QUANTIFICATION OF MEDICINAL PLANTS IDENTIFIED IN RUBBER PLANTATIONS OF VELLANIKKARA

BY

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DISSERTATION

Submitted in partial fulfilment of the
requirements for the Post Graduate Diploma
in Natural Rubber Production of the Kerala Agricultural University

Department of Plantation Crops and Spices

COLLEGE OF HORTICULTURE

Vellanikkara - Thrissur

1993

DECLARATION

I hereby declare that this dissertation entitled "**Quantification of Medicinal Plants identified in Rubber Plantations of Vellanikkara**" is a bonafide record of research work done by me and that this dessertation has not previously formed the basis for award to me, of any degree, diploma or other similar title of any other University or Society.

Vellanikkara,
4.9.93.

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CERTIFICATE

Certified that this dissertation entitled **"Quantification of Medicinal Plants identified in Rubber Plantations of Vellanikkara"** is a record of research work done independently by **Sri.A.V. RAMABHADRAN** under our guidance and supervision and that it has not previously formed the basis for the award of any degree, diploma or fellowship to him.

We, the undersigned members of the Advisory Committee of **Sri.A.V.RAMABHADRAN**, a candidate for the Post Graduate Diploma in Natural Rubber Production, agree that the dissertation may be submitted by him in partial fulfilment of the requirement of the Diploma.

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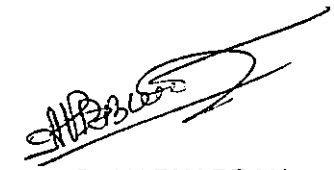

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C O N T E N T S

LIST OF TABLES

LIST OF PLATES

Introduction

1. INTRODUCTION

The forests of India are reserves of rare species of plants, majority of which are of medicinal value. So the drug resources of our country are vast and inexhaustible. The plant species of therapeutic value specified in the pharmacopoeias of various countries, are seen in abundance in the natural growth of weeds in many parts of India. The perpectual natural resources, both flora and fauna of the tropical rain forests of India have, for ages, helped the human existence by providing his basic needs such as food, clothing, shelter, fuel and medicines.

Considerable number of rare plant species of medicinal value have become extinct due to unscrupulous deforestation. Besides, our country has lost much of the available genetic wealth since many of these drug plants have been and still continue to be gathered indiscriminately from their wild growth depleting the vegetation of its valuable medicinal plant wealth. The scarcity of plants of therapeutic value is creating problems. It is time that we make energetic efforts to build up arboretums and gene banks covering important medicinal plants to facilitate the genetic improvement of cultivars for profitable cultivation and better health care.

The allocation of land for cultivation of new crops like medicinal plants will be very much limited especially in a State like Kerala with overcrowding population. Natural rubber plantation in India which covers more than 4.66 lakh hectares, is a potential

area where many medicinal plants are seen as undergrowths.

The natural vegetation in the rubber plantation is destroyed during weeding operations and intercropping. Even then, a sizable number of herbs and shrubs of annual and perennial nature are seen as under growths in the plantations many of which have medicinal value. These plants are widely used in folk medicine and indigenous medicines and have good demand in the local market. Raghavan (1992) has identified and catalogued 50 species of medicinal plants in the rubber plantation at Vellanikkara owned by the Kerala Agricultural University.

The objective of the present study is to assess the total biomass production of medicinal plants observed as weeds in rubber plantations and to quantify their officinal part. Further, this will provide information on the possibilities of introducing some of the viable medicinal plants as intercrops in mature rubber plantations which in turn will help to strengthen research activities in this line.

Review of Literature

2. REVIEW OF LITERATURE

From time immemorial, plants of therapeutic value were used for treatment. The excavations at Mohanjodaro and Harappa have brought to light several therapeutic substances like "Silajatu", remedy for diabetes, rheumatism etc. and leaves of neem tree (Azadirachta indica A. Juss). This points out to the high quality of the medical science that was prevalent at that time in India (Dash, 1978).

Use of medicinal plants for treatment dates back to even 5000 years and has become codified in Ayurveda, which contains over 8000 herbal remedies. Ayurveda, in fact, is the foundation stone of the ancient medical science in India. It was followed by Charaka and Susrutha. The celebrated classical texts in Ayurveda are Charaka and Susrutha Samhitas. It is seen that Ayurveda had reached the zenith of its development between 500 BC and 1000 AD.

The available informations revealed that the first systematic work which codified the medicinal use of plants of India is "Hortus Malabaricus" by Von Rheedes (1678). A series of works on medicinal plants were published by eminent authors in the later years. Kirtikar and Basu (1935) summarised and compiled the earlier literature on medicinal plants. In their book entitled "Indian medicinal plants" plates of Indian medicinal herbs have been given which largely help for identification of plants. The description and uses of 3535 medicinal plants were given by Rao (1914).

The "Wealth of India" published by the Council of Scientific and Industrial Research had provided the results of investigation of many drugs. Mooss (1953) had described the properties of drug plants and given notes on the identification of important medicinal plants. Another noteworthy work on this topic is "Indian Materia Medica" by Nadkarni (1954).

Chopra et al. (1956) described the pharmacological action and uses and chemical constituents of common medicinal plants of India. Chopra et al. (1958) has also given notes on the pharmacopoeial and allied drugs commonly used in India. Dastur (1962) described the morphological characters, action and uses of common medicinal plants of India and Pakistan. The plants that can be used as single drug remedies were reported by Mooss (1976). Dey (1988) introduced the Indian Medicinal plants used in Ayurvedic preparations.

Secondary metabolites of medicinal plants

Plants known as medicinal or officinal, are rich in secondary metabolites which are potential sources of drugs and essential oils. The biosynthesis of secondary metabolites although controlled by genetic make up is affected strongly by environmental influences. As a result, there are fluctuations in the concentration and quantities of the secondary metabolites such as alkaloids, glycosides, volatile oils and steroids. Other characteristic constituents are flavanoids, resins, saponins, tannins and terpenoids. These organic

compounds are synthesised by the plants during the metabolic process when they grow.

The effect of a drug is different when it is administered in its original, complex, biochemical package and by the isolated active principle. For example, Rauvolfia serpentina is one among the most important plants native to India. The roots of the plant have been used in the indigenous medicine from ancient times. The importance of the root drug and the alkaloids obtained from it have been recognised in the allopathic system, in the treatment of hypertension or as sedative and tranquilising agent. A large number of alkaloids have been isolated from the roots of this plant. The important ones among these are ajmaline, ajmalicine, ajmalinine, rescinamine, reserpine, reserpinine and serpentinine. When reserpine was used as a tranquiliser, patients became depressed in many cases. But when the total extract of the root was administered, there was no depression in patients. We can elucidate the reason for this beneficial total effect of the plant extract as a synergistic or modifying action of the accompanying chemicals in the extract on the pharmacological activity of the main constituents (Mossa et al., 1987).

It is known that 121 chemical substances of known structure are still extracted from plants that are useful as drugs throughout the world (Farnsworth and Soejarto, 1988).

Cultivation of medicinal plants

It is a laborious task to collect plant species of medicinal value from the forest, since they are widely scattered. The difficulty experienced with accessibility to the remote areas in the forest and collection of plants from the scattered areas have resulted in the hike of prices of medicinal plants.

The flora of India is considered to be a rich emporium of drug plants. During the last four decades, the research on medicinal and aromatic plants have shown considerable development in India. Recently, there is an advancement in the research and development work in growing and processing of medicinal and aromatic plants in many other countries of Asia, Africa and Latin America.

For the existence of the pharmaceutical industry, a regular supply of all drugs of standard quality is essential. For this, systematic cultivation of indigenous plants is to be ensured. The exotic varieties are to be introduced and cultivated. Medicinal plants like digitalis, cinchona, pyrethrum etc. have been tried in botanical gardens and in tea and coffee plantations. The cultivation of drugs and narcotics occupy only a small percentage of the total area under cultivation. Cinchona, hemp, tobacco, opium etc. occupy a comparatively small acreage (Chopra et al., 1958).

Recently, cultivation of medicinal plants in India is gaining momentum. The ICAR through their co-ordinated research projects,

is sponsoring such activity in the North Eastern, Northern and Southern India. A number of drug farms have been started. In certain parts of Kashmir, digitalis, belladona, hyoscyamus, pyrethrum, senna etc. are successfully cultivated. In Karnataka, cultivation of wattle, pyrethrum, derris, cinchona, geranium, peppermint and tung tree is successful. The high demand of Rauvolfia serpentina has necessitated its extensive cultivation in various parts of the country. Various agencies have also come forward now, for the promotion of cultivation of medicinal plants which have good demand in the local market. Catharanthus roseus is being cultivated on a large scale since its demand is high. The possibility of growing 13 medicinal/aromatic plants as inter-crops in 8 to 20 year old coconut plantation was reported by Nair et al. (1991). The viable species identified were greater galangal, periwinkle, panikurka, eruveli, channakkuva, tulasi (3 spp), koduveli, sarpagandha (2 spp), mango ginger and kacholam. These were found to be shade tolerant plants. Intercropping of medicinal plants in coconut plantation can fetch additional income to lakhs of farmers.

Cultivation of medicinal plants in rubber plantation

Weeds are a serious problem in all rubber plantations. The climatic conditions under which rubber is grown, promotes the rapid and luxuriant growth of weeds. As soon as the land is cleared for planting, natural weed species dominate the area. The most common species found in such condition is Chromolena

odorata. Other common weeds are Mimosa pudica, Imperata cylindrica, Pennisetum polystygon, Borreria spp and Lantana aculeata (Potty et al., 1980).

The competition by weeds for sunlight, water and nutrients results in suppressed growth of rubber plants. The competition for light will exist only in the initial one or two years. Blocking of drainage channels by weeds has also been experienced. Competition for water and nutrients will continue throughout the immaturity period. Uncontrolled growth of weeds will hinder the cultural operation in a rubber plantation. The weeds may also act as alternative host for insects as well as pathogenic fungi which may increase the incidence of pests and diseases. These reasons necessitate efficient weed control measures in rubber plantations. Weed control is normally done by manual weeding. Chemical weeding is also done in a limited extent. Establishment of leguminous cover crop is another effective method to smother weeds. It is estimated that weeding operation alone shares 34 per cent of the total cost of cultivation of rubber in its immature phase. Weed growth is comparatively less in mature plantations since the canopy is closed.

It is found that many of the weeds in rubber plantations are having medicinal value. These plants have good local demand for the preparation of Ayurvedic medicines. So these can be tried as intercrops in rubber plantations and this will help to conserve the endangered species.

There are recent reports of attempts made to cultivate medicinal plants in rubber plantation also. Certain shade tolerant medicinal plants that can be intercropped in rubber plantation during its immature phase are mentioned in the annual report of the Rubber Research Institute of India, Kottayam (1987-88). More than 24 species have been reported as potential intercrops. Rubber Research Institute of India had adopted trench planting system and it was reported that about 11,000 numbers of koduveli or 18,000 numbers of karimkurinji or 36,000 numbers of sarpagandhi plants can be planted per hectare as intercrops in Rubber Plantation. Plants like Adhatoda beddomei (Cheria adalotakam), Adhatoda vasica (Valia adalotakam), Rauvolfia serpentina (Sarpagandhi), Holostemma annulare (Adapathiyan), Kaempferia galanga (Kacholam), Alpinia galanga (Chittaratha), Sida rhombifolia (Kurumthotti), Pueraria species (Kattupayar), Desmodium species (Kattuzhunnu), Strobilanthus haenianus (Karinkurinji) etc. were reported to be shade tolerant species which can be cultivated successfully in the Rubber Plantations (RRII, 1989).

The trials conducted at the Central Experiment Station of the Rubber Research Institute of India showed that the biological bunds raised with Strobilanthus haenianus were found to perform well in conserving soil and water. It was also found that Strobilanthus species attract honey bees for four months. Rauvolfia serpentina, Holostemma annulare, Sida rhombifolia and Pueraria species (Kattupayar) did not perform well under mature canopy. Adhatoda

beddomei, A. vasica, Strobilanthus haenianus, Plumbago rosea, Kaempferia rotunda, K. galanga and Alpinia galanga were found to come up well under deep shade (RRII, 1989). It was reported from the trials, that cultivation of medicinal plants like Strobilanthus haenianus, Adhatoda vasica, A. beddomei, Plumbago rosea, Alpinia galanga, Kaempferia rotunda, in rubber plantations can fetch additional income.

Statistically laid out trials were initiated at the Central Experiment Station of the Rubber Research Institute of India at Chethackal (1990) to study the yield potential and nutritional requirements of intercrops and the effect of intercrops on the latex yield.

3. MATERIALS AND METHODS

In an earlier investigation, Raghavan (1992) had collected, identified and catalogued 50 medicinal plants found among the weed population in the Vellanikkara rubber estate owned by the Kerala Agricultural University. The present study is its continuation.

The Vellanikkara rubber estate covers a total extent of 88.07 ha. The area is located at 10° 31' N latitude and 76° 13' E longitude at an altitude 40 m above MSL. The average annual rainfall during the last three years was 316.4 cm. Relative humidity ranges from 51 to 88 per cent. The details of materials and techniques adopted during the course of investigation are presented hereunder.

The plants of medicinal value were collected from the 'Priyadarsini' Block which is located just behind the estate office and factory. This was the area where replanting was done in 1978 and 1979. The extent of this block was 8.50 ha. The topography is undulating. Soil is lateritic with rocky patches here and there. Planting was done at a spacing of 4.9 x 4.9 and 4.6 x 4.6 m. Soil conservation works were undertaken. Initial planting density was 423/ha. At the time of study, the stand was only 352/ha. The reduction in stand per hectare was due to natural calamities like wind and drought in the subsequent years of planting. The vacancies were scattered in the plantation. The clones planted in

the area were RRIM 600, 623, 628 and RRII 105. Canopy was dense in the entire block. There was light penetration in the vacant patches.

Maintenance and upkeep operations were done according to the recommendation of the Rubber Board. Leguminous cover crop was established in the early years of planting. It was faded away due to the closure of the canopy leaving traces of the legume here and there. Weeds were slashed 2 to 3 times a year. Grazing of cattle was strictly prohibited.

The area where weeds were available in a hectare was calculated as follows:

Distance between two rubber plants	:	4.6 m
Width of line weeded portion	:	2 m
Stand per hectare	:	352
Area occupied by the trees (line weeded portion) (4.6 m x 2 m x 352)	:	3250 m^2
Balance area available for weed growth	:	6750 m^2

For the collection of medicinal plants, the area was divided into three zones. The 25 m width of the periphery area was designated as zone 1. The next 25 m width of the area inner to outer zone was designated as the zone 2 and the balance area towards the centre as zone 3. Medicinal plants were collected randomly from 10 points in each zone, using a square iron frame

of 0.5 m. The frame was thrown at random at 10 places in a zone and the medicinal plants in each square were collected. The different medicinal plant species collected from each unit area were sorted out and counted separately species wise. The following details were recorded in a proforma already prepared for the study.

1. Total number of plants in a unit area (species wise)
2. Number of plants of a particular species in a unit area
3. Frequency (Number of plants/area) m^2
4. Height of the plant
5. Number of tillers/branches
6. Wet/dry matter production (whole plant in g/unit area)
7. Wet/dry matter production from different plant parts (g/unit area)
8. The details regarding binomial nomenclature, vernacular name and family were recorded for each species collected. The details of the main crop in the surveyed area such as clone, age, spacing, cultural operations, soil conservation practices, intercropping adopted etc. also were recorded.

The details of the medicinal plants were collected during January 1993 and June 1993.

The plants collected from the field were washed to remove the dirt and spread in shade to drain the moisture. The root and shoot were separately weighed and weights recorded. The plant parts were kept in paper covers and dried in the oven at 60°C till a constant weight is attained. Then the dry weights were recorded. Shoot root ratios were also calculated.

Results and Discussion

4. RESULTS AND DISCUSSION

The results of the study were tabulated and given in Tables 1 to 7.

There were 21 plant species belonging to 16 families in zone 1, 12 plant species belonging to 12 families in zone 2 and 14 plant species belonging to 11 families in zone 3 (Table 1). The diagramatic representation of distribution of medicinal plants in different zones has been given in Figure 1 & Plates 1, 2 and 3 show the growth of medicinal plants in rubber plantations.

In zone 1, the frequency varied from 0.4 to 8.8/2.5 m^2 (Table 2a). Plants like Acalypha indica, Calotropis gigantea, Scoparia dulcis, Rauvolfia serpentina, Cleome viscosa and Tridax procumbens were seen towards the periphery of this zone where light penetration was more. It was noticed that plants like Boerhaavia diffusa, Calotropis gigantea and Passiflora foetida produced higher biomass when compared to other species identified in the zone (Table 2b). The distribution of biomass of shoot and root gave a different picture. In the case of Calotropis gigantea, the root had a higher contribution than that of the shoot and this was confirmed by the shoot root ratio of 1:4. A better vegetative growth was reflected in the case of Acalypha indica and Cleome viscosa. The higher contribution of the shoot system might have resulted in the poor root system. This is confirmed by the shoot root ratio of 6.75:1 and 7.5:1 respectively (Table 2b). Total biomass production was found to be 277.05 g/2.5 m^2 in zone 1.

Table 1. Zone wise distribution of medicinal plants

Sl. No.	Scientific name	Family	Zone		
			1	2	3
1	2	3	4	5	6
1	Acalypha indica Linn.	Euphorbiaceae	✓	-	-
2	Achyranthes aspera Linn.	Amaranthaceae	✓	-	-
3	Aerva lanata Juss.	Amaranthaceae	✓	-	-
4	Biophytum sensitivum DC.	Oxalidaceae	✓	-	-
5	Boerhaavia diffusa Linn.	Nyctaginaceae	✓	-	-
6	Calotropis gigantea Linn.	Asclepiadaceae	✓	-	-
7	Calicopteris floribunda Lam.	Combretaceae	-	-	✓
8	Cardiospermum helicacabum Linn.	Sapindaceae	✓	-	-
9	Cleome viscosa Linn.	Capparidaceae	✓	-	-
10	Clerodendron infortunatum Linn.	Verbenaceae	-	✓	✓
11	Curculigo orchioides Gaertn.	Amaryllidaceae	✓	✓	✓
12	Cyclea peltata Hook f. and Thoms.	Menispermaceae	✓	✓	✓
13	Cynodon dactylon Pers.	Gramineae (Poaceae)	✓	-	-
14	Cyperus rotundus Linn.	Cyperaceae	-	✓	-
15	Elephantopus scaber Linn.	Compositae	-	✓	✓
16	Emilia sonchifolia Dc.	Compositae	-	-	✓
17	Ficus hispida Linn.	Urticaceae	-	✓	-
18	Glycosmis cochinchinensis Pierre ex Engler.	Rutaceae	-	✓	-
19	Hemidesmus indicus R. Br.	Asclepiadaceae	✓	✓	✓
20	Ichnocarpus frutescens R.Br.	Apocynaceae	✓	✓	✓
21	Lantana aculeata Linn.	Verbenaceae	-	✓	-
22	Leucas aspera Spreng	Labiatae	✓	-	-
23	Lygodium flexuosum (SW.)	Polypodiaceae	-	-	✓
24	Mimosa pudica Linn.	Leguminosae (Mimosaceae)	-	✓	-

Contd.

Table 1. Continued

1	2	3	4	5	6
25	Naregamia alata Wight & Arn.	Meliaceae	-	-	✓
26	Passiflora foetida Linn.	Passifloraceae	✓	-	-
27	Phyllanthus niruri Linn.	Euphorbiaceae	✓	-	-
28	Phyllanthus reticulatus Poir	Euphorbiaceae	✓	-	-
29	Rauvolfia serpentina Benth. ex Kurz For.	Apocynaceae	✓	-	-
30	Scoparia dulcis Linn.	Scrophulariaceae	✓	-	-
31	Sida retusa Linn.	Malvaceae	-	✓	-
32	Sida rhombifolia Linn.	Malvaceae	-	-	✓
33	Stachytarpheta indica Vahl.	Verbenaceae	✓	-	-
34	Tridax procumbens Linn.	Compositae	✓	-	-
35	Urena lobata Linn.	Malvaceae	-	-	✓
36	Vernonia cinerea Less.	Compositae	-	-	✓
37	Zizyphus oenoplia Mill.	Rhamnaceae	-	-	✓

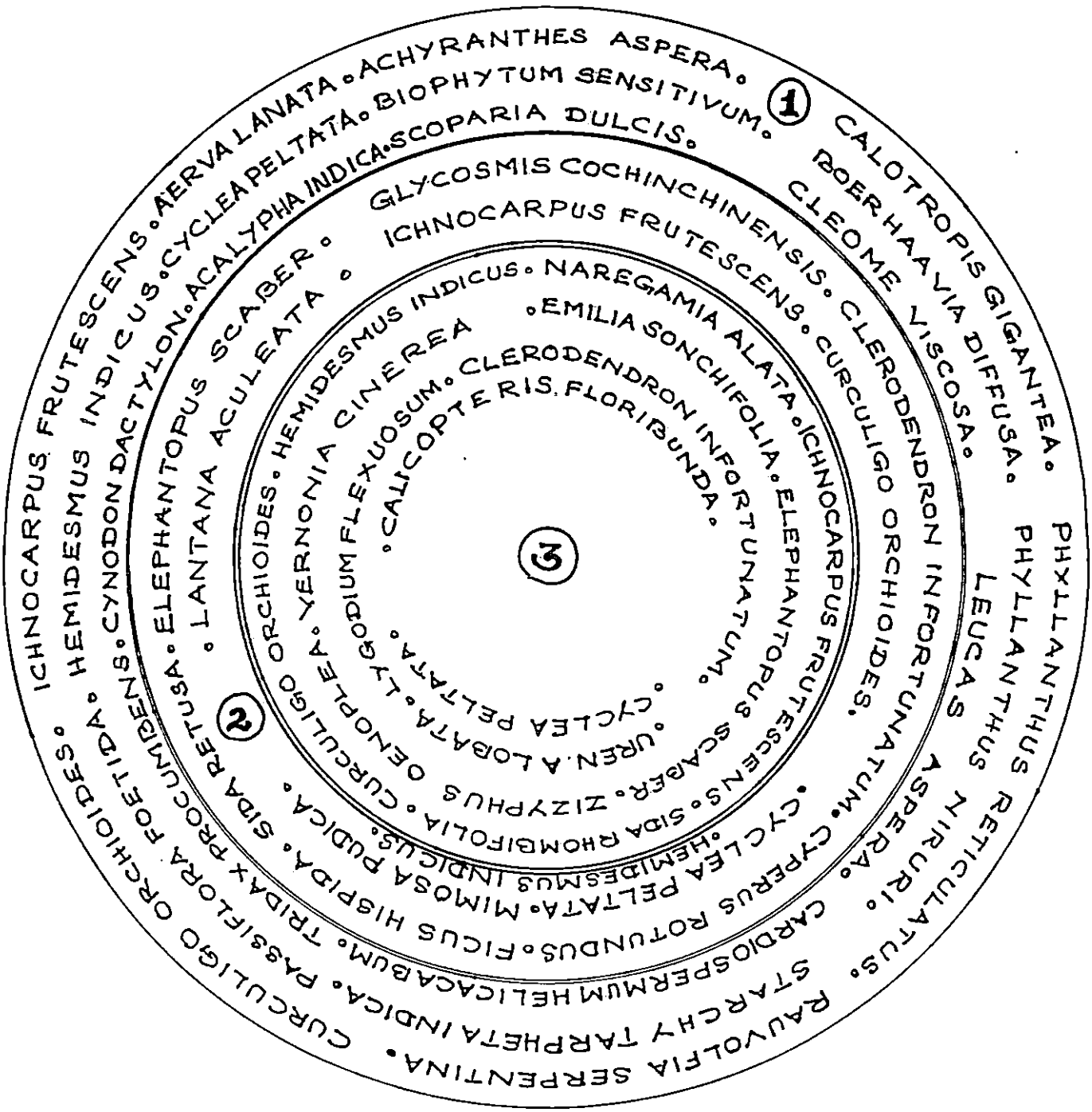

Fig.1. Digramatic representation of the Estate showing distribution of Medicinal plants

Plate 1. Curculigo orchioides (Nilappana) growing in rubber plantations

Plate 2. Elephantopus scaber (Anachuvadi) growing in rubber plantations

Plate 3. Ficus hispida (Param) growing in rubber plantations

Table 2a. Details of medicinal plants identified in Zone 1

Sl. No.	Scientific name	Vernacular name	Family	Frequency	Average height/ length (cm)	No. of branches	Officinal part
1	Acalypha indica Linn.	Kuppamani	Euphorbiaceae	1.2	39.33	-	Whole plant
2	Achyranthes aspera Linn.	Kadaladi	Amaranthaceae	0.8	32.5	2	"
3	Aerva lanata Juss.	Cheroola	Amaranthaceae	0.4	27	9	"
4	Biophytum sensitivum DC.	Mukkutti	Oxalidaceae	0.4	5	-	"
5	Boerhaavia diffusa Linn.	Thazhuthama	Nyctaginaceae	1.2	99.33	8	"
6	Calotropis gigantea Linn.	Erukku	Asclepiadaceae	0.4	60	2	"
7	Cardiospermum helicacabum Linn.	Vallïuzhinja	Sapindaceae	2.0	11.75	-	"
8	Cleoma viscosa Linn.	Kattukaduku	Capparidaceae	0.4	45	3	"
9	Curculigo orchioides Gaertn.	Nilappana	Amaryllidaceae	1.2	21	-	Root
10	Cyclea peltata Hook f. & Thoms.	Padakizhangu	Menispermaceae	0.4	100	2	"
11	Cynodon dactylon Pers.	Karuka	Graminae	8.8	20	-	Whole plant
12	Hemidesmus indicus R.Br.	Naruninti	Asclepiadaceae	0.4	40	1	Root
13	Ichnocarpus frutescens R.Br.	Palvalli	Apocynaceae	0.4	30	2	"
14	Leucas aspera Spreng.	Thumba	Labiatae	0.4	34	-	Whole plant
15	Passiflora foetida Linn.	Poochapazham	Passifloraceae	0.4	142	2	"
16	Phyllanthus niruri Linn.	Kizhanelli	Euphorbiaceae	2.0	21.2	-	"
17	Phyllanthus reticulatus Poir.	Niruri	Euphorbiaceae	1.6	41	-	"
18	Rauvolfia serpentina Benth ex Kurz For.	Sarpagandhi	Apocynaceae	0.4	40	-	Root
19	Scoparia dulcis Linn.	Kallurukki	Scrophulariaceae	0.4	58	7	Whole plant
20	Stachytarpheta indica Vahl.	Katapunuttu	Verbenaceae	0.8	49	-	"
21	Tridax procumbens Linn.	Odiyanpachila	Compositae	0.8	31	6	"

Table 2b. Total biomass production of medicinal plants in Zone 1

Sl.No.	Scientific name	Fresh weight (g)			Dry weight (g)			Driage (%)			Shoot root ratio
		A	B	C	A	B	C	A	B	C	
1	Acalypha indica Linn.	17.5	1.5	19.0	2.7	0.4	3.1	15.43	26.67	16.32	6.75:1
2	Achyranthes aspera Linn.	16.0	6.0	22.0	4.0	2.5	6.5	25.00	41.66	29.54	1.6:1
3	Aerva lanata Juss.	11.3	1.2	12.5	3.0	0.3	3.3	26.55	25.00	26.40	10:1
4	Biophytum sensitivum DC.	-	-	0.5	-	-	0.2	-	-	40.00	-
5	Boerhaavia diffusa Linn.	194.4	37.2	231.6	60.0	15.3	75.3	30.86	41.13	32.51	4:1
6	Calotropis gigantea Linn.	52.0	96.0	148.0	10.7	43.2	53.9	20.58	45.00	36.42	1:4
7	Cardiospermum helicacabum Linn.	1.8	0.2	2.0	0.4	0.1	0.5	22.22	50.00	25.00	4:1
8	Cleome viscosa Linn.	6.4	0.8	7.2	1.5	0.2	1.7	23.44	25.00	23.61	7.5:1
9	Curculigo orchioides Gaertn.	12.0	17.0	29.0	1.7	4.8	6.5	14.16	28.23	22.41	1:2.8
10	Cyclea peltata Hook f. & Thoms.	10.0	26.0	36.0	3.3	10.0	13.3	33.00	38.46	36.94	1:3
11	Cynodon dactylon Pers.	-	-	84.5	-	-	23.6	-	-	27.93	-
12	Hemidesmus indicus R.Br.	10.5	13.0	23.5	4.0	5.2	9.2	38.09	40.00	39.14	1:1.3
13	Ichnocarpus frutescens R.Br.	3.7	6.1	9.8	1.0	1.7	2.7	27.02	27.86	27.55	1:1.7
14	Leucas aspera spreng.	8.9	0.7	9.6	1.8	0.2	2.0	20.22	28.57	20.83	9:1
15	Passiflora foetida Linn.	223.6	6.4	230.0	35.0	1.8	36.8	15.65	28.13	16.00	19:1
16	Phyllanthus niruri Linn.	12.5	1.5	14.0	2.5	0.25	2.75	20.00	16.66	19.64	10:1
17	Phyllanthus reticulatus Poir.	8.3	8.7	17.0	2.5	3.8	6.3	30.12	43.68	37.06	1:1.5
18	Rauvolfia serpentina Benth ex Kurz For.	20.5	10.0	30.5	3.6	4.0	7.6	17.56	40.00	24.92	1:1
19	Scoparia dulcis Linn.	25.7	3.1	28.8	6.9	1.2	8.1	26.85	38.70	28.13	5.75:1
20	Stachytarpheta indica Vahl.	43.4	7.0	50.4	8.4	1.8	10.2	19.35	25.71	20.24	4.7:1
21	Tridax procumbens Linn.	33.6	2.0	35.6	3.0	0.5	3.5	8.93	25.00	9.83	6:1

A - Shoot; B - Root; C - Total

In zone 2, the frequency varied from 0.4 to 2.8/2.5 m^2 (Table 3a). It was seen that the biomass production was more in the case of Cyclea peltata and Ficus hispida when compared to other species. The proportion of root was higher than the shoot in the case of Curculigo orchioides, Cyclea peltata, Cyperus rotundus, Hemidesmus indicus and Ichnocarpus frutescens. In six species, the proportion of shoot was higher. These were Clerodendron infortunatum, Ficus hispida, Glycosmis cochinchinensis, Lantana aculeata, Mimosa pudica and Sida retusa. The highest shoot root ratio of 5:1 was noticed in the case of Mimosa pudica. Total biomass production in zone 2 was 97.6 g/2.5 m^2 (Table 3b).

In zone 3, the frequency varied from 0.4 to 2.8/2.5 m^2 (Table 4a). Out of 14 species eight species had higher contribution of shoot (Table 4b). They were Calicopteris floribunda, Clerodendron infortunatum, Emilia sonchifolia, Naregamia alata, Sida rhombifolia, Urena lobata, Vernonia cinerea and Zizyphus oenoplia. In the case of Elephantopus scaber, the shoot root ratio was 1:1. The biomass production was 87.9 g/2.5 m^2.

It was seen that the biomass production in zone 1 was higher than that of the other two zones. It was 283.86 per cent higher than that of the biomass production of zone 2 and 315.18 per cent higher than that of zone 3. There was a remarkable decrease in the biomass production in zone 2 and 3. The reason that can be attributed to this phenomenon is that the light penetration was

Table 3a. Details of medicinal plants identified in Zone 2

Sl. No.	Scientific name	Vernacular name	Family	Frequency	Average height/ length (cm)	No. of branches	Officinal part
1	Clerodendron infortunatum Linn.	Peruvalam	Verbenaceae	0.4	44	-	Whole plant
2	Curculigo orchioides Gaertn.	Nilappana	Amaryllidaceae	0.8	26	-	Root
3	Cyclea peltata Hook f. & Thoms.	Padakizhangu	Menispermaceae	0.4	200	-	"
4	Cyperus rotundus Linn.	Muthanga	Cyperaceae	2.8	30	7	Tuber
5	Elephantopus scaber Linn.	Anachuvadi	Compositae	2.4	-	-	Whole plant
6	Ficus hispida Linn.	Param	Urticaceae	0.8	31	-	Shoot
7	Glycosmis cochinchinensis Pierre ex Engler.	Panal	Rutaceae	0.4	38	-	Whole plant
8	Hemidesmus indicus R.Br.	Naruninti	Asclepiadaceae	0.4	40	-	Root
9	Ichnocarpus frutescens R.Br.	Palvalli	Apocynaceae	0.4	30	-	Root
0	Lantana aculeata Linn.	Kongini	Verbenaceae	0.4	75	-	Whole plant
1	Mimosa pudica Linn.	Thottavadi	Leguminosae	0.8	40.5	3	"
2	Sida retusa Linn.	Kurumthotti	Malvaceae	1.2	32.3	-	"

Table 3b. Total biomass production of medicinal plants in Zone 2

. Scientific name	Fresh weight (g)			Dry weight (g)			Driage (%)			Shoot root ratio
	A	B	C	A	B	C	A	B	C	
Clerodendron infortunatum Linn.	33.2	9.0	42.2	6.9	3.7	10.6	20.78	41.11	25.12	2:1
Curculigo orchioides Gaertn.	5.0	7.0	12.0	0.7	1.8	2.5	14.00	25.71	20.83	1:2.5
Cyclea peltata Hook f. & Thoms.	20.0	38.0	58.0	6.6	18.2	24.8	33.00	47.89	42.76	1:3
Cyperus rotundus Linn.	10.0	13.0	23.0	2.0	3.3	5.3	20.00	25.38	23.04	1:1.6
Elephantopus scaber Linn.	22.0	14.0	36.0	3.2	3.4	6.6	14.54	24.28	18.33	1:1
Ficus hispida Linn.	37.0	17.0	54.0	9.3	6.7	16.0	25.14	39.41	29.63	1.4:1
Glycosmis cochinchinensis Pierre ex Engler.	8.5	3.7	12.2	3.2	1.8	5.0	37.65	48.65	40.98	1.8:1
Hemidesmus indicus R.Br.	12.0	15.0	27.0	4.8	6.1	10.9	40.00	40.66	40.37	1:1.2
Ichnocarpus frutescens R.Br.	3.2	6.2	9.4	1.0	2.2	3.2	31.25	35.48	34.04	1:2
Lantana aculeata Linn.	10.0	4.8	14.8	2.7	2.0	4.7	27.00	41.67	31.76	1.3:1
Mimosa pudica Linn.	6.4	1.0	7.4	2.0	0.4	2.4	31.25	40.00	32.43	5:1
Sida retusa Linn.	13.0	4.0	17.0	3.9	1.7	5.6	30.00	42.50	32.94	2.3:1

A - Shoot; B - Root; C - Total

Table 4a. Details of medicinal plants identified in Zone 3

Scientific name	Vernacular name	Family	Frequency	Average height/ length (cm)	No. of branches	Officinal part
Calicopteris floribunda Linn.	Pullani	Combretaceae	0.4	51	4	Whole plant
Clerodendron infortunatum Linn.	Peruvalam	Verbenaceae	0.4	40	-	"
Curculigo orchioides Gaertn.	Nilappana	Amaryllidaceae	2.8	26.71	-	Root
Cyclea peltata Hook f. & Thoms.	Padakizhangu	Menispermaceae	0.4	150	2	Root
Elephantopus scaber Linn.	Anachuvadi	Compositae	0.8	25	-	Whole plant
Emilia sonchifolia Dc.	Muyalcheviyan	Compositae	0.8	24	-	"
Hemidesmus indicus R.Br.	Naruninti	Asclepiadaceae	0.8	47	-	Root
Ichnocarpus frutescens R.Br.	Palvalli	Apocynaceae	0.4	35	-	Root
Lygodium flexuosum (SW)	Vallippanna	Polypodiaceae	0.4	74	-	Whole plant
Naregamia alata Wight & Arn.	Nilanarakam	Meliaceae	1.6	23.4	5	"
Sida rhombifolia Linn.	Anakurumthotti	Malvaceae	0.4	38	3	"
Urena lobata Linn.	Ooram	Malvaceae	0.4	30	3	"
Vernonia cinerea Less.	Poovamkurunthal	Compositae	0.4	29	-	"
Zizyphus oenoplia Mill.	Kottavalli	Rhamnaceae	0.4	30	2	Root

Table 4b. Total biomass production of medicinal plants in Zone 3

Scientific name	Fresh weight (g)			Dry weight (g)			Driage (%)			Shoot root ratio
	A	B	C	A	B	C	A	B	C	
Calicopteris floribunda Linn.	34.5	6.0	40.5	10.1	2.7	12.8	29.28	45.00	31.60	3.7:1
Clerodendron infortunatum Linn.	30.0	8.0	38.0	6.3	3.2	9.5	21.00	40.00	25.00	2:1
Curculigo orchioides Gaertn.	15.0	20.0	35.0	2.0	5.5	7.5	13.33	27.50	21.43	1:2.7
Cyclea peltata Hook f. & Thoms.	14.0	30.0	44.0	4.5	14.0	18.5	32.14	46.67	42.05	1:3
Elephantopus scaber Linn.	11.2	6.3	17.5	1.9	1.7	3.6	16.96	26.98	20.57	1:1
Emilia sonchifolia DC.	7.6	0.6	8.2	1.2	0.2	1.4	15.78	33.33	17.07	6:1
Hemidesmus indicus R.Br.	11.3	14.5	25.8	4.5	6.0	10.5	39.82	41.38	40.70	1:1.3
Ichnocarpus frutescens R.Br.	4.1	6.6	10.7	1.2	2.3	3.5	29.27	34.85	32.71	1:2
Lygodium flexuosum (SW)	5.4	4.5	9.9	1.3	1.8	3.1	24.07	40.00	31.31	1:1.5
Naregamia alata Wight & Arn.	24.9	3.8	28.7	5.0	1.8	6.8	20.08	47.37	23.69	3:1
Sida rhombifolia Linn.	5.4	1.2	6.6	1.3	0.6	1.9	24.07	50.00	28.79	2:1
Urena lobata Linn.	9.7	1.7	11.4	2.7	0.7	3.4	27.84	41.18	29.82	4:1
Vernonia cinerea Less.	1.4	0.3	1.7	0.3	0.1	0.4	21.43	33.33	23.53	3:1
Zizyphus oenoplia Mill.	9.0	4.2	13.2	3.0	2.0	5.0	33.33	47.62	37.88	1.5:1

A - Shoot; B - Root; C - Total

more in zone 1 than that of zone 2 and 3. The light penetration from the sides might have favoured the growth of undergrowths since zone 1 was on the periphery.

In the area studied, there were 37 species belonging to 25 families (Table 5). The family compositae had the highest representation of species. There were four plants viz. Elephantopus scaber, Emilia sonchifolia, Tridax procumbens and Vernonia cinerea. Euphorbiaceae, Malvaceae and Verbenaceae had three species each, Amaranthaceae, Apocynaceae and Asclepiadaceae had two species each and the other 18 families had one species each.

The species like Achyranthes aspera, Calotropis gigantea, Clerodendron infortunatum, Cyclea peltata, Hemidesmus indicus, Ichnocarpus frutescens, Scoparia dulcis and Vernonia cinerea were seen in all seasons of the year. The above species were collected in January 1993 (Summer) and June 1993 (Rainy) and the details of fresh weight, dry weight and driage were tabulated separately in Table 6.

It was seen that the percentage of dry weight decreased in all cases in June 1993, except that of Cyclea peltata. In the case of Cyclea peltata, the percentage of dry weight was 36.46 in January 1993 and 42.05 in June 1993. The quantity of roots collected in June 1993 was far more than the quantity collected in January 1993 (Table 6).

Table 5. Family wise distribution of medicinal plants

Sl.No.	Family name	Scientific name
1	2	3
1	Amaranthaceae	1. Achyranthes aspera Linn.
		2. Aerva lanata Juss.
2	Amaryllidaceae	Curculigo orchioides Gaertn.
3	Apocynaceae	1. Ichnocarpus frutescens R.Br.
		2. Rauvolfia serpentina Benth. ex Kurz For.
4	Asclepiadaceae	1. Calotropis gigantea Linn.
		2. Hemidesmus indicus R.Br.
5	Capparidaceae	Cleome viscosa Linn.
6	Combretaceae	Calicopteris floribunda Lam.
7	Compositae	1. Elephantopus scaber Linn.
		2. Emilia sonchifolia DC.
		3. Tridax procumbens Linn.
		4. Vernonia cinerea Less.
8	Cyperaceae	Cyperus rotundus Linn.
9	Euphorbiaceae	1. Acalypha indica Linn.
		2. Phyllanthus niruri Linn.
		3. Phyllanthus reticulatus Poir.
10	Graminae	Cynodon dactylon Pers.
11	Labiatae	Leucas aspera spreng.
12	Leguminosae	Mimosa pudica Linn.
13	Malvaceae	1. Sida retusa Linn.
		2. Sida rhombifolia Linn.
		3. Urena lobata Linn.

Contd.

Table 5. Continued

1	2	3
14	Meliaceae	Naregamia alata Wight & Arn.
15	Menispermaceae	Cyclea peltata Hook f. and Thoms.
16	Nyctaginaceae	Boerhaavia diffusa Linn.
17	Oxalidaceae	Biophytum sesitivum DC.
18	Passifloraceae	Passiflora foetida Linn.
19	Polypodiaceae	Lygodium flexuosum (SW)
20	Rhamnaceae	Zizyphus oenoplia Mill.
21	Rutaceae	Glycosmis cochinchinensis Pierre ex Engler.
22	Sapindaceae	Cardiospermum helicacabum Linn.
23	Scrophulariaceae	Scoparia dulcis Linn.
24	Verbenaceae	1. Clerodendron infortunatum Linn. 2. Lantana aculeata Linn. 3. Stachytarpheta indica Vahl.
24	Urticaceae	Ficus hispida Linn.

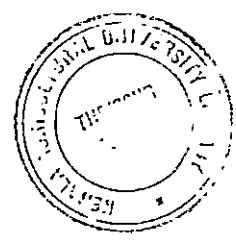

Table 6. Distribution and biomass production of medicinal plants in January and June 1993

Sl. No.	Scientific name	January, 1993									June, 1993								
		Fresh weight (g)			Dry weight (g)			Driage (%)			Fresh weight (g)			Dry weight (g)			Driage (%)		
		A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
1	Achyranthes aspera	9.0	4.5	13.5	4.5	1.5	6.0	50.00	33.33	44 44	8.0	3.0	11.0	2.0	1.25	3.25	25.00	41.67	29 55
2	Calotropis gigantea	42.0	88.0	130.0	12.1	46.8	58.9	28.81	53.18	45.31	52.0	96.0	148.0	10.7	43.20	53.90	20.57	45.00	36.42
3	Clerodendron infortunatum	19.0	13.0	32.0	10.0	8.0	18.0	52.63	61.54	56.25	33.2	9.0	42.2	6.9	3.7	10.60	20.78	41.11	25.12
4	Cyclea peltata	12.0	10.0	22.0	4.0	4.0	8.0	33.33	40.00	36.36	14.0	30.0	44.0	4.5	14.0	18.50	32.14	46.67	42.05
5	Hemidesmus indicus	35.0	115.0	150.0	17.0	70.0	87.0	48.57	60.87	58.00	11.3	14.5	25.8	4.5	6.00	10.50	39.82	41.38	40.70
6	Ichnocarpus frutescens	3.5	7.2	10.7	1.1	2.8	3.9	31.43	38.89	36.45	3.2	6.2	9.4	1.0	2.20	3.20	31.25	35.48	34.04
7	Scoparia dulcis	40.6	5.2	45.8	14.7	2.0	16.7	36.20	38.46	36.46	25.7	3.1	28.8	6.9	1.20	8.10	26.85	38.70	28.13
8	Vernonia cinerea	6.0	1.5	7.5	1.0	0.5	1.5	16.66	33.33	20.00	1.4	0.3	1.7	0.3	0.10	0.40	21.43	33.33	23.53

A - Shoot; B - Root; C - Total

This can be explained by the fact that during January the annual plants are in the mature stage, during the ensuing summer months most of the plants perish and new plants are produced with the onset of rain. But Cyclea peltata do not perish in summer and remain perennial.

A large number of species were seen where the canopy was sparse. These included Achyranthes aspera, Calycopteris floribunda, Glycosmis cochinchinensis, Naregamia alata, Passiflora foetida, Sida rhombifolia, Sida retusa and Urena lobata. A few species were seen scattered in the plantation. These were Cardiospermum helicacabum and Calotropis gigantea.

Species like Hemidesmus indicus, Ichnocarpus frutescens, Curculigo orchioides and Cyclea peltata were seen uniformly distributed in the plantation and their population was high.

The estimated quantities of officinal part of medicinal plants that could be available from one hectare of plantation without any additional investment is given in Table 7.

Though Raghavan (1992) catalogued 50 species of medicinal plants seen as undergrowths in the rubber plantation of Vellanikkara, only 34 species could be located and quantified in the present study. Sixteen species could not be located since the studies were undertaken during January which was comparatively a drier period and June which was the beginning of the rainy season. Further,

Table 7. Estimation of yield of officinal parts of viable medicinal plants

Sl.No.	Scientific name	Officinal part	Yield/ha (kg)
1	Cyclea peltata	Tuber	80
2	Hemidesmus indicus	Root	310
3	Ichnocarpus frutescens	Root	20
4	Curculigo orchioides	Root	50
5	Cyperus rotundus	Tuber	35
6	Sida retusa	Whole plant	45

only random selection was made and hence some species might have escaped from the study. However, three new species viz. Acalypha indica, Phyllanthus reticulatus and Sida retusa were located during the study and they were also quantified.

Summary and Conclusion

5. SUMMARY AND CONCLUSION

An attempt was made to quantify the weeds valued as medicinal plants in mature rubber plantations. The study was carried out during 1993 in 15 to 16 year old plantations of Kerala Agricultural University located at Vellanikkara, Trichur District.

Survey was conducted and samples were collected during the months of January and June 1993.

The following species were collected and the fresh weight, dry weight and shoot root ratio were worked out. The details such as species, family and shoot root ratio were as shown below.

Sl. No.	Scientific name	Family	Shoot root ratio
1	2	3	4
1	Acalypha indica Linn.	Euphorbiaceae	6.75:1
2	Achyranthes aspera Linn.	Amaranthaceae	1.6:1
3	Aerva lanata Juss.	Amaranthaceae	10:1
4	Biophytum sensitivum DC.	Oxalidaceae	-
5	Boerhaavia diffusa Linn.	Nyctaginaceae	4:1
6	Calotropis gingantea Linn.	Asclepiadaceae	1:1
7	Calicopteris floribunda Lam.	Combretaceae	3.7:1
8	Cardiospermum helicacabum Linn.	Sapindaceae	4:1
9	Cleome viscosa Linn.	Capparidaceae	7.5:1

1	2	3	4
10	Clerodendron infortunatum Linn.	Verbenaceae	2:1
11	Curculigo orchioides Gaertn.	Amaryllidaceae	1:3
12	Cyclea peltata Hook f. and Thoms.	Menispermaceae	1:3
13	Cynodon dactylon Pers.	Gramineae (Poaceae)	
14	Cyperus rotundus Linn.	Cyperaceae	1.7:1
15	Elephantopus scaber Linn.	Compositae	1:1
16	Emilia sonchifolia Dc.	Compositae	6:1
17	Ficus hispida Linn.	Urticaceae	1.3:1
18	Glycosmis cochinchinensis Pierre ex Engler.	Rutaceae	1.8:1
19	Hemidesmus indicus R. Br.	Asclepiadaceae	1:1.3
20	Ichnocarpus frutescens R.Br.	Apocynaceae	1:2
21	Lantana aculeata Linn.	Verbanaceae	1:1
22	Leucas aspera Spreng	Labiatae	9:1
23	Lygodium flexuosum (SW.)	Polypodiaceae	1:1.5
24	Mimosa pudica Linn.	Leguminosae (Mimosaceae)	5:1
25	Naregamia alata Wight & Arn.	Meliaceae	3:1
26	Passiflora foetida Linn.	Passifloraceae	19:1
27	Phyllanthus niruri Linn.	Euphorbiaceae	10:1
28	Phyllanthus reticulatus Poir	Euphorbiaceae	1:1.5
29	Rauvolfia serpentina Benth. ex Kurz For.	Apocynaceae	1:1
30	Scoparia dulcis Linn.	Scrophulariaceae	5.75:1

1	2	3	4
31	Sida retusa Linn.	Malvaceae	2.3:1
32	Sida rhombifolia Linn.	Malvaceae	2:1
33	Stachytarpheta indica Vahl.	Verbenaceae	4.7:1
34	Tridax procumbens Linn.	Compositae	6:1
35	Urena lobata Linn.	Malvaceae	4:1
36	Vernonia cinerea Less.	Compositae	3:1
37	Zizyphus oenoplia Mill.	Rhamnaceae	1.5:1

In January 1993, plants like Achyranthes aspera, Calotropis gigantea, Clerodendron infortunatum, Cyclea peltata, Hemidesmus indicus, Ichnocarpus frutescens, Scoparia dulcis and Vernonia cinerea were seen in the area studied and these plants were quantified. These species did not dry up during the dry months indicating their drought tolerant nature.

The study revealed that a sizable quantity of crude drugs for the preparation of medicines can be exploited from the under growths in the rubber plantations without much difficulty.

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