.K. and George Mathew. 2001. Seed handling and nursery practices for selected forest trees of Kerala. Final Technical Report of ICFRE – World Bank Forestry Research Education and Extension Project. Kerala Forest Research Institute, Peechi.
- Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. *Manual of Seeds of Forest Trees, Bamboos and Rattans*. Kerala Forest Research Institute, Peechi, Kerala. pp. 228-229.
- Dent, T.V. 1948. Seed storage with particular reference to the storage of seed of Indian forest plants. *Indian Forest Records (New Series) Silviculture*, 7: 134 pp. Manager of Publications, Delhi.

- FRI. 1984. Troup's The Silviculture of Indian Trees. Vol. V. The Controller of Publications, Delhi.
- Khotpal, R.R., Kulkarni, A.S. and Bhakare, H.A. 1994. Composition of Ambadi, Akhrot and Behada seed phospholipids. Indian Journal of Pharmaceutical Sciences. 56: 184-186.
- Luna, R.K. 1996. Plantation Trees. International Book Distributors, Dehra Dun, India.
- Naidu, C.V. and Swamy, P.M. 1994. Effect of seed oil cakes as fertilizer on growth and biomass production of Terminalia bellerica (Gaertn.) Roxb. Indian Forester. 120: 1084-1088.
- Negi, A.K. and Todaria, N.P. 1993. Improvement of germination of some Himalayan tree seeds by temperature treatment. Seed Science and Technology. 21(3): 675-678.
- Rai, S.N. 1999. Nursery and Planting Techniques of Forest Trees in Tropical South-Asia. Eastern Press, Bangalore, India.
- Rukmini, C. and Rao, P.U. 1986. Chemical and nutritional studies on Terminalia bellirica Roxb. kernel and its oil. Journal of the American Oil Chemists' Society. 63: 360-363.
- Sasidharan, N. 2004. Forest Trees of Kerala. Kerala Forest Research Institute, Peechi, Kerala, India.
- Sen Gupta, J.N. 1937. Seed weights, plant percents, etc. for forest plants in India. Indian Forest Records (New Series) Silviculture, 2:221 pp. Manager of Publications, Delhi.
- Shashi Chauhan, Bhupendra Singh, Bhatt, B.P. and Todaria, N.P. 2007. Effects of the altitude of seed origin and storage on the germination of three Terminalia species, Garhwal Himalaya, India. Forests Trees and Livelihoods. 17(4): 339-344.
- Shivanna, H., Balachandra, H.C. and Suresh, N.L. 2007. Effect of pre-sowing treatment on germination of Terminalia bellerica (Ber). Karnataka Journal of Agricultural Sciences. 20(2): 442-443.
- Yadava, R.N., Kavita Rathore and Rathore, K. 2001. A new cardenolide from the seeds of Terminalia bellerica Fitoterapia. 72: 310-312.

Terminaliacatappa

Nomenclature:

Scientific name: *Terminaliacatappa*
Linn.

Vernacular name: Badam, Thallithenga (Bourdillon, 1908) (Malayalam), Vathakottainatavadam (Tamil), Badam (Hindi), Adamaram (Kannada), Malabar almond (English) (Chacko *et al.*, 2002).

Common name: Indian almond, Country almond (Chacko *et al.*, 2002). Barbados almond, Tropical almond (Bose *et al.*, 1998).

Synonyms: *Phytolacca javanica* Osbeck, *Terminalia mauritiana* Blanco, *T. moluccana* Lam. (Chacko *et al.*, 2002).

Family: Combretaceae

Subfamily:

Origin:

Distribution: Common littoral tree occurring along the tropical sea coasts of Indian and Pacific Oceans, from the Seychelles to India, Malaysia, Philippines, Moluccas and Timor. Native of the Andaman, adjacent islands and Malay Peninsula. Planted extensively in tropical India both as avenue and fruit (Luna, 1996; Bose *et al.*, 1998; Chacko *et al.*, 2002).

Description: A large handsome tall deciduous tree, up to 25 m high, with horizontally spreading whorled branches from the main stem; trunk often buttressed at the base (Bose *et al.*, 1998).

Flowering season: February - May and October - November (Bourdillon, 1908). March till the end of June (Bose *et al.*, 1998).

Fruiting season: Ripen at June - July, and again in December to January (Chacko *et*

al., 2002). July to October (Bose *et al.*, 1998), January to July (Bourdillon, 1908).

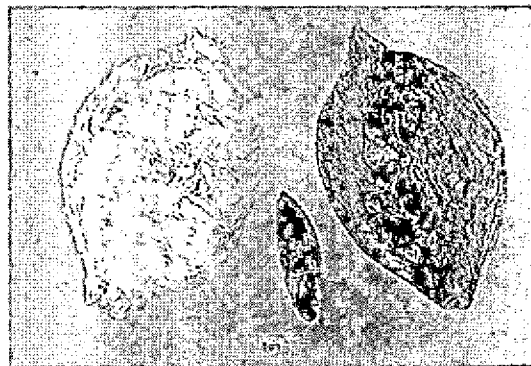
Flowers: White in axillary spikes. The upper flowers male, lower ones bisexual; calyx tube with 5 small teeth (Bose *et al.*, 1998).

Fruits: Yellowish, ellipsoidal drupe, somewhat laterally compressed, 5-6 x 3-4 cm size with a porous fleshy pericarp and hard endocarp enclosing the edible seed (Chacko *et al.*, 2002).

Fruit type: Drupe.



Branch with fruits



Fruits and seed

Seeds: Nut-like seeds covered with fibrous and fleshy rind (Bose *et al.*, 1998).

Seed dimension:

Seed length: 3.8-6.3 cm (Chacko *et al.*, 2002).

Seed width:

Seed thickness:

Seed weight: 150 to 850 seeds/kg (Kindt *et al.*, 1997); 176 seeds/kg (FRI, 1984; Chacko *et al.*, 2002). Seed germination and seedling height is directly correlated with seed weight (Abdul Assiset *et al.*, 1992).

Seed dispersal: Birds (Meehan *et al.*, 2002).

Seed collection: Collect the mature ripe fruits from the tree by shaking the branches manually. Fruits are also collected from the ground (Chacko *et al.*, 2002).

Transportation of seeds: Fruits are transported in ventilated containers as quickly as possible to the processing centre (Chacko *et al.*, 2002).

Seed processing: De-pulp the fruits and dry them under shade (Chacko *et al.*, 2002).

Seed storage: Orthodox (CABI, 1998). The depulped fruits can be stored for about six months (Chacko *et al.*, 2002).

Viability period: Under ambient temperatures it is viable for six months (Chacko *et al.*, 2002).

Seed emptiness: Low (Chacko *et al.*, 2002).

Seed pre treatment: Soak the seeds in cold water for 24hrs (Chacko *et al.*, 2002). Partial removal of the seed coat (Prinset *et al.*, 1994).

Germination type: Epigeal (Chacko *et al.*, 2002).

Germination percentage: 30 to 80 (Carlowitz, 1991; Chacko *et al.*, 2002). Germination percent in garden soil and with untreated seeds is 63% (Lanting, 1982).

Germination period: No information (Chacko *et al.*, 2002).

Nursery technique: Seeds are sown in germination trays containing vermiculite and watered regularly. Seedlings are transplanted into polybags of size 22.5 cm x 17.5 cm filled with soil based potting mixture (Chacko *et al.*, 2002). Seedlings grown in potting medium of 3 kg sand/soil/FYM in equal proportions in plastic containers reach a mean height of 45.2 cm and 2.7 cm girth (Gopakumar and Gopikumar, 1993).

Propagation:

· **Method of propagation:** By seeds.

Vegetative propagation:

Pests: No information (Chacko *et al.*, 2002).

Diseases: No information (Chacko *et al.*, 2002). *Cryptococcus neoformans* remain viable for 100 days after infection in almond trees (Huerfano *et al.*, 2001).

Medicinal properties: The fluid from the bark is used to treat diabetes and is used as a tonic. The juice of the young leaves is used to cure skin diseases and for the treatment of headache and colic. The bark extract is said to be a remedy for dysentery and bilious fever (Bose *et al.*, 1998). Aqueous extracts of fruit possess antidiabetic potential (Nagappa *et al.*, 2003). The kernel of seeds has aphrodisiac activity and is useful in the treatment of certain forms of sexual inadequacies, such as premature ejaculation (Ratnasooriya and Dharmasiri, 2000).

Uses: The timber is used in house building and in general carpentry. It is suitable for rafter, scantlings, posts and beams. The seeds are edible (FRI, 1984; Chacko *et al.*, 2002). The leaves contain a colouring matter used for colouring silks and wools. The tree commonly planted on roadside and in parks and gardens as ornamental tree (Bose *et al.*, 1998). The seeds contain low levels of essentially non-toxic lectin,

moderate amounts of trypsin inhibitors and negligible quantities of alpha-amylase inhibitors and have therefore great potential as dietary protein source for man and livestock (Grant *et al.*, 1995). Seeds are used for the production of edible oil (Hasei, 1981). *Terminaliacatappa* seeds are rich in saturated fatty acids (Gupta *et al.*, 1983).

Wood properties: The wood is greyish or pinkish brown with inconspicuous streaks,

without any distinct heartwood. It is moderately hard and moderately heavy wood. It is a diffuse porous wood with growth rings delimited by dark coloured fibrous tissues and sometimes also by interrupted lines of soft tissues. Pores moderate sized, scanty, joined by wavy bands of soft texture. Rays fine (Bourdillon, 1908).

References:

- Abdul Assis, Gopikumar, K., Anoop, E.V. and Assis, A. 1992. Correlation studies between seed and seedling characters in *Terminalia* species. *Myforest*. 28: 159-163.
- Bose, T.K., Das, P. and Maiti, G.G. 1998. *Trees of the world*, Vol. 1. Regional Plant Resource Centre, Orissa. India. pp. 466.
- Bourdillon, T.F. 1908. *Forest trees of Travancore*. International Book Distributors, Dehradun. pp. 173.
- CABI. 1998. *The Forestry Compendium – A Silvicultural Reference*. Module 1. CABI Publishing, CAB International, Wallingford, Oxon, OX108DE, UK.
- Carlowitz, P.G.V. 1991. *Multipurpose Trees and Shrubs: Source of seeds and Inoculants*. International Council for Research in Agroforestry, Nairobi, Kenya.
- Chacko, K.C., Pandalai, R.C., Seethalakshmi, K.K., Mohanan, C., George Mathew and Sasidharan, N. 2002. *Manual of Seeds of Forest Trees, Bamboos and Rattans*. Kerala Forest Research Institute, Peechi, Kerala. pp. 230-231.
- FRI. 1984. *Troup's The Silviculture of Indian Trees*. Vol. V. The Controller of Publications, Delhi.
- Gopakumar, S. and Gopikumar, K. 1993. Standardisation of containers for growth and vigour of tree seedlings in the nursery. *Journal of Tropical Forest Science*. 6: 26-36.
- Grant, G., More, L.J., McKenzie, N.H., Dorward, P.M., Buchan, W.C., Telek, L. and Pusztai, A. 1995. Nutritional and haemagglutination properties of several tropical seeds. *Journal of Agricultural Science*. 124: 437-445.
- Gupta, R., Rauf, A., Ahmad, M.A., Ahmad, F., Osman, S.M. and Ranjana Gupta. 1983. Chemical screening of seed oils. *Journal of the Oil Technologists' Association of India*. 15: 6-7.
- Hasei, H.F. 1981. Use of the seeds of *Terminaliacatappa* for the production of edible oil. ii + 35 pp.

- Huerfano, S., Castaneda, A. and Castaneda, E. 2001. Experimental infection of almond trees seedlings (Terminaliacatappa) with an environmental isolate of *Cryptococcus neoformans* var. *gattii*, serotype C. *Revista Iberoamericana de Micologia*. 18: 131-132.
- Kindt, R., Mausya, S., Kimotho, J. and Waruhiu. 1997. Tree seed suppliers Directory: Sources of Seeds and Microsymbionts. International Centre for Research in Agro Forestry (ICRAF), Nairobi, Kenya.
- Lanting, M.V. Jr. 1982. Germination of talisai (Terminaliacatappa Linn.) seeds. *Sylvatrop*. 7: 27-34.
- Luna, R.K. 1996. Plantation Trees. International Book Distributors, Dehra Dun, India.
- Meehan, H.J., McConkey, K.R. and Drake, D.R. 2002. Potential disruptions to seed dispersal mutualisms in Tonga, Western Polynesia. *Journal of Biogeography*. 29: 695-712.
- Nagappa, A.N., Thakurdesai, P.A., Rao, N.V., Jiwan Singh and Singh, J. 2003. Antidiabetic activity of Terminaliacatappa Linn fruits. *Journal of Ethnopharmacology*. 88: 45-50.
- Prins, H., Maghembe, J.A. and Maghembe, J.A. 1994. Germination studies on seed of fruit trees indigenous to Malawi. Special Issue: Agroforestry research in the African miomboecozone. Proceedings of a regional conference on agroforestry research in the African miomboecozone held in Lilongwe, Malawi, 16-22 June 1991. *Forest Ecology and Management*. 64: 111-125.
- Ratnasooriya, W.D. and Dharmasiri, M.G. 2000. Effects of Terminaliacatappa seeds on sexual behaviour and fertility of male rats. *Asian Journal of Andrology*. 2: 213-219.

Terminalia chebula

Nomenclature:

Scientific name: *Terminalia chebula* Retz.

Vernacular name: Kadukka (Malayalam), Harara, Haritaki (Hindi), Kadukhai (Tamil) Aralaikai, Alalai (Kannada) (Chacko *et al.*, 2002).

Common name: Myrabolan tree, Harir, Harad, Gall nut (Chacko *et al.*, 2002), Chebulicmyrobalan (Bose *et al.*, 1998).

Synonyms: *Terminalia tomentella* Kurz, *T. parviflora* Thwaites, *Myrobalanus chebula* Gaertn. (Chacko *et al.*, 2002).

Family: Combretaceae

Subfamily:

Origin:

Distribution: Grown in many tropical parts of the countries like India, Sri Lanka, Nepal, Sri Lanka, Myanmar and in South East Asia (Bose *et al.*, 1998). In India, it occurs in Himalayan tracts from river Ravi, eastwards, to West Bengal and Assam up to 1500 m. In Kerala, it occurs in moist deciduous forests up to 600 m (FRI, 1984; Chockoet *et al.*, 2002).

Description: Slow growing, medium to large deciduous tree with rounded crown and spreading branches attaining a height of 24 m and a breast height diameter of 80 cm (FRI, 1984; Chacko *et al.*, 2002).

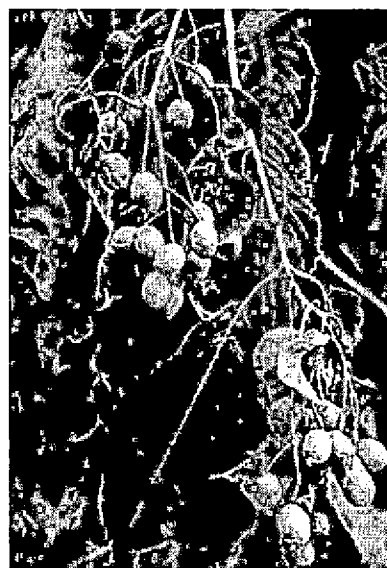
Flowering season: March to April (Bourdillon, 1908). March- June (outer Himalayas), July- August (Central India), April to July (Bose *et al.*, 1998).

Fruiting season: Ripen at November - March (Bose *et al.*, 1998). November to May (FRI, 1984; Chacko *et al.*, 2002).

Flowers: Small greenish white, fragrant, bisexual, about 6 mm in diameter in terminal spikes. Calyx campanulate (Bose *et al.*, 1998).

Fruits: Hard drupe, ellipsoidal or ovoid, woody, obscurely angled, 2.5 to 4 x 1.5 to 2 cm (Chacko *et al.*, 2002).

Fruit type: Drupe.



Branch with fruits



Fruits

Seeds: Seed oblong, thick, obscurely angled.

Seed dimension:

Seed length: 3 cm (Chacko *et al.*, 2002).