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# *Crop Improvement for a Better Tomorrow*

[A Memoir of the Department of Plant Breeding and Genetics  
(1972 - 2005)]

Compiled by:

Dr. Dijee Bastian  
Dr. Achamma Oommen



**DEPARTMENT OF PLANT BREEDING & GENETICS  
COLLEGE OF HORTICULTURE  
KERALA AGRICULTURAL UNIVERSITY  
VELLANIKKARA, KERALA  
2005**

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Publication released on the eve of the winter school on Intellectual Property Rights of Genetic Resources – dimensions and tools held at the College of Horticulture, KAU from 9<sup>th</sup> – 29<sup>th</sup> Nov, 2005.

## PREFACE



The Department of Plant Breeding and Genetics has brought laurels in the field of crop improvement since its inception in 1972 with the formation of the College of Horticulture, Kerala Agricultural University. A good number of students produced from this department occupy the highest positions in the ICAR and allied institutes. A considerable number of externally aided projects are also ongoing in the Department. Looking at its horizontal and vertical growth, the Head of the Department has been declared as the Drawing and Disbursing Officer when the AICRP on Medicinal Plants was attached to the Department in 2003-04. It is now an independent department with its goals and objectives, moving forward step by step under the dynamic leadership of Dr. Achamma Oommen, who put yeoman's service before she retires in the first quarter of 2006. The members of the faculty could attend several national and international workshops / seminars / symposia / short courses organized within and outside the country. The Department could organize an ICAR sponsored short course on "Emerging trends in conservation, utilization and management of genetic resources" between 22<sup>nd</sup> Sep.-1<sup>st</sup> Oct. 2003 and Workshops on Patent awareness and Seed's Bill For the first time in the University, they could highlight on Geographical Indications of Goods and its relevance under the WTO regime in the global scenario for the benefit of the farming community.

I am extremely happy to note that a publication of this nature, wherein the results of research projects in crop improvement taken up by the Department since its inception, has been brought out in an abridged form in connection with the scheduled Winter School entitled "Intellectual Property Management of Genetic Resources – Dimensions and Tools", being organized from 09-11-2005 to 29-11-2005 at the Department in the College of Horticulture, KAU. It is a commendable work. I hope this will be read widely by the concerned teachers and scientists and utilized in their future programmes for further improvement.

I must congratulate Dr. Achamma Oommen and her team for timely action in bringing out this publication in its own style.

**Dr. GSLHV Prasada Rao**  
Associate Dean

## FOREWORD

*The Department of Plant Breeding and Genetics is a statutory department of the College of Horticulture functioning from the very inception. From 1972 to 1976 the department was offering courses for undergraduate students. During 1976 M.Sc. (Ag.) programme and in 1983 Ph.D. Programme were commenced. So far 60 students were awarded MSc. (Ag.) degree and 20 students doctoral degree from the Department. The intake capacity at present is four students in MSc. (Ag.) and two in Ph.D.*

*A Sugarcane Research Project aided by the ICAR was functioning in the Department from 1979 to 1984 at Vellanikkara Centre, with subcentres at Thiruvalla and Menonpara. The Department had taken leadership to implement a NATP project on medicinal plants during 2000 to 2004, with Kerala Agricultural University as the lead centre and TNAU, ANGRAU and OUAT as co-operating centres. Presently, an All India Network Project on Medicinal and Aromatic Plants with its 17 ongoing research projects is functioning in the Department. A unique herbal garden of an area of 4 ha. comprising a collection of about 400 medicinal plants are being maintained in the Department. This herbal garden housing rare medicinal plants is a point of attraction to the Ayurvedic doctors, dignitaries, academicians, officers of the State Department of Agriculture, farmers and students visiting Kerala Agricultural University. Research on medicinal plants had led to the release of a long pepper variety, "Viswam".*

*Apart from this, five externally aided research projects and other Kerala Agricultural University projects are functioning here. The concept of participatory plant breeding in crop improvement was pilot tested in the Department under the GALASA programme. Successful completion of the programme lead to the evolution of two rice varieties viz., Kunjunganju Varna and Kunjunganju Priya. Apart from these crop varieties, promising accessions especially in coleus, cowpea and medicinal rice are in the pipeline. The Department has well equipped laboratories for tissue culture, cytogenetics, biochemistry and plant physiology.*

*Plant physiology is attached to the Department of Plant Breeding and Genetics. The unit is effectively imparting crop physiology courses for both UG and PG students of Agriculture and Horticulture. The unit also provides technical support to other disciplines as and when required in tackling field problems.*

*The scientists of the Department actively participate in the day-to-day activities of the college and they serve as resource persons in various seminars and workshops conducted by the Agricultural Department and other agencies. Moreover, the Department is instrumental in organizing many national and state level workshops, seminars, ICAR winter schools in the area of conservation and utilization of Plant Genetic Resources and Intellectual Property Rights in agriculture. In this occasion, we acknowledge the contributions made by the former Heads of the Departments and other scientists who worked in the department which has paved the way for all the development of this department.*

**Dr. ACHAMMA OOMMEN**  
**Professor & Head**  
**Dept. of Plant Breeding**  
**& Genetics**

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## **FORMER HEADS OF DEPARTMENT**

### **Department of Agricultural Botany**

1 Dr. K. M. N. Namboodiri : 1975- 1995

### **Department of Plant Breeding and Genetics**

2. Dr. K. M. N. Namboodiri : 1995

3. Dr. K.Pushkaran : 1995-2004

## **PRESENT STAFF POSITION**

### **A) TEACHING**

1. Dr. Achamma Oommen, Professor & Head.
2. Dr. K.T. Presanna Kumari, Associate Professor.
3. Dr. K. Nandini, Associate Professor
4. Dr. C.R. Elsy, Assistant Professor (Senior Scale)
5. Dr.R Sujatha, Assistant Professor
6. Dr. Dijee Bastian, Assistant Professor.

### **B) SUPPORTING STAFF**

Shri. P B Sivadasan, Lab Assistant (Gr. II)

## LIST OF COURSES OFFERED

### I. Under Graduate Programme

1	Pbgn. 1101	Elements of Genetics and Cytogenetics	2 + 1
2	Pbgn. 1202	Principles of Plant Breeding	2 + 1
3	Pbgn. 2203	Breeding of Crops	2 + 1
4	Pbgn. 3204	Seed Production and Certification	2 + 1

### II Post Graduate Programme

#### 600 Series Courses- For M.Sc. (Ag.)

1	PBGen. 601	Elements of Genetics	2 + 1
2	PBGen. 602	Cytogenetics I	2 + 1
3	PBGen. 603	Cytogenetics II	2 + 1
4	PBGen. 604	Molecular Genetics	2 + 0
5	PEGen. 605	Population Genetics	2 + 1
6	FBGen. 606	Radiation Genetics	1 + 1
7	PBGen. 607	Genetic Basis of Plant Breeding	2 + 1
8	PBGen. 608	Methods of Plant Breeding	2 + 1
9	PBGen. 609	Breeding of Self Fertilized Crops	2 + 1
10	PBGen. 610	Breeding of Cross Fertilized Crops	2 + 1
11	PBGen. 611	Breeding of Asexually Propagated Crops	2 + 1
12	PBGen. 612	Breeding of Tree Crops	2 + 1
13	PBGen. 613	Seed Production, Testing and Certification	2 + 1
14	PBGen. 651	Seminar	0 + 1



### 700 Series Courses- For Ph. D

1	PBGen. 701	Cytogenetics of Crop Plants	2 + 0
2	PBGen. 702	Extra Nuclear Inheritance	2 + 0
3	PBGen. 703	Genetic Engineering	2 + 0
4	PBGen. 704	Biochemical Genetics	2 + 0
5	PBGen. 705	Plant Cell and Tissue Culture	2 + 1
6	PBGen. 706	Heterosis Breeding	2 + 1
7	PBGen. 707	Mutation Breeding	2 + 1
8	PBGen. 708	Polyploidy Breeding	2 + 1
9	PBGen. 709	Resistance Breeding	2 + 1
10	PBGen. 710	New Frontiers of Crop Breeding	2 + 1
11	PBGen. 711	Evolution of Crops and Plant Genetic Resources Utilization	2 + 1
12	PBGen. 751	Seminar	0 + 1
13	PBGen. 752	Seminar	0 + 1

## LIST OF EXTERNALLY AIDED PROJECTS

1. Commercial rice hybrids for Kerala – Evolution of two – line rice hybrids using WC genes and TGMS lines. (KSCSTEC)  
**P.I - Dr.V.V.Radhakrishnan , Associate Professor.**
2. Participatory plant breeding for the development of rice varieties suited for specific agroecological situations of Kerala. (KSCSTEC)  
**P.I - Dr.C.R.Elsy, Assistant Professor.**
3. Evaluation of popular black pepper cultivars of North and South Kerala for growing as bush pepper. (KSCSTEC)  
**P.I - Dr.K.Arya, Assistant Professor.**
4. Comparative evaluation of red and white flowered ecotypes of sacred lotus (*Nelumbo nucifera* Gaertn.). (KSCSTEC)  
**P.I - Dr.K.T.Presanna Kumari, Associate Professor**
5. Exploration, collection, evaluation and standardisation of quality planting materials of important medicinal plants of Kerala.  
**(National Medicinal Board)**  
**P.I - Dr.V.V.Radhakrishnan , Associate Professor**

### KAU – Plan

6. Adaptability of photo-insensitive *Coleus* mutants in Central regions of Kerala.

## LIST OF M.Sc. (Ag) DEGREE RECIPIENT

Chandrika	Dr. K.M.N. Namboodiri	Genetic Studies in cowpea
Nandini, K.	Dr. Luckins C. Babu	Seed Biology and Seedling characteristics of important weeds in Kerala
Inasi, K.A.	Dr. K.M.N. Namboodiri	Studies on inter-varietal hybrids in cowpea
Jalajakumari, M.B.	Dr. K.M.N. Namboodiri	Variability studies in cowpea
Sumathikuttiamma B	Dr. K.M.N. Namboodiri	Investigations on inter-varietal F <sub>2</sub> hybrids in cowpea
Balakrishnan, P. C	Dr. K.M.N. Namboodiri	Genetic Divergence in coconut
Kanakamony, M. T.	Dr. Luckins C. Babu	Formulation of a key for identification of the different types of pepper <i>Piper nigrum</i> L
Kavitha K. Mydin	Dr. T. V. Viswanathan	Screening blackgram genotypes under moisture stress conditions in rice fallows
Rosamma, C. A.	Dr. K.M.N. Namboodiri	Biometrical studies in banana
Gregory Zachariah	Dr. K. Kumaran	Genetic variability and correlation studies in cocoa ( <i>Theobroma cacao</i> L.)
Tessy Joseph	Dr. K. Kumaran	Floral Biology and fruit development in varikka and koozha types of Jack ( <i>Artocarpus heterophyllus</i> Lam)
Jayaprakash Naik	Dr. N. K. Vijayakumar	Cytotoxic and clastogenic effects of some insecticides in <i>Allium cepa</i> L
Madhu, P.	Dr. K. Kumaran	Pollination Pod set and compatibility studies in open pollinated progenies of cocoa variety <i>Forasteo</i>
Elsy, C. R.	Dr. K.M.N. Namboodiri	Pollination Studies in cashew
Jayanthi, S.	Dr. K.M.N. Namboodiri	Biological effects of gamma rays and EMS in the M <sub>1</sub> generation of redgram ( <i>Cajanus cajan</i> L.)
Neema V. P.	Dr. K.M.N. Namboodiri	Genomic relationship in <i>Vigna</i> sp.
Brenda Valentina	Dr. K.M.N. Namboodiri	Biological effects of gamma rays and EMS in the M <sub>2</sub> generation of redgram ( <i>Cajanus cajan</i> L.)

Mini, K.C.	Dr. T. V. Viswanathan	Karyomorphology pollen sterility and seed set in vettiver ( <i>Veteveria zizanooides</i> )
Sajikumar, T. A.	Dr. Achamma Oommen	Genetic resource evaluation of groundnut ( <i>Arachis hypogea</i> L.) for resistance for tikka leaf spot
Sujatha, R.	Dr. K.M.N. Namboodiri	Variability in inter-varietal F <sub>1</sub> hybrids and open pollinated seed progenies of black pepper ( <i>Piper nigrum</i> L.)
Radhakrishnan G.R.	Dr. T. V. Viswanathan	Evaluation of selections and hybrids of vetiver ( <i>Veteveria zizanooides</i> L.)
Sunil, K. P.	Dr. Achamma Oommen	Anthe culture in cocoa
Jolly Anthony	Dr. Achamma Oommen	Somatic Embryogenesis in cocoa ( <i>Theobroma cacao</i> L.)
Homey Cheriyan	Dr. N. K. Vijayakumar	Genetic analysis of yield attributes in Cocoa ( <i>Theobroma cacao</i> L.)
Narayanan, A. K.	Dr. Luckins C. Babu	Collection cataloguing and evaluation of <i>Rauwolfia</i> spp
Rekha K.	Dr. T. V. Viswanathan	Cytogenetic analysis in Kacholam
Swapna M.	Dr. Achamma Oommen	Germplasm evaluation in horse gram
Jiji Joseph	Dr. V. K. Mallika	Plantlet regeneration through somatic embryo genesis in cocoa
Jaya Manuel	Dr. T. V. Viswanathan	Comparative evaluation of selected types of <i>Piper longum</i> (Linn)
Siby Thomas	Dr. S. G. Sreekumar	Variability of biological nitrogen fixation traits and yield in blackgram ( <i>Vignamungo</i> (L.) Hepper)
Latha E. V.	Dr.T. V. Viswanathan	Evaluation of Kacholam ( <i>Kaempferia galanga</i> L.) types for morphological variability and yield
Prakash K. M.	Dr. K Pushkaran	Biometrical analysis of yield and other attributes in <i>coleus</i>
Lissymol J. Vadakoot	Dr. K. T. Presannakumari	Evaluation of morphoanatomical variations in <i>Ocimum</i> spp
Ajith Mohan N. K.	Dr. K. Pushkaran	Induction of polyploidy in Kacholam ( <i>Kaempferia galanga</i> L.)

Manjula M.	Dr. K. K. Ibrahim	Gametocidal properties of certain chemicals in rice ( <i>Oryza sativa</i> L.)
Fancy Parameswaran	Dr. K. T. Presannakumari	Reproductive biology and enzyme studies in <i>Ocimum</i> spp
Raji Varghese	Dr. K. Pushkaran	Standardisation of selection criteria for cocoa hybrids
Sinhumole P.	Dr. K. K. Ibrahim	Genetic variability and correlations in nine divergent varieties of coconut ( <i>Cocos nucifera</i> L)
Thara Manoharan	Dr. K. Nandini	Cytological and biochemical changes in aged and osmoprimed seeds of Chillies ( <i>Capsicum annum</i> L.)
Sreejaya K.C.	Dr. V. V. Radhakrishnan	Genetic divergence and selection parameters in basmathi rice
Faseela K.V.	Dr. Mareen Abraham	Genetic analysis in F <sub>2</sub> and F <sub>3</sub> progenies of selected crosses of rice varieties of diverse origin
Deepa K.P.	Dr. V. V. Radhakrishnan	Variability analysis of allogamous traits in rice ( <i>Oryza sativa</i> L)
Srinivasa Reddy G	Dr. C. R. Elsy	Characterisation and evaluation of the rice ( <i>Oryza sativa</i> L) cultivar Njavara
Laiju Paul K.	Dr. K. K. Ibrahim	Variability in morphological, Physiological and biochemical characters in Kalmegh ( <i>Andrographis paniculata</i> Nees.)
Ambily S.Nair	Dr. C. A. Rosamma	Genetic and physiological analysis of ratooning in rice ( <i>Oryza sativa</i> L.)
Jyothi C	Dr. M. T. Kanakamony	Genetics of bruchid ( <i>Callosobruchus</i> Sp.) resistance and yield in cowpea.
Anila P	Dr.T. Girija	Impact of seed deterioration on seedling vigour in mango ( <i>Mangifera indica</i> L.)
Sindhu V. K	Dr. K. Nandini	Physiological genetics of character associations in hybrid rice ( <i>Oryza sativa</i> L.)
Usha Vani D.	Dr. V. G. Jayalakshmi	Morphological, biochemical and molecular markers for the genetic analysis of cashew ( <i>Anacardium occidentale</i> ).

Jyothi. R.	Dr. V. V. Radhakrishnan	Stability analysis of kunjukunju rice cultures ( <i>Oryza sativa</i> L.)
Shinoj P.	Dr. Mareen Abraham	Stability analysis of selected mutants of coleus ( <i>Solenostemon rotundifolius</i> ).
Vidhu Francis P.	Dr. M. T. Kanakamony	G x E interaction in the F <sub>6</sub> generation of wide crosses of rice.
Sumarani P.	Dr. K. Arya	Genetic analysis of F <sub>2</sub> and F <sub>3</sub> generations for yield attributes and resistance to distortion mosaic virus disease in bittergourd.
Chandrasahsan V. T.	Dr. Dijee Bastian	Androgenesis in rice ( <i>Oryza sativa</i> L.)
Anisha George	Dr. Mareen Abraham	Genetics of trailing habit in yard long bean ( <i>Vigna unguiculata</i> var. <i>sesquipedalis</i> (L) Verd court ).
Chandrasekhar S. S.	Dr. C. R. Elsy	Genotype x Environment interaction in commercial rice ( <i>Oryza sativa</i> ).
Divya Satheesh	Dr. C. A. Rosamma	Convergent breeding for new plant type in rice ( <i>Oryza sativa</i> ).
Gayathri G.	Dr. K. Arya	Standardisation of invitro propagation techniques in thathiri ( <i>Woodfordia fruticosa</i> (L) Kurz.)
Ambika Rajendran P.	Dr. Dijee Bastian	Invitro mutagenesis in rice ( <i>Oryza sativa</i> ).

## LIST OF Ph.D DEGREE RECEIPIENTS

Radhakrishnan V.V.	Dr. K.M.N.Namboodiri	Genetic studies in red gram ( <i>Cajanus cajan</i> L).
Achamma Oommen	Dr.K.M.N.Namboodiri	Genetic analysis in red gram ( <i>Cajanus cajan</i> L).
Presanna Kumari K.T.	Dr.K.M.N.Namboodiri	Seed dormancy in groundnut.
Tessy Joseph	Dr.K.M.N.Namboodiri	Genetic analysis of productivity and seed dormancy in groundnut ( <i>Arachis hypogaea</i> ).
Kanakamony M.T.	Dr.K.M.N.Namboodiri	Induction of genetic variability in kacholam ( <i>Kaempferia galanga</i> L).
Bindu M.R.	Dr.V.K.Mallika	Standardisation of <i>invitro</i> techniques for rooting, hardening and micrografting in cocoa.
Rose Mary Francis	Dr. Achamma Oommen	Genetic analysis of certain clones,hybrids and inbreds in cocoa
Rosamma C.A.	Dr.N.K.Vijayakumar	Identification of stable male sterile lines and better com biners for exploitaton of hybrid vigour in rice ( <i>Oryza sativa</i> L.)
Vanaja T.	Dr. Luckins.C.Eabu	Genetic analysis of high yielding rice varieties of diverse origin.
Homey Cheriyian	Dr.N.K.Vijayakumar	<i>Agrobacterium</i> mediated genetic transformation in black pepper ( <i>Piper nigrum</i> L).
Mercy M.A.	Dr. Luckins.C.Babu	Genotypic evaluation and screening for drought tolerance in wild <i>Hevea</i> germplasm.
Sujatha R.	Dr.V.K.Mallika	Characterisation of field established tissue culture derived black pepper ( <i>Piper nigrum</i> L) plants using morphological, cytological and molecular markers.
Veena Vigneswaran	Dr.K.Kumaran	Exploitation of male sterility in sesame ( <i>Sesamum indicum</i> L).
Biju S.	Dr.V.V.Radhakrishnan	Alternative sources of cytoplasmic male sterility and genetic analysis of fertility restoration in rice ( <i>Oryza sativa</i> L).

Arunachalam P	Dr.V.V.Radhakrishnan	Breeding for resistance to distortion mosaic virus in bittergourd ( <i>Momordica charantia</i> L).
Mareen Abraham	Dr.V.V.Radhakrishnan	Assessment and induction of variability for higher yield and photoinsensitivity in coleus.
Kuriakose K.P	Dr.K.Pushkaran	Heterosis breeding and in <i>invitro</i> mutagenesis in pineapple ( <i>Ananas comosus</i> (L) Merr.)
Minimol J S	Dr. K.T.Presanna Kumari	Morphogenesis and reproductive biology of sacred lotus ( <i>Nelumbo nucifera</i> Gaertn.)
Sanal Kumar. K	Dr.C.R.Elsy	Biochemical and molecular characterization of Njavara types of rice ( <i>Oryza sativa</i> L).
Ambili S. Nair	Dr. V. V. Radha Krishnan	Breeding for two line hybrids in rice ( <i>Oryza sativa</i> L.)



## POST GRADUATE STUDENTS IN ROLL

Karuppaiyan R.	Dr. K. Nandini	Breeding for resistance to shoot and fruit borer ( <i>Earias vittella</i> F) in okra ( <i>Abelmoschus esculentus</i> (L..) Moench)
Jitha Jaleel	Dr. K. Nandini	Characterisation of long pepper ( <i>Piper longum</i> L.) genotypes using morphological, anatomical and molecular markers
Latha M.	Dr. K. T. Presannakumari	Characterization and systematic evaluation of genetic resources of the Genus <i>Vigna</i>
Vishnuvardhan Reddy Banda	Dr. V. V. Radha Krishnan	Exploration, collection and evaluation of Brahmi ( <i>Bacopa monniera</i> )
Sani George	Dr. Dijee Bastian	Reproductive biology and <i>in vitro</i> propagation techniques of <i>Kumizhu</i> ( <i>Gmelina arborea</i> )
Aswathi M. V.	Dr. K. T. Presannakumari	Study of reproductive Biology and <i>In vitro</i> propagation techniques in Bael ( <i>Aegle marmelos</i> )
Marimuthu M.	Dr. C. R. Elsy	G X E interaction of NPT lines in Rice –

## JUNIOR POST GRADUATE STUDENTS

1. Raji Namboodiri
2. Kishore Boddu
3. Shareesh

## CEREALS

### **1. Manjula, M. 1996. Gametocidal properties of certain chemicals in rice (*Oryza sativa* L.). M.Sc. (Ag.) thesis.**

Three chemicals viz., ethrel, maleic hydrazide and streptomycin were sprayed at 4000, 6000 and 8000 ppm at spikelet differentiation stage or pollen mother cell formation stage in rice variety Annapurna and Athira. Pollen and spikelet sterility differed with chemical, concentration and variety. Maleic hydrazide was the most effective in inducing pollen sterility up to 99.3%. Ethrel was moderately effective and streptomycin failed to induce pollen sterility. Maleic hydrazide at 4000 ppm appeared to be the most ideal treatment for population improvement programme. On the other hand, in hybrid rice programme that require almost complete male sterility, maleic hydrazide at 8000 ppm at spikelet differentiation stage or at 6000 ppm at pollen mother cell formation stage appeared to be more suitable.

### **2. Rosamma, C. A. 1998. Identification of stable male sterile lines and better combiners for exploitation of hybrid vigour in rice (*Oryza sativa* L.). Ph. D thesis.**

Two cytoplasmic male sterile source viz., WA and *Oryza perennis* were used in the study to identify stable male sterile lines as well to locate the best combiners. Seven lines were found stable for pollen and spikelet sterility. When crossed with CMS lines having WA cytoplasm, Jyothi, Aruna, Pavizham and Ptb-10 produced more number of sterile hybrids and hence these varieties can be used as maintainers. More number of fertile hybrid combinations was produced by Annapoorna, Matta Triveni, Kanchana, IR 36 and Aishwarya indicating the use of these varieties as restorers for WA cytoplasmic source. Similarly, when crossed with CMS lines having *O. perennis* cytoplasm all the genotypes under study produced sterile hybrids and no restorers could be identified for this new source of cytoplasmic male sterility. Fertility restoration was found to be polygenically inherited. The male sterile line IR 68890 A was the best combiner for most of the agronomic traits, and IR 68890 A x Aishwarya was the best specific hybrid combination.

**3. Vanaja, T. 1998. Genetic analysis of high yielding rice varieties of diverse origin.** Ph. D thesis.

The cytoplasm of Vytilla 3 was identified as an alternative source for cytoplasmic male sterility in rice for warm humid tropical climate of Kerala, while IR 36 and Hraswa were proposed as maintainer and Matta Triveni as restorer line. Varieties Vytilla 3, Mahsuri, Matta Triveni and Karthika were identified as good general combiners. From the F<sub>2</sub> generation seven early stabilized promising lines and 26 promising segregants were selected. Two early stabilized lines possessed most of the ideotype features proposed by IRRI with preferable cooking quality. The yield and yield components were found to be under the control of all the three types of gene actions namely, additive, dominance and epistasis. Hence intercrossing of early segregating generations derived from multiple crosses seems to be the best suited method for yield improvement in rice.

**4. Sreejaya, K.C. 1999. Genetic divergence and selection parameters in basmati rice.** M.Sc. (Ag.) thesis.

Thirty eight advanced breeding lines of basmati rice evolved at various research centre in India were grown to select high yielding quality types suited to Kerala ecosystem. The genotypes exhibited variation in almost all characters. Number of days to panicle initiation, kernel breadth, L/B ratio and taste showed maximum heritability. It was observed that, while selecting genotypes for higher yield potential, emphasis should be given for comparatively long vegetative period, short period from panicle initiation to 50 percent flowering and dwarf plant type. Selection model was formulated consisting of the characters viz., yield per hectare, number of days to panicle initiation, height of plant at harvest, number of panicles per m<sup>2</sup>, alkali value and elongation ratio. Basmati culture 385 and UPR-BS-92-4 were identified as superior among the genotypes studied.

**5. Ambili S. Nair. 2000. Genetic and physiological analysis of ratooning in rice (*Oryza sativa* L.).** M.Sc. (Ag.) thesis.

The study was carried out to understand the genetic and physiological factors governing the ratooning in 50 rice genotypes. Five rice varieties viz., CO 43, 1R 20, White ponni, Ponmani and Mangala Mahsuri recorded better in terms of ratoon performance. The estimates of GCV, heritability and genetic gain were

high in the case of ratoon crop for most of the characters studied. The study revealed that ratoon yield can be improved by selecting crop varieties having long duration, more number of grains per panicle, more number of unproductive tillers per plant and reduced grain production per day. Genetic and physiological analysis revealed that the varieties IR 20, Mangala Mahsuri, White ponni and Ponmani can be recommended as genotypes suitable for ratooning in Kerala. By using these varieties about one-third of the main crop yield can be achieved without increasing the land area.

**6. Deepa, K.P. 2000. Variability analysis of allogamous traits in rice (*Oryza sativa* L.). M.Sc. (Ag.) thesis.**

This study was conducted in order to estimate the amount of variability for floral traits influencing out-crossing in high yielding, local and wild genotypes and CMS lines. Significant variation was observed in all the characters studied. Highest genotypic and phenotypic co-efficient of variations were observed for stigma exertion followed by percent out-crossing and residual pollen. Significant positive correlation was observed between out-crossing and the floral traits-flag leaf angle and spikelet opening–closing durations. V20A, V20B, Jaya, Kanchana, Bharathi, Neeraja, Kairali, Nandyar, Chennellu, *Oryza longistamina*, *Oryza officinalis* and *Oryza spontanea* had good floral traits that favours out-crossing.

**7. Faseela, K.V. 2000. Genetic analysis in F<sub>2</sub> and F<sub>3</sub> progenies of selected crosses of rice varieties of diverse origin. M.Sc. (Ag.) thesis.**

The F<sub>2</sub> and F<sub>3</sub> progenies of selected crosses of rice varieties were studied to isolate promising lines having desirable ideotype features. Components of heritable variation revealed a decreased trend of variability of characters in F<sub>2</sub> and F<sub>3</sub>. Genotypic correlation among different yield components in F<sub>2</sub> and F<sub>3</sub> revealed that semi-dwarf plants with higher L/B ratio and lesser grain weight increased the yield. The correlation and path analysis study suggested that during selection, breeder should give emphasis on semi-dwarf plant stature, higher number of productive tillers, compact panicles, reduced number of secondary branches and high L/B ratio of grains with reduced density. All the four crosses studied were promising to derive superior segregants, the best among them being IR 36 x Matta Triveni.

**8. Srinivasa Reddy, G. 2000. Characterisation and evaluation of the rice (*Oryza sativa* L.) cultivar Njavara. M.Sc. (Ag.) thesis.**

Morphological and biochemical characterization of 13 genotypes of 'Njavara' rice collected from different parts of Kerala were carried out. Morphological characterization indicated that the genotypes were distinct among themselves. Five accessions yielded on par with the check variety Ptb-10. Biochemical characterization revealed the possibility of utilizing peroxidase, esterase and protein polymorphism for identifying the Njavara genotypes. Most of the Njavara genotypes expressed high protein content than Ptb-10. The genotypes N2 and N8 from Chittoor and Alwaye respectively, were recommended to be included in weaning and invalid foods owing to their high protein content. The genotypes N2, N3 and N12 (the first two from Chittoor and the third from Thrissur) showed higher number and content of free amino acids. Starch grain characterization revealed the use of its size to be used for varietal characterization in conjunction with morphological and biochemical markers. The genotype N 7, a type from Tellicherry, was found to possess better digestibility due to low amylose content, high amylase activity and high soluble carbohydrate content. Variability studies indicated that fat content, straw yield and grain yield provided a good genetic base for selection. Low amylase activity, short and narrow leaves, shorter panicles, low 1000 grain weight, slender grains, short duration genotypes and smaller starch grains appeared to favour high protein content.

**9. Biju, S. 2001. Alternative sources of cytoplasmic male sterility and genetic analysis of fertility restoration in rice (*Oryza sativa* L.).**

Ph. D thesis.

In a study to identify an alternative source of cytoplasmic male sterility for warm humid tropics and genotypes for fertility restoration, Bhadra and Vytilla 3 were found to be a good sterile cytoplasmic source. Crosses between Vytilla 3 x IR 36 resulted in cent percent male sterility in the  $F_2BC_3$  generation. As regard to grain yield and components Bhadra showed highest positive *gca* effects followed by Matta Triveni. The percentage of heterosis in experimental hybrids was high enough to explore the prospects of hybrid rice suited to warm humid tropics. Many of the yield contributing traits were controlled by both allelic contributions

and its interactive effects. Hence, for improving the characters, hybridization followed by selection was suggested.

**10. Sindhu, V. K. 2001. Physiological genetics of character associations in hybrid rice (*Oryza sativa* L.). M.Sc. (Ag.) thesis.**

Three hybrids and their parental genotypes of rice were evaluated to understand how different genotypes complement one another physiologically and also to identify the stages at which the better physiological efficiency contribute to heterosis. It was found that the heterotic advantages resulted in two ways *viz.*, generalized morphologic improvement in growth and yield attributes and efficiency enhancement. The stability of chlorophyll a/b ratio and the differential changes of NRase enzyme activity, both at different phenophases shall serve as a better index for selection of genotypes in rice breeding programme. Biochemical character like peroxidase and catalase revealed that the magnitude of physiological expression is independent of genetic capabilities. The soluble protein and enzyme activity at tillering phase appears to be the most critical in deciding the yield of rice.

**11. Jyothi, R. 2002. Stability analysis of Kunjukunju rice cultures (*Oryza sativa* L.). M.Sc. (Ag.) thesis.**

Stability analysis of eight Kunjukunju' rice cultures conducted in three locations *viz.*, Palakkad, Thrissur and Ernakulam revealed that the culture K-6 was stable in different environments for many of the yield and yield traits. It can be selected as the most stable, high yielding and well adapted Kunjukunju rice culture for Palakkad, Thrissur and Ernakulam locations. The variety Kanchana grown as check was adapted only to favourable environments for many of the yield traits and unfavourable for many environments.

**12. Vidhu Francis Palathingal. 2003. G x E interaction in the F<sub>6</sub> generation of wide crosses of rice (*Oryza sativa* L.). M.Sc. (Ag.) thesis.**

G x E interaction in the F<sub>6</sub> generation of some wide crosses of rice was studied at three locations *viz.*, Mannuthy, Pattikkad and Adatt. The nine cultures studied exhibited high variability and heritability for most of the yield characters. Correlation and direct and indirect effects of the characters on yield also differed between the environments indicating the profound influence of location on the

character. Stability analysis revealed that among the nine rice cultures studied, culture C26T(b) was stable over locations for most of the yield traits with maximum grain yield C80 was the next stable culture.

**13. Chandrahasan, V.T. 2004. Androgenesis in rice (*Oryza sativa* L.) breeding. M.Sc. (Ag.) thesis.**

An investigation was carried out to produce double haploid lines through anther culture using the F<sub>1</sub> hybrids obtained by using IR 36 as ovule parent and Ptb 45 as pollen parent. Callus induction was maximum in N6 medium supplemented with maltose 60 mg/l, 2,4D 2 mg/l and kn 0.5 mg/l followed by N6 medium supplemented with maltose 60 mg/l, 2,4-D 2 mg/l and kn 1 mg/l. The percentage of embryogenic calli was higher than non-embryogenic calli. The frequency of green plants and albinos were 85.71 percent and 14.29 per cent respectively. Regeneration frequency of embryogenic and non-embryogenic calli was 27.19 percent and 22.22 percent respectively. Of the 30 green plants obtained, 21 were homozygous diploids and the rest were haploids. Frequency of spontaneous doubling was 70 percent.

**14. Chandrasekhar, S.S. 2004. Genotype x Environment interaction in commercial rice (*Oryza sativa* L.) hybrids. M.Sc. (Ag.) thesis,**

Seven commercial rice hybrids and two check varieties were evaluated for eighteen characters across three farming situations of central zone of Kerala. In general, hybrids performed better than the check with respect to yield and yield contributing characters. As regard to grain quality, check varieties showed superior performance over hybrids. The traits such as days to 50 percent flowering, plant height, straw yield per hectare, harvest index, number of days to physiological maturity, productivity per day and volume expansion ratio can be used for direct selection for yield improvement since they had exhibited significant positive correlation with grain yield. In stability analysis KRH 2 recorded highest mean value and regression coefficient less than unity. It performed well even under poor management conditions, hence KRH 2 can be recommended for general cultivation in central zone of Kerala. NSD 2 was recommended under better management conditions.

**15. Ambika Rajendran, R. 2005. *In vitro* mutagenesis in rice**

**(*Oryza sativa* L.). M.Sc. (Ag.) thesis.**

An investigation on *in vitro* mutagenesis in rice was undertaken to estimate LD<sub>50</sub> values and optimum doses for gamma rays and EMS and identifying desirable plants. Mature dehulled seeds of Ptb-26 were raised in MS medium with different combinations of 2,4-D and kn. Callus induction studies and callus proliferation studies revealed that MS + 2,4-D 2.0 mg/l + kn 0.5 mg/l were best for callus induction and proliferation. Estimation of LD<sub>50</sub> value for gamma rays and EMS revealed 30 Gy and 4Mm as respective LD<sub>50</sub> doses. Callus regeneration medium used was MS + NAA 2 mg/l + kn 4 mg/l + BAP 0.5 mg/l and the rooting medium used was MS + NAA 2 mg/l + kn 0.5 mg/l. The percentage of success of hardening obtained was 85.20%. Optimum doses for gamma rays include 10 Gy and 20 Gy and for EMS the doses were 2mM and 4mM. Six tissue culture variants were identified as desirable based on panicles plant<sup>-1</sup>, panicle length, grains panicle<sup>-1</sup> and grain yield plant<sup>-1</sup>.

**16. Divya Satheesh. 2005. Convergent breeding for new plant type in rice**  
**(*Oryza sativa* L.). (M.Sc. (Ag.) thesis.**

Combining ability analysis in 24 hybrids derived through crossing six lines and four testers revealed higher magnitude of SCA variance compared to GCA variance for 23 characters suggesting the preponderance of non-additive gene action. Among the hybrids Matta Triveni x Ponmani and Matta Triveni x Mahsuri were rated as superior cross combinations, which can be exploited in the creation of new plant type. The characters like panicle weight, panicle length, grains per panicle, plant height, 1000 grain weight, total dry matter, grain density and root length showed significant positive correlation and positive direct effect on yield revealing that the improvement of these characters can directly increase grain yield.

## **PULSES**

**1. Jayanthi, S. 1986. Biological effects of gamma rays and EMS in the M<sub>1</sub> generation of red gram (*Cajanus cajan* L.). M.Sc. (Ag.) thesis.**

Seeds of Red gram variety SA-1 were subjected to 5 doses of gamma rays (10, 20, 30, 40 and 50 K rad) and 5 doses of EMS (0.3%, 0.4%, 0.5%, 0.6% and



0.7%). There were no significant differences between two durations of chemical treatments (6 hours and 8 hours) and two presoaking times (2 hours and 4 hours) with respect to percentage of mutant plants induced. Lower doses of both mutagens stimulated germination and the per cent germination did not vary in the case of gamma irradiation while in the case of EMS it decreased with increasing concentrations of the chemicals. Gamma ray treated seeds took longer time for germination compared to those treated with EMS. Survival percentage of seedlings reduced with increase in dose of the mutagens. The rate of reduction in root length, shoot length, plant height, pollen and seed fertilities was directly proportional to the increase in doses of both gamma rays and EMS. EMS was more effective in reducing pollen and seed fertilities. Chlorophyll chimeras (in very low frequencies) and morphological variations like dwarf plants, crinkled leaves, reduced canopy size, prolonged flowering duration as well as reduced flowering duration and lower number of flowers and fruits were observed in the EMS treated population.

## **2. Brenda Valentina Aronha. 1987. Biological effects of gamma rays and EMS in the M<sub>2</sub> generation of red gram (*Cajanus cajan* L.).**

M.Sc. (Ag.) thesis.

Seeds of the M<sub>1</sub> generation of red gram variety SA-1 were made use of to raise the M<sub>2</sub> generation to study their biological effects. It was observed that in the chlorophyll mutation frequency estimated on M<sub>2</sub> progeny row basis and M<sub>2</sub> seedling basis, the pattern of change in the frequency in relation to dose was found to be the same not only for gamma rays but also for EMS. In the case of both the mutagens the frequency did not appear to exhibit any dose relationship. The spectrum of chlorophyll mutants obtained include xantha, vridis, chlorina, maculata and albiviridis. The frequency of the different types of chlorophyll mutants was found to vary with the different doses of both the mutagens and did not show any dose relationship. In general, gamma rays induced six types of chlorophyll mutants and only three types could be seen in EMS. The viable mutation frequency was estimated on M<sub>2</sub> progeny row basis. Viable mutants produced by gamma rays showed dose-dependence up to 40 K rads from where it decreases to 50 K rads. In the case of EMS, the frequencies did not show any dose relationship. Gamma irradiation induced changes in growth habit, leaf size and shape while EMS induced changes in growth habit, time of flowering, leaf

size and shape and seed colour. The mutagenic effectiveness of EMS was found to be higher than that of gamma rays in producing chlorophyll mutations. With respect to efficiency of the mutagens, gamma rays have a higher efficiency than EMS as judged by magnitude of lethality, injury and sterility caused by the two mutagens.

**3. Radhakrishnan, V.V. 1998. Genetic studies in red gram (*Cajanus cajan* L.).**  
Ph. D thesis.

An analysis of genetic diversity among the 112 genotypes of red gram obtained from NBPGR, Vellanikkara and TNAU, Coimbatore revealed that the genotypes of the same place of origin fell into different clusters, while those of diversified origin fell into same cluster. The genotypes studied were grouped into five clusters. Based on inter and intra cluster distances 20 genotypes were selected for variability and correlation studies. Both additive and non-additive gene actions were involved in the expression of different characters. Significant positive correlation existed between yield component characters and yield. These characters were inter-correlated indicating that these characters can be improved simultaneously. Path coefficient analysis showed that 93 percent of the variation in yield was contributed by the ten components considered in path coefficient analysis. A selection index was formulated with seed yield, number of pods per plant and hundred seed weight which can be used for isolating superior genotypes

**4. Achamma Oommen, 1990. Genetic analysis in red gram**  
**(*Cajanus cajan* L.).** Ph. D thesis.

A 5 x 5 diallel cross in red gram excluding reciprocals revealed predominance of additive gene effects for all characters except days to first flowering. The line PLA 550 was the best general combiner while the cross UPAS 120 x IC 15708 was the best hybrid with significant *sca* effects. The analysis of generation means by using six parameter models revealed the importance of both additive and dominance gene effects in the expression of these characters. As the yield and yield components were under the control of all the three types of gene action, reciprocal recurrent selection procedure seems to be the best suited method of breeding for improvement of the crop.

**5. Swapna, M. 1993. Germplasm evaluation in horse gram (*Dolichos biflorus* L.). M.Sc. (Ag.) thesis.**

The study was undertaken to evaluate the variability existing in a population of 50 genotypes of Horse gram. High heritability and genetic advance exhibited by pod length and pods per plant suggests the possibility of these traits to be improved by direct selection. Environmental effects were found to be comparatively higher for yield and seeds per pod. Pods per plant and seeds per plant showed maximum correlation to yield. Positive significant correlation were noticed between plant height and pod length, number of primary branches and pods per plant, days to 50 per cent flowering and days to maturity, pod length and seeds per pod and between 100 seed weight and days to maturity. Divergence analysis gave eleven clusters of which cluster II and VI showed maximum distance of the cluster members from cluster centroids. The members of these two clusters could be considered superior as parents for hybridization programmes. The maximum mean value for yield was exhibited by members of cluster II. The maximum contribution towards genetic divergence was made by the character 100 seed weight. Growth analysis based on physiological parameters like dry matter production, NAR, CGR, LAI and HI suggested that an ideal plant type will be one in which maximum dry matter production, NAR, LAI was observed during the middle growth stages. An efficient partitioning of dry matter towards the reproductive part was also an essential criterion.

**6. Siby Thomas. 1994. Variability of biological nitrogen fixation traits and yield components in black gram (*Vigna mungo* (L) Hepper). M.Sc. (Ag.) thesis.**

Analysis of variance revealed significant differences among the varieties for all the characters except pod number, seeds per pod and harvest index. High heritability coupled with high genetic advance was recorded for nodule weight in the secondary roots and number of secondary roots suggesting the reliability of these characters. Grain yield recorded high positive genotypic correlation with most of the yield components, biological yield and harvest index and negative genotypic correlation with the nitrogen content in the plant at 50% flowering. High positive genotypic correlation of pod number per plant and seeds per pod with grain yield per plant indicates that selection based on one or more of the above components may result in the improvement of grain yield. Weight of

nodules in the secondary roots, had high variability, heritability, genetic advance and genotypic correlations with nitrogen content in the plant at 50% flowering and harvest index may be considered during selection programmes for identifying black gram genotypes having high nitrogen fixation capacity.

## OILSEEDS

1. **Sajikumar, T. A. 1989. Genetic resources evaluation of Groundnut (*Arachis hypogaea* L.) for resistance to tikka leaf spot.**  
M.Sc. (Ag.) thesis.

Screening groundnut genotypes resistant to tikka leaf spot was carried out using 257 groundnut germplasm. Out of these, 4 genotypes were moderately susceptible, 197 susceptible and 56 highly susceptible. None of the varieties were immune, highly resistant or moderately resistant. A total of 25 genotypes with low disease intensity in field conditions combined with high / moderate yield were selected for glass house screening where artificial inoculation of the disease was done and the disease intensity was estimated. All the genotypes were susceptible to the disease. The lowest disease intensity was in C-145-12-P-14. Significantly high variability among the 257 accessions was observed for all the eleven components of yield studied. Disease intensity had significant correlation with pod number per plant, shelling percentage, 100 pod weight and 100 kernel weight.

2. **Presanna Kumari, K.T. 1992. Seed dormancy in groundnut.** Ph. D thesis.

The presence of seed dormancy in 419 genotypes of groundnut, received from ICRISAT, Hyderabad was studied. The period of dormancy ranged from 20 – 110 days and varied with botanical groups *viz.*, *hypogaea*, *fastigiata* and *vulgaris*. The factors responsible for dormancy were found to be residing in the cotyledons and seed coat. Leaching improved the germinability of decoated seeds whereas it failed to elicit germination in intact seeds. This indicates that germination inhibitors may be present in the cotyledons, and testa. Seed treatment in  $\text{HgCl}_2$  @ 1:1000 for five minutes broke the dormancy. The study of germinability of  $F_1$ ,  $F_2$  and  $F_3$  seeds on the day of harvest indicated that dormancy was controlled by polygenes.

**3. Tessy Joseph. 1997. Genetic analysis of seed dormancy and productivity in groundnut. (*Arachis hypogaea* L.). Ph. D thesis.**

Evaluation of 14 dormant and 14 non dormant groundnut genotypes revealed the presence of significant variability among them. Analysis of three lines, five tester and their hybrids revealed the importance of additive gene action for most of the characters except for pod yield and number of mature pods, for which non additive gene effects were important. Significant heterobeltiosis for yield was observed in five crosses. The dormancy studies in different generations revealed the dominance of dormancy over non dormancy; and dormancy was found to be a quantitative trait. The generation mean analysis indicated that non-allelic gene interactions were present for seed dormancy. Hence pedigree method of breeding with selection from advanced generations will be ideal for fixing the character.

**4. Veena Vigneswaran. 2001. Exploitation of male sterility in sesame (*Sesamum indicum* L.). Ph. D thesis,**

In order to assess the variability and to estimate the combining ability of selected lines of sesamum, sixty genotypes, of diverse origin, were evaluated and were grouped into eight clusters. One genotype from each cluster was selected and crossed in diallel to find out the best general combiners and to use them for inducing male sterility through hybridization and mutagenesis. Genetic studies revealed that the principal yield determining components were number of capsules on main stem and capsules per plant. Combining ability studies showed the importance of additive, non additive and maternal effects in all characters. The varieties Thilak and OS 2 were the best general combiners. By mutagenesis, a linear increase in the sterility with increase in the doses of mutagens was noted. Chemical mutagens induced more steriles than physical mutagens and these plants had normal female fertility and seed set. This male sterility was found to be governed by a single recessive gene. Wide hybridization between *Sesamum indicum* x *S. malabaricum*, F<sub>1</sub>s had high percentage of pollen fertility, while the reciprocals had little capsule set. This shows a positive role of the wild cytoplasm on pollen sterility in crosses where *S. malabaricum* is used as female parent. Progenies of back crosses, BC<sub>1</sub> and BC<sub>2</sub> exhibited more attributes of the recurrent parent with high level of male sterility.

## VEGETABLES

### 1. Chandrika, P. 1979. Genetic studies in cowpea. M.Sc. (Ag.) thesis.

In a preliminary studies, 210 genotypes of cowpea were evaluated for 15 characters, from which 56 varieties representing the maximum, minimum and mid-value for all the characters were selected for further detailed evaluation. Variability was found to be genetic for all characters studied except the number of primary branches per plant indicating scope for selection. Based on the genetic distance, the author highlighted promising donor parents for inter-varietal hybridization programme.

### 2. Inasi, K.A. 1980. Studies on inter-varietal hybrids in cowpea.

M.Sc. (Ag.) thesis.

Sixteen inter varietal hybrids were produced and evaluated along with their parents for 15 economic characters. Varying degrees of hybrid vigour could be noticed for all the characters. The cross between P.118 and G<sup>2</sup>.PLS.139 could be adjudged as the best hybrid followed by P.118 x C.152 x N.E-I for pod yield per plant. Heterosis could be observed to the same extent in hybrids of both genetically related and unrelated parents.

### 3. Jalajakumari, M.B. 1981. Variability studies in Cowpea. M.Sc. (Ag.) thesis.

Studies undertaken with 17 cowpea varieties representing seventeen clusters showed significant differences for all the 16 characters studied. The major portion of the total variability was due to genetic causes. Heritability in the broad sense was high for all characters except for flowering spread and number of flowers per plant. Expected genetic advance has shown that, by selecting five percent superior plants from the available population, yield could be increased by 64.15g per plant. Number of primary branches, number of pods per plant, length and weight of individual pods, 100 seed weight, seed length, pod and seed yield per plant exhibited parallelism in the high estimates of heritability and genetic gain might be due to the action of additive genes and could be improved straight away through selection. Pattambi Local-1 was found to be exceptionally high yielder. Seed yield was highly correlated with pod number, pod weight, seeds per pod, breadth of seed, seed thickness and pod yield. Path co-efficient

analysis revealed that pod yield, breadth of seed, pod number had high direct positive effect on seed yield.

**4 Sumathikutty Amma, B. 1981. Investigations on inter varietal F<sub>2</sub> hybrids in Cowpea. M.Sc. (Ag.) thesis.**

The 16 F<sub>2</sub>s derived from inter varietal crosses were evaluated along with their respective parents for 15 economic characters. Two families from each F<sub>2</sub> lines were selected. Most of the characters were found to be inherited as quantitative characters controlled by either polygenes or by a few major genes with their action being suitably modified by minor genes. Cross derivatives GP.PLS.139 x P.118 and Red seeded selection x Kolingi Payar was identified suitable for grain production and dual purpose. For raising vegetable cowpea as summer fallows cross derivatives of Pannithodan Early x Kolingi Payar white, Manjeri black x Kolingi Payar white and IC.20729 x Red seeded selection were recommended.

**5. Jayaprakash Naik, B. 1983. Cytotoxic and clastogenic effects of some insecticides in *Allium cepa* L. M.Sc. (Ag.) thesis.**

Cytotoxic and clastogenic effects of three commonly used insecticides aldrin, carbofuran and phorate were tested in *Allium cepa* L. Aldrin was found to be drastically mitodepressive compared to carbofuran and phorate while phorate increased mitotic index in lowest dose. Carbofuran showed only marginal reduction. However, both the compounds reduced mitotic index at recommended doses as well as at higher doses. Aldrin exhibited a dose and period responsiveness, while carbofuran and phorate could not with regard to mitotic index. Aldrin was an effective toxicant on both genetic material and proteins. The various chromosome abnormalities noticed were stickiness, bridges, laggards, blurred chromosome borders, chromatin bridge, micronuclei, non-orientation of metaphase, precocious movement in anaphase, chromatin bodies, irregular anaphase, star metaphase, strays, beaked nuclei break, C-metaphase and unequal nuclei in their decreasing order of occurrence. Carbofuran and phorate could not induce anomalies to a significant level in the lowest doses tried (0.0075 and 0.02% respectively). The most frequent abnormality found in carbofuran was chromosome bridge followed by stickiness and laggards. Phorate showed linear relationship in inducing chromotoxicities with respect to concentrations and

period of treatment. The major types of abnormalities recorded were bridges, breaks and stickiness. It can be tentatively concluded that they cannot be considered completely safe at the field dose of application on the cellular constituents of the organism. The results call for extensive testing of these chemicals in other test systems as well.

#### **6. Neema, V.P. 1986. Genomic relationship in *Vigna* species.**

M.Sc. (Ag.) thesis.

The genomic relationship between two subspecies of *Vigna unguiculata* i.e. *unguiculata* and *sesquipedalis* were studied. It was found that two subspecies were easily crossable and had high pre-fertilization shed. The 2n chromosome number of subspecies *unguiculata* was 22, and that of *sesquipedalis* was 24. The F<sub>1</sub> hybrid between these sub species had 2n = 23. Length of meiotic and somatic metaphase chromosome was high in subspecies *sesquipedalis* low in *unguiculata* and intermediate in the F<sub>1</sub> hybrid. Both subspecies and hybrid had almost similar TF percentage which gave an indication of similarity in their Karyotypes. Pollen fertility was more in subspecies *sesquipedalis*. Reciprocal differences was seen in the case of morphological characters like plant height, number of primary branches, internodal length, seeds per pod, seed colour and seed volume. However, these differences were not seen traceable in the cytology of the hybrid.

#### **7. Prakash, K.M. 1996. Biometric analysis of yield and other attributes in *Coleus* (*Coleus parviflorus* Benth.). M.Sc. (Ag.) thesis.**

Highly significant differences were noticed among 30 *Coleus* genotypes for most of the quantitative characters in the open and shaded condition. Low heritability and low genetic advance were shown for most of the economically important tuber characters in the open while heritability and genetic advance were much greater in the shaded condition for economically important characters. Expected genetic advance has shown that by selecting five percent superior plants from available population, tuber yield could be increased by 52 g per plant in the shaded conditions. Correlation studies indicated that shoot length, number of leaves per plant, leaf area per plant, number of tubers per plant, tuber girth and tuber length are highly correlated with yield under open condition. Under shaded conditions all shoot characters are negatively correlated



and tuber characters like number, length, girth and individual weight are to be given emphasis for identifying a high yielding genotype because of their high positive genotypic correlation with tuber yield. Path analysis projected greater emphasis for improving tuber girth, number of tubers per plant, individual tuber weight and tuber length in open condition in selection while tuber number, individual tuber weight and tuber girth should be given emphasis when selection is done for tuber yield in shade grown coleus.

**8.Thara Manoharan. 1999. Cytological and biochemical changes in aged and osmoprimered seeds of chillies (*Capsicum annum* L.).**

M.Sc. (Ag.) thesis.

The study revealed that loss of viability in chillies seeds was mainly due to biochemical lesions. Since the chillies seeds could retain the innate capacity to germinate and produce quality seedlings up to two months of storage period, osmoprimering was found beneficial after two months of storage. PEG-6000 and NaCl was the best osmoticum for post storage priming treatments in aged chillies seeds, however, NaCl was advocated as it was more economical than PEG.

**9. Jyothi, C. 2001. Genetics of Bruchid (*Callosobruchus* sp.) resistance and yield in cowpea. M.Sc. (Ag.) thesis.**

High variability among parents and hybrids was observed for yield and bruchid resistance. The characters namely number of eggs laid, number of adult beetles emerged, number of bore holes produced, loss of cotyledon per seed and tannin content exhibited high heritability, genetic advance and GCV indicating preponderance of additive gene effects. A positive association among yield attributes with yield prevailed in parents and hybrids. Genotypes having a thicker seed coat showed better resistance to pulse beetle attack and this character was found to be independent in gene action. Kanakamoni among the lines and EC390231 among testers were the most promising genotypes for hybridization and selection as they recorded high positive *gca*. The crosses Kanakamoni x IC 2010902 followed by C152 x EC 390231 were found to be superior for pod yield. C152x EC 367711 and V 240 x IC 2010902 showed resistance to pulse beetle. Kanakamoni, C 152, EC 390231 and IC 201092 were

recommended for evolving resistant varieties through hybridization and selection.

**10. Arunachalam, P. 2002. Breeding for resistance to distortion mosaic virus in bitter melon (*Momordica charantia* L.). Ph. D thesis.**

Out of the eighty six genotypes of bitter melon screened against bitter melon distortion mosaic virus (BDMV), nine were found field resistant. The line IC68275 was the best general combiner for BDMV resistance. Two hybrids *viz.*, IC 68263 B x IC 68275 and IC 68275 x IC 68342 B produced by using this line as one of the parent also showed field resistant to BDMV but recorded moderate yield. Therefore, these hybrids were recommended for growing in areas or seasons of high incidence of distortion mosaic. Two other hybrids IC 682 A x Preethi and VKV 134 x IC 18342 B were found to be high yielding; but can be grown only in seasons of less incidence of BDMV. The BDMV resistance is controlled by polygenes and their expressions are highly influenced by environment. The incidence of the disease in Kerala was more during summer.

**11. Mareen Abraham. 2002. Assessment and induction of variability for higher yield and photosensitivity in Coleus (*Coleus parviflorus* Benth.). Ph. D thesis.**

In order to induce variability for photo insensitivity and higher yield in coleus both *in vivo* and *in vitro* mutagenesis were resorted. The entire collections were grouped into ten clusters. Representative samples from each cluster were subjected to mutagenic treatment. Mutation has changed the plant height, time taken for tuberisation and tubers per plant. Selected mutants showed photoin sensitivity to tuberization, an acceptable qualitative change. Mutant 131 and 61 were identified as promising photo insensitive mutants for year around cultivation. One photo insensitive tissue culture mutant was identified, which needs further evaluation. This study also pointed out that increased harvest index plant<sup>-1</sup>, tuber weight plant<sup>-1</sup> and reduced plant height contributed maximum to tuber yield.

**12. Shinoj, P. 2003. Stability analysis of selected mutants of coleus (*Solenostemon rotundifolius* (peir) J.K.Morton). M.Sc. (Ag.) thesis.**

Stability analysis of fourteen lines of Coleus, which comprised of eleven promising mutants, two released varieties and one local cultivar showed significant difference for many of the economic traits over locations. Selection for yield should be based on low tuber numbers, low starch content and high protein content. Further the tuber should be white coloured, delicious, non groovy and smooth. From the study it was suggested that ideal plant architecture in coleus should have optimum starch and protein content, good texture and medium flavour. Stability analysis identified mutants '641' and '352' as the most stable high yielding well adapted genotypes for many of the economic traits over locations.

**13. Sumarani, P. 2003. Genetic analysis of F<sub>2</sub> and F<sub>3</sub> generations for yield attributes and resistance to distortion mosaic virus disease in bitter gourd (*Momordica charantia* L.). M.Sc. (Ag.) thesis.**

The F<sub>2</sub> and F<sub>3</sub> generation of three selected crosses and parents were evaluated for yield attributes and resistance to BDMV. Significant variation was noticed for almost all characters except anthesis of male and female flowers. Highest phenotypic co-efficient of variation and genotypic co-efficient of variation were observed for BDMV followed by fruit yield and fruit weight in both generations. High heritability coupled with high genetic gain was noted for fruit weight, fruit yield and co-efficient of infection. These characters are controlled mainly by additive genes which rendered scope for direct selection. High yield was achieved by higher sex ratio, higher fruit weight, long fruit, optimum number of female flowers and low incidence of BDMV. Based on the results, populations derived from the crosses IC 68335 x Preethi and IC 68263 B x Preethi were the best genotypes with high yield and resistance to BDMV consecutively in both generations.

**14. Anisha George. 2004. Genetics of trailing habit in yard long bean (*Vigna unguiculata* var. *sesquipedalis* (L) Verdcount). M.Sc. (Ag.) thesis.**

Pod yield can be increased by selecting genotypes having shorter days for first flowering and harvesting increased pods per plant, lower number of seeds per pod, lower number of branches and higher pod number. Trailing type Lola

has higher breeding value compared to Vjlayanthi and TC-99-1 and can be exploited for heterotic vigour for many of yield attributes. The segregants can be used for fixing characters of both bush type coupled with trailing habit. Trailing and bush characters showed a 3:1 monohybrid ratio and stem pigmentation (purplish green) showed a dihybrid ratio of 9:7 in the F<sub>2</sub> segregants of different combinations. Flower colour (purple: white) and pod colour (purple: green) showed a monogenic segregation of 3:1 whereas seed coat colour showed dominant epistatic gene action (12 : 3 :1) in various crosses.

## FRUITS

### 1. Rosamma, C.A. 1982. Biometrical studies in Banana. M.Sc. (Ag.) thesis.

Biometrical studies in 48 banana cultivars belonging to five genomic groups showed highly significant variation between varieties for all the eighteen characters. The major portion of total variability in almost all characters was due to genetic causes. Expected genetic advance had shown that, by selecting five percent superior plants from the population, yield could be increased by 8.76 Kg per plant. Bunch weight was highly correlated with girth of the pseudostem at the base, total number of leaves per plant, leaf area, number of hands per bunch and bunch length. Weight of the individual finger, total number of fingers per bunch, bunch length and number of hands per bunch showed high direct positive effect on yield per plant. Comparison of the efficiency of different selection indices showed a higher efficiency for the index obtained when characters *viz.*, bunch weight, number of hands per bunch, bunch length, number of fingers per bunch and weight of the individual finger was taken into consideration.

### 2. Tessy Joseph. 1983. Floral biology and fruit development in 'varikka' and 'koozha' types of Jack (*Artocarpus heterophyllus* Lam.). M.Sc. (Ag.) thesis.

Studies on floral biology of Jack ('varikka' and 'koozha' types) showed differences in the pattern of male and female spike production. Male spikes were produced from October to February, while female spike production confined to only three months, starting from late November. The perianth tubes of male flowers were free from each other and that of the female flower were fused in the middle. In a male spike anthesis continued up to 5-7 days and the peak period of anthesis was between 12 Noon and 4 PM in a day. The peak time of anther

dehiscence was between 6 PM and 7 PM on the day of its emergence. The emergence of stigma on a female spike continued for about 3 weeks. Fruit set under natural conditions was 83.33 percent and the fruit drop ranged from 30 to 40 percent. The whole spike after anthesis developed into a large composite fruit which was a 'false fruit', with the persistent perianth forming the bulk of the fruit. The time required for full development of fruit ranged from 100 to 138 days. The two types-'varikka' and 'koozha' did not differ for most of the flower and fruit characters except for the texture of flakes. 'Varikka' had hard flakes while 'koozha' had soft mushy flakes.

**3. Elsy, C. R. 1985. Pollination studies in Cashew. M.Sc. (Ag.) thesis.**

Pollination studies in cashew showed that the period of flower opening in both male and hermaphrodite flowers was same. The peak period of flower opening for male flowers was between 7 and 9 hour and for hermaphrodite flowers between 9 and 11 hour. Climate factors such as temperature, sunshine hours, relative humidity and wind velocity did not influence on the magnitude of flower opening. When compared to natural pollination, assisted pollination resulted in significantly higher initial fruit set indicating the inefficiency of pollinating agents. But a major portion of the set fruits dropped at different stages of development. In both natural and hand pollinated cases, the fruit drop was more in early stages of development. In completely bagged panicles, no fruit was set, confirming the cross pollinated nature of cashew. The failure of fruit set in water sprayed panicles ruled out the possibility of water as a pollinating agent. Wind plays a significant role in cashew pollination along with insects like red and black ants, honeybees and butterflies which frequently visit cashew inflorescence.

**4. Anila, P. 2002. Impact of seed deterioration on seedling vigour in mango (*Mangifera indica* L.). M.Sc. (Ag.) thesis.**

While assessing the seedling characters of three varieties of mango viz., Chandrakaran, Moovandan and Puliyan, seedling girth was found to be the most variable character. The response of girth to variation in seed weight due to loss in moisture contents of the seed was also high indicating that this character may be influenced by both genetic factor as well as the physiological condition of the seed. The critical moisture content for Chandrakaran,

Moovandan and Puliyan was 24%, 30% and 28% respectively. The height, girth, internodal length and number of leaves were highly depended upon the moisture content of seed. Polyembryonic nature of these varieties was not affected by seed desiccation. Biochemical characters like chlorophyll, phenol and sugar content decreased with seed desiccation. Electrolyte leakage was found to be high with seed desiccation leading to reduction in viability.

**5. Ushavani, D. 2003. Morphological, biochemical and molecular markers for the genetic analysis of cashew ( *Anacardium occidentale* L ).**  
M.Sc. (Ag.) thesis.

The morphological, biochemical and molecular characteristics of twelve cashew genotypes were studied. Among the fourteen morphological characters studied, number of perfect flowers, number of nuts, apple weight, nut weight and kernel weight provided a clear separation of the genotypes. Correlation and path studies revealed significant positive correlation and direct effect of tree height and number of nuts on yield. The genotypes studied were grouped into four clusters and H-1593 was found to be the most divergent genotype. Biochemical studies showed the genotype H-1593 as lowest in phenol content. Seed storage protein studies distinguished K-22-1 from all others by a single unique band. Molecular studies involved RAPD analysis using four primers. Two primers opp-5 and opp-10 could distinguish varieties Mdk-2 and Mdk-1 with amplicons 22 and 25 respectively. Dendrogram constructed based on the study grouped together Kanaka and Dharasree, Mdk-1 and Mdk-2 and H-1600 and P-3-2 with the latter two being the closest of all. On comparative study, H-1600 (Damodar ) was tied to Dharasree in biochemical studies and with P-3-2 in molecular studies. In morphological studies also, it was placed close to P-3-2 indicating the proximity of Indian accessions with those of South America. From this study a similar trend was seen for morphological and molecular markers in deducting the genetic divergence. However, biochemical markers need more refinement.

**6. Kuriakose, K.P. 2004. Heterosis breeding and *in vitro* mutagenesis in Pineapple (*Ananas comosus* [L] Merr. ).** Ph. D thesis.

Six genotypes of pineapple, differing for various characters, were crossed in all possible combinations. The crosses exhibited differences in the extend of cross compatibility. Out of the thirty cross combinations, only sixteen reached the

final stage of evaluation of the progenies. Mauritius and PKDA were the most compatible parents. The hybrids were evaluated for growth, yield and quality parameters. The hybrids were evaluated for five characters viz., fruit weight without crown, TSS, total sugar, pulp weight percentage and juice weight percentage. The cross Mauritius x Kew was having the highest heterosis in four out of the five characters and it was superior to many of the cultivated varieties. For *in vitro* mutagenesis shoot tips were cultured in MS medium supplemented with BAP and the callus cultures obtained were irradiated with gamma rays at different doses. Variations such as chlorophyll mutants, leaf chimeras were seen. Irradiation of *in vitro* culture at 30 Gy gave enhanced vigour in growth of plantlets.

## SPICES & PLANTATION CROPS

### 1. Balakrishnan, P.C. 1982. Genetic divergence in coconut.

M.Sc. (Ag.) thesis.

Biometrical studies in 24 cultivars of coconut maintained in the germplasm collection at RARS, Pilicode for 17 economic characters showed high amount of variability among the cultivars. A major portion of the observed variability in all the characters except weight of unhusked and husked nuts, weight of meat per nut and copra content was found to be environmental. Number of rachis per inflorescence and number of female flowers in an inflorescence contributed maximum, and weights of husked and unhusked nuts minimum to total divergence. Based on genetic distance the 24 cultivars could be grouped into six distinct clusters.

### 2. Kanakamany, M.T. 1982. Formulation of a key for identification of the different types of pepper (*Piper nigrum* L.). M.Sc. (Ag.) thesis,

A key for genotype identification in black pepper was formulated using 28 quantitative and 17 qualitative characters recorded from 45 black pepper types maintained in the germplasm collection of Pepper Research Scheme. The characters identified as the diagnostic features of *Piper nigrum* were sexual composition of flowers in a Spike, length of spike, leaf characters (shape, base & margin) and colour of the lamina of the mature leaf in the upper & lower sides.

**3. Gregory Zachariah 1983. Genetic variability and correlation studies in cocoa (*Theobroma cacao* L). M.Sc. (Ag.) thesis.**

The extent of variability and degree of correlation of 26 morphological characters of cocoa trees (var. Forastero) were estimated utilizing the germplasm of 135 trees established at Alpara in Thrissur district. High PCV and GCV were reported for thickness of pod husk and weight of pod. Number of pods per tree, seed index and trunk girth had significant correlation with yield. Significant inter correlation were noticed for wet weight of beans per pod, number of beans per pod and weight of pod.

**4. Madhu, P. 1984. Pollination, Pod set and compatibility status in open pollinated progenies of cocoa var. Forastero. M.Sc. (Ag.) thesis.**

The peak flowering time in the open pollinated progenies of cocoa var. Forastero at Vellanikkara was between November and April with anthesis starting at 2-4 PM, extending up to 2-4 PM on the subsequent day. Entomophily was the rule. Maximum stigma receptivity was between 10 AM to 12 Noon. The study revealed that hand pollination increased pod set by 48 % but incidence of Cherville wilt caused 37.04 to 70.37 % loss of immature pods. The occurrence of self incompatibility in the species could be exploited for hybrid development.

**5. Sreelatha, P.C. 1987. Variability studies in certain T x CDO F<sub>1</sub> hybrids of coconut (*Cocos nucifera* L.). M.Sc. (Ag.) thesis.**

Investigations on the variability in 14 F<sub>1</sub> combinations of T x CDO coconut, revealed no significant differences between pollen parents in their contribution to the progenies in any of the 17 characters studied, unlike the female parents. The number of spadices was found to be highly correlated with the number of buttons set followed by the number of functional leaves and number of female flowers produced. Production of spadices and female flowers were found to be high during March-May and absent during October-December. Heavy rain during active female phase affected button set adversely. Fertility and viability of pollen were found to be very high throughout the year except during April- May.

**6. Sujatha, R. 1991. Variability in intervarietal F<sub>1</sub> hybrids and open pollinated seed progenies of black pepper (*Piper nigrum* L.). M.Sc. (Ag.) thesis.**



The germplasm consisting of 492 open pollinated seed progenies and 45 F<sub>1</sub> hybrids maintained at Pepper Research Station, Panniyur were evaluated for 4 qualitative and 21 quantitative traits. The vines exhibited significant variability for all characters. Number of spikes per vine, length of spike and developed berries per spike had high correlation with yield and significant heterosis was reported for these characters in several F<sub>1</sub> hybrids.

**7. Sunil, K. P. 1992. Anther culture in cocoa (*Theobroma cacao* L.).**

M.Sc. (Ag.) thesis.

Anther culture for haploid production was standardized in cocoa using chlorine water as the sterilization agent and modified H3 Medium supplemented with NAA (1 mg/l) and 2 iP (0.1 mg/l) for callus induction. Pro-embryoids developed were subcultured in ½ MS supplemented with 2 ip (0.1 mg/l) and GA 3 (0.3 mg/l) for development of embryoids into plantlets. Stage of development of the anthers, environmental conditions at the time of collection of anthers, culture conditions and media composition were reported to be crucial factors in callus induction, proliferation and embryoids formation. The genotypic difference was also reported. Hybrid genotypes responded favorably during all stages of culturing. Criollo was the quickest in callus formation. Pretreatment like temperature shock and light on callus induction and UV rays on callus growth were reported to have no effect. Also suspension culture and pollen culture were unsuccessful in cocoa.

**8. Homey Cheriyan 1993. Genetic analysis of yield attributes in cocoa (*Theobroma cacao* L.).** M.Sc. (Ag.) thesis.

Genetic studies conducted in a population of 244 trees consisting of 19 hybrids and 15 parents of cocoa revealed high variability for yield in terms of wet bean weight as well as pod numbers. The variability shown by clonal parental population was due to non genetic causes whereas, variability shown by the hybrids were genetic and were significant for most of the characters studied. The pod and bean characters showed high heritability. The pod number and wet bean weight per pod were suggested as important selection parameters. The scope of establishing poly cross garden in cocoa for population improvement was also reported.

**9. Jolly Antony 1993. Somatic embryogenesis in cocoa**  
**(*Theobroma cacao* L.). M.Sc. (Ag.) thesis.**

Somatic embryogenesis was reported in cocoa using cotyledons and embryogenic leaves of immature embryo in MS basal medium supplemented with NAA (2 mg/l), thiamine (1 mg/l), casein hydrolysate (0.2 %) and coconut water (15 %). Auxins especially NAA was reported as essential component of the medium whereas cytokinin was inhibitory. Germination of embryoids was standardized in hormone free ½ MS liquid medium with 5 % Sucrose. Decotyledonisation was found to enhance plantlet differentiation for short growth. NAA and GA 3 were the best while IBA promoted rooting. The size of the embryoids (4-6 mm) had a significant role in germination and regeneration. Genotypic difference on response to *in vitro* culturing was also reported. Amelonado was found superior to Criollo, Trinitario and Amazon types.

**10. Jiji Joseph 1994. Plantlet regeneration through somatic embryogenesis**  
**in cocoa (*Theobroma cacao* L.). M.Sc. (Ag.) thesis.**

Embryogenic calli were produced from cotyledon and embryonic axis of immature embryos of cocoa using MS basal medium with NAA (1.8 mg/l), thiamine (1 mg/ l), coconut water (15 %) and sucrose (4 %) kept in dark at 13±2°C. Normal and aberrant embryoids were originated singly or in clusters. The explants taken from hybrid genotypes were reported to have better response than that from selfed progenies. Liquid of MS media with 5 % sucrose favoured germination of embryoids. The plantlets produced were hardened and micrografted to three week old seedling rootstock.

**11. Bindu, M.R. 1997. Standardisation of *in vitro* techniques for rooting,**  
**hardening and micrografting in cocoa (*Theobroma cacao*).**  
Ph. D thesis.

*In vitro* culturing of nodal segments of cocoa in the WPM medium with growth regulators produced large number of shoots. Rooting was very poor under *in vitro* condition and was completely absent under *ex vitro* condition. Maximum rooting was obtained when the shoots were pretreated in IBA for 3 seconds followed by culturing in the basal medium. The rooted shoots should be potted in a medium containing a mixture of soiltrite and potting mixture. *In vitro* micrografting and *ex vitro* micrografting were possible in Cocoa. The best root

stock for *in vitro* micrografting was axenic seedlings cultured in half MS medium devoid of sucrose. *In vitro* shoots from nodal segments were found to be very good scion material for grafting. *Ex vitro* micrografting recorded lower percentage of success than *in vitro* micrografting. The most significant achievement of this investigation was the standardization of the technique of *in vitro* micrografting by which the rooting problem can be surmounted to a great extent.

**12. Raji Varghese 1998. Standardisation of selection criteria for cocoa hybrids.** M.Sc. (Ag.) thesis.

A selection was standardized for cocoa hybrids using 29 hybrids and their 18 parents. The height and girth of one year old seedlings was found to influence the yield and using these a multiple regression equation was constructed for determining wet bean yield. The vegetative vigour was reported to be correlated with precocity. The pod length and number of beans of hybrids and female parents showed significant correlation. Characters like pod width, seed length, seed width had high heritability. Among the different hybrids H 4 (GI 10.3 x GVI 54) was found promising.

**13. Rose Mary Francies. 1998. Genetic analysis of certain clones, hybrids and inbreds in cocoa.** Ph. D thesis.

Genetic studies in cocoa conducted using various populations namely, clones, biconal crosses, biconal pair crosses and inbreds showed wide spectrum of variability in the population. The highest variability was observed in yield of dry beans per tree and precocity of bearing. Strong correlation was observed for yield with pod weight, dry weight per bean and efficiency index. Multiple regression and path analysis revealed the importance of dry weight per bean, bean size and efficiency index in determining the yield in Cocoa. High correlation exhibited by many traits was due to indirect effects. Selection index based on the above traits recorded a relative efficiency of 150.35 percent over direct selection. The rate of inbreeding depression was more in the second generation compared to that in the first inbred generation. The performance of hybrids indicated that the chances for occurrence of a high frequency of heterotic crosses and high values of heterosis are more, when the parental divergence is moderate.

**14. Sindhumole, P. 1998. Genetic variability and correlation in nine divergent varieties of coconut (*Cocos nucifera* L.).**

M.Sc. (Ag.) thesis.

An experiment conducted at Instructional Farm, College of Horticulture on nine Coconut varieties showed significant varietal variance among several characters. Economic characters showed the highest genotypic co-efficient of variation. Among the four reproductive characters studied for seasonal variability viz., spadix length, branches per spadix, female flowers per spadix and fruit set showed maximum variation. These two characters had been low during the rainy months. Among the economic characters only nut yield was correlated with both vegetable and reproductive characters. Other economic characters depended only on vegetative characters. Trunk height produced highest direct effects on the economic characters. Correlation, regression and path analysis suggested that reproductive characters had less effect on economic character.

**15. Homey Cheriyan, 2000. *Agrobacterium*–mediated genetic transformation in black pepper (*Piper nigrum* L.).** Ph. D thesis.

By using different explants, *Agrobacterium* mediated transformation experiments were carried out with varying factors. None of the explants showed callus induction in the screening media. Prolonged survival of the *Agrobacterium* in the tissues could be the reason for non multiplication of transformed cells. Callus transformation was carried out with different factors affecting transformation. Excessive exudation of phenol was noticed in all the treatments. Ineffective elimination of *Agrobacterium* and/or the super virulent character of the strain leading to the hypersensitive response of callus to bacterial infection could be the reason for failure of transformed cells to multiply.

**16. Sujatha, R. 2001. Characterisation of field established tissue culture derived black pepper (*Piper nigrum* L.) plants using morphological, cytological and molecular markers.** Ph. D thesis.

Morphological and biochemical characterization and field evaluation of tissue culture derived pepper plants produced at CPBMB, Vellanikkara in relation to their performance in the field at PRS, Panniyur was carried out. Each of the experimental vines was characterized using morphological traits based on the descriptor formulated by NBPGR. The cytological studies ruled out any variation

caused by a change in the chromosome number, which are possible in *in vitro* cultured plants. Most of the biometric as well as qualitative observations showed uniformity in the clones as well as TC plants. The TC plants exhibited better vigour and uniformity compared to conventional clones. The molecular markers provided a specific identity for each of the experimental vines. The zymogram based on peroxidase as well as RAPD banding pattern has given a very clear fingerprint characteristic of each vine. The assessment of interclonal variability using morphological and molecular markers indicated great variability in qualitative and quantitative traits between TC subhakara and clonal subhakara. Using RAPD, it was conclusively proved that the vines labeled as TC P4. This is probably due to an error in labeling while the TC plantlets were transported from Vellanikkara to Panniyur.

**17. Mercy, M.A. 2001. Genotypic evaluation and screening for drought tolerance in wild *Hevea* germplasm. Ph. D thesis.**

About 99 wild *Hevea* germplasm lines conserved in the Rubber Research Institute of India, Kottayam were studied to assess the genetic variability present among the materials for characters associated with drought tolerance. Preliminary screening of the germplasm accessions for drought tolerance was carried out based on cell membrane stability. The injury to cell membrane due to drought was studied and from this study 10 accessions were selected. It could be inferred that drought resistance mechanism is a complex factor involving a number of physiological, morphological, biochemical and anatomical parameters. The parameters such as stomatal conductance under water stress, variable fluorescence / maximal fluorescence ( $F_v/F_m$ ), ratio of chlorophyll fluorescence, growth of basal diameter under water stress, chlorophyll and epicular wax contents, thickness of palisade tissue and palisade cell number per unit length of palisade tissue are some of the reliable parameters for identifying genotypes having drought tolerance. Based on some of the highly related parameters with drought tolerance, genotypes were ranked for each selected character. Comparing the rank sum obtained for each genotype, the superiority of the accessions was assessed. Based on this, the best genotype identified was MT 41 followed by MT 55 and AC 650.

## MEDICINAL & AROMATIC PLANTS

1. Mini, K.S. 1989. Karyomorphology, pollen sterility and seed set in vetiver (*Vetiveria zizanioides* (Linn.) Nash.). M.Sc. (Ag.) thesis.

Karyomorphology, pollen sterility and seed set in eleven cultivars of Vetiver were studied. The accessions include both North Indian type and South Indian type besides a hybrid. Observations on plant morphology indicated no clear-cut morphological features employable for exact identification of North Indian and South Indian types of Vetiver. The somatic chromosome number ( $2n = 20$ ) was constant in all cultivars. However, the cultivars differed cytologically with respect to chromosome size and shape, total chromatin content and meiotic configuration during different stages of division. Presence of meiotic abnormalities like bridges and laggards were observed in all cultivars with high frequency in ODV-4. This cultivar also showed high percentage of pollen sterility. A direct relationship between meiotic abnormalities and pollen sterility was noticed. Studies on seed set pattern of different cultivars revealed very low set, mostly nil upon selfing, while all the cultivars produced fairly high quantity of seeds upon open pollination.

2. Radhakrishnan, G. R. 1991. Evaluation of selections and hybrids of vetiver (*Vetiveria zizanioides* (Linn.) Nash.). M.Sc. (Ag.) thesis,

Vetiver cultivars derived through clonal selections and hybridization were evaluated for root characteristics and oil content. Observations on root characters revealed the superiority of ODV-3 in almost all root characters except root diameter. National collections had roots with maximum diameter. Hybrid 8 was also found superior in root characters. Shoot weight was the highest in ODV-3. No significant difference was observed among the different treatments with respect to shoot root ratio. National collection, in general produced highest root oil especially NC 66415 and NC 66403 whereas ODV-3 produced the lowest percentage of oil. Hybrid 8 had maximum oil yield on per hectare basis. Studies on physio-chemical properties revealed that national collections had in general high specific gravity, refractive index and optical rotation. Oil from national collections was found laevorotatory whereas ODV-3 had dextrorotatory oil. Acid value was higher in hybrids. Ester content, ester value and total vetiverol were higher in national collections. ODV-3 also had high total vetiverol. GLC studies

revealed the superiority of NC 66416 with respect to oil quality. It had high vetiverol, Vetiverone and low terpene content. Vetiverol was maximum in ODV-3 but had minimum vetiverone in its oil. Hybrid 8 was also found superior with maximum vetiverone content and fairly high content of vetiverol. Results of the experiment in pots showed that crops had better performance in pot condition with respect to all characters, but for oil content. Observations on plant morphology indicated no clear-cut morphological features employable for exact identification. Data on root characters had shown that the South Indian types had, in general, long roots with maximum number and weight than national collections. Root diameter in South Indian types was less. Performance of hybrids was better than national collections.

### **3. Narayanan, A.K. 1993. Collection, cataloguing and evaluation of *Rauwolfia* spp. M.Sc. (Ag.) thesis,**

A study on collection, cataloguing and evaluation of *Rauwolfia* spp. was conducted to understand the distribution pattern of various species of *Rauwolfia* in Kerala and to make a detailed descriptive study of the morphological and anatomical characters of the different species of *Rauwolfia* and a preliminary comparative evaluation study for the total alkaloids in roots and the chlorophyll content of aerial parts. The study on distribution aspects showed that *R. serpentina* was widely distributed in Kerala but the frequency of occurrence was low, while *R. tetraphylla* was widely distributed in non forest areas only, with a higher frequency of occurrence. *R. densiflora* and *R. beddomei* are in a state of near extinction while *R. micrantha* has almost disappeared from Kerala. Morphological and anatomical characters and the morphology and viability of pollen grains showed wide variability among different species of *Rauwolfia*. Total alkaloid content of roots, chloroform extract and total chlorophyll content of aerial parts varied with different species and ecotypes of *Rauwolfia*. The conditions for the higher root alkaloid production in *R. serpentina* may not be favourable for the alkaloid production in *R. tetraphylla*. The chloroform extract and total chlorophyll content of aerial parts were negatively correlated to the total root alkaloid content in all the species of *Rauwolfia*. The relationship between these was found to be Total alkaloid content =  $2.047 - 0.016 \times$  chloroform extract of aerial parts or  $2.304 - 1.434 \times$  total chlorophyll content of aerial parts.

This relationship can be effectively utilized in the estimation of root alkaloids in *Rauwolfia* spp. even at the early stages of growth without uprooting the plants.

**4. Rekha, K. 1993. Cytogenetic analysis in kacholam (*Kaempferia galanga* L.). M.Sc. (Ag.) thesis.**

Cytogenetic study on Kacholam (local selection Vellanikkara) in relation to seed set was undertaken to confirm the chromosome number, to determine the nature of ploidy and to find out reasons for seedless ness in relation to cytology and floral biology. The procedure for karyotype studies in Kacholam was standardized. Pretreatment of the roots in alpha-bromonaphthalene for 4 hrs at 4°C followed by fixation in Carnoy's fluid for 24 hours and staining overnight in Snow's carmine were effective in getting best cytological preparations. Mitotic studies revealed that this species is a polyploid and with all probability a pentaploid with  $2n = 5x = 55$ . This somatic chromosome number is being reported for the first time in Kacholam. The karyotype was found to be a symmetric one and belonged to '1a' group of Stebbins (1958). Meiotic studies revealed the presence of associations involving 3, 4, 5 and 6 chromosomes in addition to the bivalents and univalent. However, the number of multivalent was much less than expected and later meiotic abnormalities were rather almost absent. Pollen grains also exhibited reasonable fertility and viability. Based on both mitotic and meiotic studies it was indicated that *Kaempferia galanga* L. is a segmental allopolyploid with five sets of genomes designated as  $A_1 A_2 A_2 A_2 A_2$ . Studies on floral morphology and artificial pollinations to induce seed settled to the conclusion that seedless ness in the crop is mainly due to the incompatibility factors in the style and stigma. The spiny stigma does not permit the proper adherence and germination of the pollen grains and the pollen tube growth was not sufficient to surpass the lengthy style and to reach the ovary. Attempts to induce seed set by hand pollination and stub pollination also failed.

**4. Jaya Manuel. 1994. Comparative evaluation of selected types of *Piper longum* (Linn.) in coconut plantations. M.Sc. (Ag.) thesis,**

Comparative evaluation of five selected types of *Piper longum* (Linn.) namely Cheematippali, Panniyur, Mala, Pattambi and Kaanjur was carried out to identify a type suitable for large scale cultivation. The five types differed for eleven vegetative characters namely length of the longest stem, number of



leaves per hill, number of stems per hill, number of vegetative branches per stem, leaf length, leaf width, petiole length, plant spread, internodal length on main stem, number of spike bearing branches per stem and angle of insertion of spike bearing branch and for three productive characters namely number of spikes per spike bearing branch, green spike yield and dry spike yield at one or all of the stages for which observations were recorded. Of the above characters only eight characters showed high and significant correlation with yield. Correlation studies and path analysis revealed that angle of insertion of spike bearing branch, number of stems per hill, number of spikes per spike bearing branch and number of spike yield were the most important characters influencing dry spike yield. Panniyur recorded the maximum alkaloid content in percentage with respect to total alkaloid output from an unit area of land while Mala recorded minimal alkaloid content. Dry spike yield per hectare was high for Cheematippali. Cheematippalli showed consistently superior performance for all the important characters at all the stages and could be recommended for large scale cultivation after multi-location trials. Kaanjur can also be considered as a promising type.

**6. Latha, E.V. 1994. Evaluation of kacholam (*Kaempferia galanga* L.) types for morphological variability and yield. M.Sc. (Ag.) thesis.**

This study was carried out to assess the extent of morphological variability and yield contributing characters in the local collections of *Kaempferia* and to identify types with high yield potential for large scale cultivation and to compare the performance under open and shaded (intercrop in coconut garden) conditions. Considerable variability was noticed for number of leaves, LAI, days to flowering, spread of flowering, plant spread, number of main and secondary rhizomes, fresh rhizome yield, dry rhizome yield, biological yield and oil percentage both under open and shaded condition. Fresh rhizome yield was more under open condition whereas dry rhizome yield was comparable under both condition which indicates that Kacholam can be grown as an intercrop in coconut garden. 'Ponnukkara' performed well while 'Palakkad' was poor under open and shaded conditions. Oil yield was superior in 'Vellanikkara selections' under both conditions. Rhizome yield and oil yield were found to be two independent characters. This necessitates separate selection criteria for rhizome and oil yield. No morphological character was found to be correlated with oil

yield. Under open condition number of leaves, LAI, days to flowering and spread of flowering had high correlation and direct effect on yield with moderately high heritability and appreciable genetic advance. So selection will be effective for these characters. Under shade, plant spread was an important character which had high correlation and direct effect on yield. But the character recorded moderately high heritability and low genetic advance.

**7. Ajith Mohan, N. K. 1996. Induction of polyploidy in kacholam (*Kaempferia galanga* L.). M.Sc. (Ag.) thesis.**

To induce polyploidy in Kacholam cv. 'Vellanikkara Selection' rhizomes were treated with five concentrations of colchicines ( 0.05, 0.15, 0.25, 0.35 and 0.45 percent ) for two durations (four hours and six hours), the same treatment being repeated on two consecutive days. Two methods of treatment were tried; the first (M1) method was chemical application in a hole, drilled close to the sprouting bud and the second (M2) was the ordinary cotton swab method. Rhizomes with two different stages of bud sprouting *i.e.* with just emerging buds (S1) and buds at an advanced stage of sprouting (S2) were used. At the end of the crop season, 18 variants were identified and they were subjected to detailed morphological and cytological study in the next growing season. Mitotic study of the parent material confirmed that the chromosome number of Kacholam is 55. Of the 18 variants identified one was found to contain 110 chromosomes in the somatic cells. As kacholam was a pentaploid, the induced polyploid was a decaploid. The polyploid was obtained from the treatment combination S<sub>1</sub>M<sub>1</sub>T<sub>1</sub>C<sub>6</sub>. It was characterized by small plant size and reduced vigour. The leaves were thick with reduced size. Stomatal size increased conspicuously with their numbers reduced. The rhizome development was found retarded and yield was low. The rhizome morphology was on par with the normal plants. The plants flowered neither in the first season nor in the second. Three other stable variants were obtained were characterized by reduced vigour and yield.

**8. Lisymol J.Vadukkoot. 1996. Evaluation of morpho-anatomical variation in *Ocimum* Spp. M.Sc. (Ag.) thesis.**

A comparative evaluation of the morphological and anatomical features and the protein banding pattern of the four different species of *Ocimum* viz., *Ocimum tenuiflorum*, *Ocimum gratissimum*, *Ocimum basilicum* and *Ocimum*

*canum* were carried out to find out the evolutionary relationships existing among the species and to prepare a key for identification. Ample variability was observed among the four species of *Ocimum* for morphological and anatomical features as well as biochemical aspects. From the protein banding pattern study of the four species it appears that *O. gratissimum* and *O. tenuiflorum* were phylogenetically related and so also *O. basilicum* and *O. canum*. From the herbaceous nature, presence of pitted xylem vessel elements and vessels which are circular in transverse section it seems that *O. basilicum* and *O. canum* were more evolved than *O. tenuiflorum* and *O. gratissimum*.

#### **9. Fancy Parameswaran 1997. Reproductive biology and enzyme studies in *Ocimum* spp. M.Sc. (Ag.) thesis.**

Comparative evaluation of the reproductive biology and phosphorylase enzyme activity in four species of *Ocimum* viz., *O. tenuiflorum*, *O. gratissimum*, *O. canum* and *O. basilicum* were carried out. Inter specific variation for time taken for inflorescence development, completion of anthesis in an inflorescence, number of flowers per inflorescence and distance between verticles was noticed. Infra specific variations were also observed for seed moisture content, seed density, 1000 seed weight and duration of seed dormancy. Flowers of the four species were identical in basic structure although there exist variation in size, colour, hairiness and shape of floral parts. Anthesis occurred earlier in *O. canum* than the other three species. Pollen grains of *Ocimum* were hexacolpate and reticulate. However, species level difference existed with respect to size, shape and fertility of pollen grains. Self incompatibility mechanism does not exist in the species. The floral morphology and protandrous nature favours cross pollination. Comparison of 'Sanctum' and 'Basilicum' groups revealed that Sanctum group which includes *O. tenuiflorum* and *O. gratissimum* required longer time for inflorescence development than 'Basilicum' group which includes *O. canum* and *O. basilicum*. Verticles were closer in the inflorescence of 'Sanctum group' than 'Basilicum' group. Sanctum group produced less conspicuous flowers with sessile bracts and yellow pollen grains. In this group anther dehiscence occurred in bud stage. Basilicum group produced conspicuous flowers with pedicellate bracts and white pollen grains. Anther dehiscence was after flower opening in this group. Dormancy break was sudden in Sanctum group and gradual in Basilicum group.

Moisture content of *Ocimum* seeds was positively related to phosphorylase enzyme activity. Phenol content was negatively related to both moisture content and phosphorylase enzyme activity of the seeds.

**10. Kanakamony, M.T. 1997. Induction of genetic variability in kacholam (*Kaempferia galanga* L. ). Ph. D thesis.**

For inducing genetic variability in Kacholam, cultivar 'Vellanikkara local' was treated with eight doses of gamma rays and six concentrations of EMS and the three generations MV<sub>1</sub>, MV<sub>2</sub> and MV<sub>3</sub> were evaluated. The highest values for yield and yield attributing characters were obtained for 7.5 Gy gamma rays and 0.75 percent EMS treatment. Gamma rays at 15.0 Gy and EMS at 1.0 percent were most effective in inducing variability for rhizome yield and yield attributes. Correlation coefficient between yield and yield components indicated significant positive association of yield with number of leaves, tillers, leaf length, plant spread and rhizome number. Path coefficient analysis of important yield attributes indicated that an alteration in plant architecture for higher yield is possible with 7.5 Gy gamma rays. High frequency of positive variants at lower doses and high frequency of negative variants at higher doses were observed. *In vitro* studies revealed that auxiliary bud explants have the potential to induce multiple shoots as well as roots in MS medium supplemented with boric acid and sucrose.

**11. Laju Paul, K. 2000. Variability in morphological, physiological and biochemical characters in Kalmegh (*Andrographis paniculata* Nees.). M.Sc. (Ag.) thesis.**

The objectives of the study was to understand the morphological variability, growth pattern, optimum stage of harvest and the variation in different biochemical components among the ten accessions of Kalmegh (*Andrographis paniculata*) collected from Kerala and neighbouring states. Uniformity for root, inflorescence, flower and fruit characters were observed among the accessions. However, variability was observed for characters like total plant dry weight, stem dry weight, leaf dry weight and root dry weight during the first four months after transplanting. Optimum stage of harvest recommended was three months after transplanting. Physiological parameters namely leaf area and LAI showed steady increase up to three months after transplanting and thereafter declined.

At the optimum stage of harvest, heritability was high for all the characters relating to herbage yield and most of the physiological parameters. Biochemical studies revealed that the total phenol content and andrographolide content varied considerably among the accessions. Phenol content in the plant increased with an increasing dry weight while andrographolide content increased with a proportionate increase in moisture content.

## **12. Subha, K. 2000. Evaluation of reproductive biology and**

**morpho-anatomical variations in *Plumbago* spp.** M.Sc. (Ag.) thesis,

A comparative evaluation of the morphological and anatomical features as well as the reproductive biology of the three species of *Plumbago* viz., *P. rosea*, *P. zeylanica* and *P. capensis* was carried out to find out the relationship existing among the species and to prepare a key for their identification. The different species of *Plumbago* varied with respect to nature of stem, leaves, colour of petiole, leaf attachment, length of inflorescence, number of flowers per inflorescence, time taken for completion of anthesis per inflorescence and size and colour of floral parts. Though there was uniformity in the fundamental structure of the stem, variations were observed in the outline of T.S, size of epidermal cells and arrangement of chlorenchyma. In the case of root, variability was observed in thickness of cortex, nature of stone cells, presence of starch grains, etc. Study of reproductive biology revealed that anthesis occurred earlier in *P. zeylanica* compared to other two species. The period of anthesis also extent ove a wide time range in *P. zeylanica*. Even though the pollen grains were tricarpate and spherical in all the three species, differences existed with respect .o colour, size and fertility of pollen grains. Coincidence of pollen dehiscence and stigma receptivity could be attributed to good seed set in *P. zeylanica*. *Apis* species and wind were observed to be the main pollinating agents. Based on the different morphological, anatomical and reproductive characters a key for the identification of different species were proposed. A distant matrix based on morphological, anatomical and reproductive characters of three species revealed that *P. rosea* and *P. zeylanica* are more related than *P. capensis*.

**13. Gayathri, G. 2005. Standardisation of *in vitro* propagation techniques in thatthiri (*Woodfordia fruticosa* (L) kurz). M.Sc. (Ag.) thesis.**

In the *in vitro* propagation in thatthiri, direct regeneration and regeneration through callus mediated organogenesis were tried. SH medium was found to be the best basal medium for *in vitro* culture. Shoot tips were the best explants for direct organogenesis and nodal segments were the explants for indirect organogenesis. Sub-culturing three days after inoculation checked the polyphenol interference. Multiple shoot induction was obtained when shoot tips were cultured in medium supplemented with BAP 0.2 mg/l and NAA 0.5 mg/l. Callus formation was best in media with NAA 0.5 mg/l. While callus regeneration was superior in media containing BAP 0.5 mg/l. The best response in rooting was observed in media with IBA 0.2 mg/l.

**14. Minimol, J. S. 2004. Morphogenesis and reproductive biology of sacred lotus (*Nelumbo nucifera* Gaertn.). Ph.D thesis.**

Six different ecotypes of sacred lotus were evaluated *ex situ*. Variability was observed for size of lamina, longevity, petiole length, etc. The growing tip of rhizome was found to be the best propagule. Study of seasonal effect revealed that rainy season favoured growth in size of leaves and spring favoured longevity. Peak flower production was found in spring and the least in summer. No seed set was observed in protected buds indicating cross pollination. Thermogenesis was observed in fully mature flower buds and was found to correspond with stigma receptivity. Flowers were observed to be cartharophilous. Dormancy in lotus seeds can be attributed to thick waxy coating on the fruit wall, presence of water soluble inhibitors and thick macrosclerid layer in mesocarp. Embryo as such is non dormant. Mechanical scarification followed by leaching improved germinability of seeds.

## MISCELLANEOUS

**1. Nandini, K. 1981. Seed biology and seedling characteristics of important weeds in Kerala. M.Sc. (Ag.) thesis.**

A study was undertaken to understand the various aspects of seed biology and seedling characteristics of important weeds in Kerala. Shape of seed varied in different species. Higher number of seeds per fruit, low hundred seed

weight and smaller size of seeds had contributed to wider distribution of *Sphenoclea zeylanica* Gaertn., *Scoparia dulcis* Linn. Seedlings with more number of leaves (Amarantaceae) or which had foliar type of cotyledons as in *Calotropis gigantea* and *Cassia occidentalis* (L.) could establish quickly in an area through early and enhanced photosynthetic activity. Seedlings with lower shoot/root ratio had well developed root system which helped them to establish quickly, as a result of efficient absorption of water and nutrients. Seed dormancy in weed species could be broken by either pre-soaking overnight or with conc. sulphuric acid treatment. Seeds with maximum veilure co-efficient (K) value were considered to be a potential danger if introduced into the country. The beginning and completion of germination also varied in different families. In Aizoaceae and Amarantaceae beginning and completion of germination more or less coincided. Variation in germination percent was attributed to difference in environmental and seed factors.

## AINP ON MEDICINAL AND AROMATIC PLANTS

### Viswanathan Memorial Herbal Garden

Viswanathan Memorial Herbal Garden was established as a medicinal plant garden under the project AICRP on Medicinal & Aromatic Plants during 1994, mainly to conserve nearly 400 species of rare medicinal plants. Among the species some have wide range of variability which are being evaluated and documented. This is a key centre under Kerala Agricultural University to produce planting materials of most wanted medicinal plants for catering the needs of the persons engaged in medicinal plants cultivation as well as Ayurvedic physicians. As a network project of National Research Centre of Medicinal and Aromatic Plants, this centre is conducting various research projects on medicinal plants relevant to Kerala ecosystems. This centre also act as a rich resource for post graduate students of various colleges, scientists working in medicinal plant field besides ayurvedic physicians and ayurvedic drug manufacturers for academic as well as research purposes.

The following projects are being under take in at present in the scheme.

#### A. Crop Improvement

##### I. Long Pepper (*Piper longum*)

- a) Evaluation of selected genotypes for high spike yield and alkaloid yield
- b) Hybridization and evaluation of progenies for yield and quality of spikes

##### II. Chethikoduveli (*Plumbago rosea*)

- a) Germplasm collection and evaluation
- b) Reproductive biology

##### III. Asoka (*Saraca indica*)

- a) Survey, collection and evaluation of germplasm
- b) Reproductive biology



## B. Crop Production

### I. Long Pepper

- a) Comparison in performance of Vishwam variety and Anand type in laterite soil.
- b) Effect of spacing on growth, yield and quality of *Piper longum*
- c) Influence of combination of organic manures and biofertilizers on growth, yield and quality of *Piper longum*

### II. Chethikoduveli (*Plumbago rosea*)

- a) Effect of spacing on growth, yield and quality of *Plumbago rosea*
- b) Influence of combination of organic manures and biofertilizers on growth, yield and quality of *Plumbago rosea*
- c) Irrigation scheduling in *Plumbago rosea*

## C. Phytochemistry

### I. Long Pepper

- a) Quality analysis of essential oils in *Piper longum*
- b) Quality analysis of selected accessions
- c) Quality analysis of agronomic trials

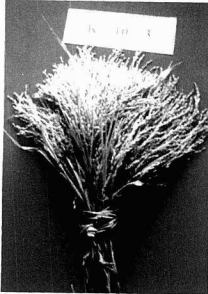
### II. Asoka

- A) Characterisation of tannins and catechol in leaf and bark
- B) Quality analysis of collected accessions

## VARIETIES RELEASED

### Rice

#### 1. Name of variety



Breeding Method	: Participatory varietal selection
Parentage	: Local rice cultivar kunjukunju
Duration	: Short duration
Yield	: 5 to 5.5 –t/ha
Adaptation	: Recommended for direct seeding and transplanting in double cropped areas of Palakkad, Thrissur and Ernakulam districts.

#### Special Features

- Pigmentation on leaf base & apiculus.
- Red kernel good cooking quality.
- Moderately resistant to major Pests & Diseases

#### 2. Name of variety



Breeding Method	: Participatory varietal selection
Parentage	: Local rice cultivar kunjukunju
Duration	: Short duration
Yield	: 5 to 5.5 –t/ha
Adaptation	: Recommended for direct seeding and transplanting in double cropped areas of Palakkad, Thrissur and Ernakulam districts.

#### Special Features

- Red kernel good cooking quality.
- Moderately resistant to major Pests & Diseases

## Trainings

1. ICAR short course on “Emerging Trends in Conservation, Management and Utilization of Genetic Resources” - 22<sup>nd</sup> Sept - 1<sup>st</sup> Oct, 2003.



2. ICAR Winter School on “Intellectual Property Management of Genetics Resources - Dimensions and Tools” - 9<sup>th</sup> - 29<sup>th</sup> Nov, 2005.



## Long Pepper

1. Name of variety : **Viswam**



Breeding Method : Clonal selection

Parentage : Cheemathippali

Duration : Perennial

Yield : Average yield open condition 800kg  
of dry spike per hectare.

Average yield as inter crop in coconut  
garden 320 kg of dry spike per hectare

Adaptation : Both under open and partially shaded conditions.

Special Features : 

- Bushy type
- Spike production from 2<sup>nd</sup> year of planting
- Spike length intermediate and medium pungency.
- On maturity spike turns shiny black
- Rich in alkaloid and piperine content

## MEETINGS AND TRAININGS ORGANIZED

### One Day Workshop

1. "Patent Awareness", funded by DST - March 2003.



2. 'Seeds Bill-2004' by IPR cell of KAU - June 2005.
3. 'Protection of Geographical Indications of Goods for Better Marketing' funded by KSCSTEC - July 2005.

**AWARD WINNERS**

1. **Dr. C. R. Elsy** Mercy Ponnaiyya and B.W X. Ponnaiyya gold medal.(1997) for the best PhD thesis from Tamil Nadu Agricultural University.
2. **Dr. C. R. Elsy** Young scientist Award (1999) for excellence in Agricultural Research instituted by STEC, Govt. of Kerala.
3. **Dr. C. R. Elsy** BOLT award (2003) for excellence in teaching instituted by AIR INDIA and Malayala Manorama.