COLLECTION, DESCRIPTION AND PERFORMANCE EVALUATION OF HERBACEOUS MEDICINAL LEGUMINOUS PLANTS OF KERALA

By

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THESIS

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DECLARATION

I hereby declare that this thesis entitled "Collection, description and performance evaluation of herbaceous medicinal leguminous plants of Kerala" is a bonafide record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship or other similar title of any other University or Society.

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Certified that this thesis entitled "Collection, description and performance evaluation of herbaceous medicinal leguminous plants of Kerala" is a record of research work done independently by Miss. Sunitha. C under my guidance and supervision and that it has not previously formed the basis for the award of any degree, fellowship, or associateship to her.

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Chapter 1

INTRODUCTION

1. INTRODUCTION

India is an evergreen emporium of medicinal plants. Medicinal plants are potential source of life saving drugs and widely utilized in the indigenous system of medicine namely Ayurveda, Sidha and Unani. Natural plant extracts and several chemical derivatives also find use in Homeopathy and Allopathy. But currently there is a reawakening which has resulted in more production and utilization of Ayurvedic drugs. It is estimated that about 300 million people are solely dependent on Ayurveda for their health and well being.

The increasing demand for plant based drugs in the pharmaceutical industry has created problems of short supply of raw materials. The destruction and degradation of natural habitats of medicinal plants has not only led to their nonavailability but also resulted in adulteration of the raw drug. The shrinking habitat of medicinal plants and the ever-increasing demand of Ayurvedic drugs pose great threat to many species that are in the verge of extinction. Leguminous medicinal plant species which form a major group among medicinal plants, are also facing similar threat. As drug yielding plants, leguminous medicinal plants have dual potentiality of enriching the soil by nitrogen fixation, at the same time, providing an extra income to the farmer by way of selling the medicinally important plant part, which in most cases is the root.

In a thickly populated state like Kerala, due to scarcity of cultivable land, the scope of cultivating medicinal plants as a pure crop is very much limited. However, their cultivation as intercrops in major plantations such as coconut and rubber holds promise. Coconut with a coverage of 8.64 lakh hectares and rubber spreading over 4.19 lakh hectares are potential areas for intercropping. About 30 per cent of the area under coconut and 10 to 15 per cent of the area under rubber plantations could be found out for the cultivation of medicinal plants. It is estimated that in our state around 3.0 lakh hectares could be brought under medicinal plants. It is under this context that the present study is important. If any of the selected medicinal plant species is proved to have potential under the intercropping system, it will not only help in improving the fertility of the soil by way of nitrogen fixation but also can contribute medicinal herbage or green manure or both. Thus there will be dual benefit to the farmer and it will be a great boon to the pharmaceutical industry and in turn to the mankind.

The present study is aimed at, to collect and botanically describe (using a descriptive blank) herbaceous leguminous medicinal plants of Kerala; to evaluate the growth and yield parameters of selected herbaceous leguminous medicinal plants in open as well as in shaded conditions; and to estimate the nitrogen fixing potential and association of mycorrhizae of selected plant species.

Chapter 2

REVIEW OF LITERATURE

2. REVIEW OF LITERATURE

Plants besides providing food, yield several valuable substances which find use in the treatment of human as well as animal ailments. Use of plants in India as drugs dates back over 5000 years and has become codified in the Ayurveda, which contains over 8000 herbal remedies. Several works have been conducted by scientists and researchers from all spheres in order to promote collection, preservation, propagation and regeneration of medicinal plants and to establish their efficacy and therapeutic values. Some of the works are cited in this chapter.

2.1 Collection and utilization of medicinal plants

The collection of drugs scattered in their natural habitats is a very difficult task and often the cost of collection increases considerably the price of the crude drugs and their preparation.

The disadvantages regarding the collection of drugs when they are growing in a state of nature in scattered areas are difficulty of access and transport, sparse distribution, indiscriminate collection leading to exterminations and ignorance of collectors leading to admixture of genuine with spurious plants. It is on account of these difficulties attempts were made to collect genuine medicinal plants and bring them under systematic cultivation. At present the cultivation of drug plants and narcotics occupy only a very small percentage of the total area under cultivation (Chopra *et al.*, 1958).

Mehta (1987) emphasised on an integrated national policy on cultivation and utilization of medicinal plants used in Ayurveda and Sidha medicines. The need to harness the modern scientific knowledge and tools of technology was also indicated to review old systems of medicine. Joshi (1992) has tried to call attention to the inclusion of medicinal plants in afforestation programme for different areas of Gujarat state. At few places, some rare, depleting or other economic species have also been suggested just to maintain the natural flora and plant association. Considering various factors viz. topography, soil, climate, existing flora, possibility of cultivation, biotic interferences and need, the land has been categorized into seven types. More emphasis is suggested on ever green species and to raise mixed forests rather than to monoculture. Existing endemic species have been preferred than exotic. The usefulness of such plants and plantations have been narrated.

Hussain (1993) compiled information on various aspects of agrotechnology of twenty one medicinal plants based on published data. Nair (1993) recommended domestication of eight wild medicinal plants of Ayurvedic importance viz. *Holostemma annulare*, *Indigofera tinctoria*, *Aloe vera*, *Withania somnifera*, *Acorus calamus*, *Adhatoda vasica*, *Kaempferia galanga* and *Kaempferia rotunda* for remunerative purposes. Ralcevic *et al.* (1995) investigated the rhizospheric microflora of some medicinal plants like liquorice, lavender and sage grown on plots without application of synthetic fertilizers. Total microflora, fungi, actinomycetes, aminoheterotrophs, cellulolysators and free nitrogen fixing bacteria were determined.

2.2 Chemical constituents of medicinal plants

It is well known that plants generally owe their virtues as medicinal agents to certain characteristic constituents like alkaloids, glycosides, saponins, flavanoids, tannins, volatile oil, steroids, resin and mucilage present in them. Plants synthesise these organic compounds during their metabolic process when they grow. The nature and amount of these chemical substances vary according to the agro-climatic conditions and growth stage of the plant (Chopra *et al.*, 1958).

The alkaloids give a bitter taste to the plant and a considerable number of drugs owe their curative properties to these principles. According to Chopra *et al.* (1958), many naturally derived drugs like morphine from poppy, nicotine from tobacco, cocaine from cocoa and caffeine from coffee are alkaloids of plant origin. Singh *et al.* (1981) described the physico chemical characteristics of the oil isolated from the petroleum ether extract of the seeds of *Cassia tora.*

Duke (1985) detected nearly 30 alkaloids from the roots of *Rauvolfia serpentina* of which reserpine is the most important. The total effect of a plant when it is administered in its original complex biochemical package is rarely produced by the isolated active principle. The reason for this beneficial total effect of the plant extract was elucidated by Mossa *et al.* (1987) as a synergistic or modifying action of the accompanying chemicals in the extract on the pharmacological activity of the main constituents.

Glycosides are much wider in occurrence than alkaloids and are sugar containing compounds. Saponins are glycosides with sterols or triterpenes as their aglycones. Saponin containing natural ingredients are sarasaparilla, alfalfa, fenugreek and licquorice (Mossa *et al.*, 1987). Panikkar *et al.* (1987) detected the presence of lecithin in the seeds of *Mucuna pruriens*.

Farnsworth and Soejarto (1988) opined that at least 121 chemical substances of known structure are extracted from plants that are useful as drugs throughout the world. According to an estimate of the World Health Organisation, approximately 80 per cent of the people in developing countries rely chiefly on traditional medicines for their primary health care needs, of which a major portion involves the use of plant extracts or their active principles.

Nair *et al.* (1988) isolated anacrotine, vitexin and orientin from the aerial parts of *Crotalaria angulata*. The first of these compounds is known to have antiinflammatory effects against carrageenan induced oedema and antihyaluronidase activity. Markham *et al.* (1989) identified new natural products, 8-C-glucosyl scutetelarein 6,7-dimethyl ether and its 2-0- apioside as minor components of the seeds of *Abrus precatorius*.

Paramar *et al.* (1989) reported the occurrence of pongamol in its pure enol form in the whole plant of *Tephrosia purpurea* together with β-sitosterol, ursolic acid and α spinasterol. Anthraquinone glycosides were isolated from the seeds of *Cassia tora* by Wong *et al.* (1989). Handa *et al.* (1990) isolated a new diuretic dipeptide from the seeds of *Dolichos biflorus* and characterised as

pyroglutamyl glutamine on the basis of chemical and spectral evidences. Its diuretic activity has been found to be two to three times more than that of acetazolamide. Phytochemical studies on the leaves of *Indigofera tinctoria* by Nair *et al.* (1990) revealed that the leaves on extraction with different solvents indicate the presence of alkaloids, steroids, proteins and carbohydrates.

Jain *et al.* (1991) identified phaseoluside-A, a new soyasapogenol-B-triglucoside from the water soluble extracts of the seeds of *Phaseolus vulgaris* along with six known sugars. Kumar *et al.* (1991) isolated four flavanoid constituents viz. kaempferol, quercetin, rutin and kaempferol 3-O-rutinoside from the heart wood of *Cassia montana.*

A novel flavanol glycoside, 3,4-di-0-methyl-quercetin 3-0-α-L rhamnopyranosyl -0- beta -D-glycopyranoside has been isolated from the stem of *Crotalaria verrucosa* by Yadava *et al.* (1994). Jahirov (1995) determined the crystal structure of abrin-a, type II ribosome inactivating protein from the seeds of *Abrus precatorius.*

2.3 Medicinal properties

Several investigations have been carried out to reveal the medicinal properties of drug yielding plants. Few such works in leguminous medicinal plants are cited below.

Mooss (1976) reported on vegetable drugs that can be used as single drug remedies with much benefit as first aid and in certain cases of common

ailments. Khonde *et al.* (1980) conducted pharmacological studies of the seeds of *Crotalaria juncea.* The extract showed hepatotoxic effect on experimental animals and exhibited connidiostatic activity against *Aspergillus niger.* A histopathological experimental study by Anand *et al.* (1981) showed that 50 per cent of the alcoholic extract of the whole plant of *Indigofera tinctoria* is effective against carbontetrachloride induced liver damage or hepatotoxicity.

Chandhoke *et al.* (1981) conducted clinical seed evaluation of *Pueraria tuberosa* for its contraceptive or emmenagogue activity.The effect of *Pueraria tuberosa* on the male reproductive system of rats was studied by Daftari *et al.* (1981). The distribution, morphology, pharmacology, pharmacognosy and clinical trials of *Pueraria tuberosa*, commonly known as vedarikand or bedarikand has been reviewed by Jani *et al.* (1981). Nikham *et al.* (1981) conducted hypoglycaemic studies on *Pueraria tuberosa.*

A survey of medicinal plants used by the tribal people of Karnala forest of Maharashtra state was done by Vartak *et al.* (1981). Out of the forty six species surveyed, eight species were used for controlling high fever, twelve were used for the control of dysentry, six were used for treating jaundice, eight were used for bronchitis, nine were used for soothing rheumatic pains and the rest eight were used for skin diseases.

Dey *et al.* (1982) conducted pharmacognostic studies on the roots and seeds of *Abrus precatorius.* The distribution, morphological characters, local names, methods of preparation, parts used and doses of *Dolichos falcatus* have

been enumerated by Chelladurai (1983). The tuber of *Dolichos falcatus*, popularly known as Minnikizhangu, an unique folk medicinal plant of the tribals of Koddikkari forest in Tamil Nadu, is used for various skin ailments.

Ghosh (1983) conducted pharmacognostical studies on the seeds of *Mucuna pruriens*. The study conducted by Gupta *et al.* (1984) indicated the use of Dasamoolakvatha (extract of the roots of ten plants including *Desmodium gangeticum*) produced aspirin like antipyretic and antiinflammatory effect against carrageenan induced oedema. It supports the use of this kvatha in various clinical conditions like pain, pleurodynia, backache, gout, pyrexia, inflammation and oedema.

Prakash (1985) conducted a comparative pharmacognostic study of *Cassia tora* and *Cassia occidientalis*. Macro and microscopical characters of the root, stem and leaf of the two species were compared.

A comparative pharmacognostic study of four species of the genus *Desmodium* was made by Prakash (1985). The salient macro and microscopical characters, measurement of individual cells and isolated elements and fluorescence of stem powders of *D. floribunda*, *D. gyrans*, *D. pulchellum* and *D. trifolium* were recorded for easy identification.

Antipyretic utility of some Indian plants in traditional medicine was revealed by Anis *et al.* (1986). Based on a survey of the Gwalior forest region in Central India, fifteen preparations made with seventeen plant species were found

to be used by Shareon tribe against pneumonia, malaria, typhoid and other fevers. Rotenoids from *Indigofera tinctoria* and their bioefficacy against cyclops, the carrier of dracunculiasis were concluded by Kamal *et al.* (1987).

Pharmacognosy, pharmacology, clinical studies and phytochemistry of four plants namely *Convolvulus pluricaulis*, *Evolvulus alsinoides*, *Canscora decussata* and *Clitoria ternatea* was reviewed by Aulakh *et al.* (1988). Liquid chromatography was used to fractionate the crude aqueous extract of *Desmodium adscendens*, a plant shown to be antianphylactic and used in Ghana for the treatment of asthma, by Addy (1989). Several chromatographically distinct active fractions were isolated and found to inhibit smooth muscle contractions.

Antimalarial effect of eight African medicinal plants was reported by Gbeassor *et al.* (1989). Crude hot water extracts from eight plants collected from Togo, West Aftrica were examined for antimalarial properties against *Plasmodium falciparum* using an *in vitro* test. Extract of *Cassia siamea* was capable of completely inhibiting the growth of *Plasmodium falciparum*. The antiinflammatory action of five *Cassia* species namely *C. alata*, *C. spectabilis*, *C. nodosa*, *C. sieberiana* and *C. siamea* was reported by Abatan (1990).

Ahmad *et al.* (1991) conducted a study on the activity of low and high doses of *Mucuna pruriens* on the central nervous system (CNS). Lower dose corresponding to the clinical dose significantly decreased the sleeping time and increased the motor activity while a high dose (three times the clinical dose) resulted in reverse effect. Thus the drug was assesed to possess CNS (Central

Nervous System) stimulant effect at low dose and CNS depressent effect at high dose.

Pharmacognostic studies on the root tubers of *Dolichos trilobus* was made by Santha *et al.* (1991). Fungitoxic effect of wild plant leaf extracts was studied by Genesan (1993). A screening programme was undertaken exclusively to test this effect on conidial germination of *Dreschlera oryzae*. One hundred per cent inhibition was observed in *Cassia mimosoides*, *Cassia tora* and *Mimosa pudica*.

Saraf *et al.* (1994) reported the antihepatotoxic activity of *Cassia occidentalis*. *Cassia occidentalis* is employed in indigenous medicine for liver ailments and is a constituent of polyherbal formulations marketed for liver diseases. An ethanol extract of leaves exhibited significant antihepatotoxic activity against liver injury.

Aphrodisiac activity of the seeds of *Mucuna pruriens* was revealed by Ananthakumar *et al.* (1994) *Mucuna pruriens* seed powder when administered in a dose of 75 mg/kg body weight daily as an aqueous suspension, increased the sexual activity of male albino rats. L-dopa, one of the constituents of the plant was reported to arouse sexual desire in patients suffering from Parkinson's disease.

Some of the effective timetested household remedies used regularly, were suggested by Shome *et al.* (1994). Gill *et al.* (1994) gave an account of

103 leguminous plants used commonly in ethnomedicinal practices of Nigeria. Sally *et al.* (1995) determined mineral elements in some medicinal plants used for the cure of various diseases.

2.4 Cultivation of medicinal plants

The importance of medicinal plants in our indigenous system of medicine has been quoted from long past, right from vedic period. The large demand for these plants and their products has necessitated their cultivation on a large scale. Efforts to domesticate and cultivate valuable medicinal plants economically had to face many hurdles. Several of these problems were tackled and attempts were made for the scientific cultivation of medicinal plants, both as pure crop in open conditions and as intercrop in major plantations like coconut and rubber.

2.4.1 Medicinal plants as pure crop in open

Reports on scientific cultivation of herbaceous medicinal legumes are scarce, except in a few such as *Cassia angustifolia* (Tinneveli Senna). Senna is suitable to drier tracts where coconut and other plantation crops do not perform well.Kapur and Atal (1982) had reported on the cultivation and utilization of Senna in India. Various aspects on the scientific cultivation of *Mucuna pruriens* was reported by Bammi and Rao (1982).

Agrotechnical studies on *Indigofera tinctoria* in experimental plots by Nair *et al.* (1990) revealed that the plant if cultivated in a scientific way, could provide 210 kg leaves on 10 cents of land. Nair (1993) standardised the package of practices and processing techniques of *Holostemma annulare* and *Indigofera tinctoria.*

The Kerala Agricultural University has standardised the package of practices recommendation for some medicinal plants viz. *Kaempferia galanga* (kacholam) and *Vetiveria zizanoides* (vetiver) (Anonymous, 1994).

2.4.2 Medicinal plants as intercrop under shaded conditions

Inter or mixed cropping in coconut gardens is very popular in the important coconut growing states in India. The pattern of development and arrangement of leaves of the coconut crown is very important from the point of view of intercropping. The transmission of light through the coconut canopy is one of the most important factors affecting the success of intercropping programmes. It has been shown that the root zone of coconut palm is concentrated laterally to a radius of 2 m only and vertically between the depths of 30 cm and 120 cm from the surface (Kushwah *et al.*, 1973).

Coconut has the advantage of having two periods (initially upto to ten years after planting and again twenty years after planting upto senescence of the crop) in its life span during which it allows sufficient light to penetrate to the ground when intercropping could be practiced (Nair *et al.*, 1974). A variety

of crops have been suggested for intercropping in coconut gardens such as cassava, amorphophallus, colocassia and greater yam. (Nelliat *et al.*, 1974; Varghese *et al.*, 1978 and Ramanujam *et al.*, 1984). Also crops like sweet potato, lesser yam, chinese potato, ginger, turmeric, pepper, black gram, green gram, red gram, cow pea, groundnut, forage crops and legumes were found to be successfully grown in coconut gardens. (Nair *et al.*, 1974; Nelliat *et al.*, 1976 and Varghese, 1976). According to Leela and Bhaskaran (1978) only 28 per cent of the land area is utilized by the coconut palm.

Intercropping in coconut gardens can substantially increase the overall productivity of land according to Liyange *et al.* (1984). It is a source of subsidiary or additional income from the coconut plantations (Pillai, 1985). Many workers (Lahiri, 1972; Singh *et al.*, 1985 and Singh *et al.*, 1990) reported successful intercropping of medicinal and cash crops. Jha and Gupta (1991) studied intercropping of medicinal plants with poplar and their phenology. Out of the sixty four plant species tried, thirteen were most suitable for intercropping with *Populus deltoides*.

Nair *et al.* (1991) reported the possibility of growing thirteen medicinal/aromatic plants as intercrops in eight to twenty year old coconut plantations when no other intercrops are usually recommended. The potential plants identified are greater galangal, periwinkle, panikurkka, iruveli, channakkuva, ocimum (3 species), koduveli, sarpagandha (2 species), mango ginger and kacholam. It was reported that the growth of these plants was not affected by the shade that prevailed in the twelve year old coconut plantation.

Attempts to cultivate medicinal plants in rubber plantations have been reported recently. Studies at the Rubber Research Institute of India, Kottayam, Kerala (1987-88) revealed that certain shade tolerant medicinal plants can be cultivated as intercrops in the rubber plantations during the unproductive period. More than 24 species have been reported as potential intercrops. In the trench planting system adopted by the Rubber Research Institute of India, it is reported that about 12,000 numbers of koduveli or 18,000 numbers of karimkurinji or 36,000 numbers of sarpagandhi plants can be planted per hectare as intercrops in the rubber plantations. Certain shade tolerant species like *Adhatoda beddomei* (cheria adalodakam), *Adhatoda vasica* (valia adalodakam), *Rauvolfia serpentina* (sarpagandhi), *Alpinia galanga* (aratha), *Sida rhombifolia* (kurumthotti), *Pueraria* species (kattupayar), *Desmodium* species (kattuzhunnu) and *Strobilanthes haenianus* (karimkurunji) were reported to be shade tolerant species which can be successfully cultivated in rubber plantations (Vijaykumar *et al*., 1989).

The biological bunds raised with *Strobilanthes haenianus* were found to perform well in conserving soil and water. *Strobilanthes* species was also found to attract honey bees for four months. *Rauvolfia serpentina*, *Holostemma annulare*, *Sida rhombifolia* and *Pueraria* species did not perform well under mature canopy. *Adhatoda beddomei*, *Adhatoda vasica*, *Strobilanthes haenianus*, *Plumbago rosea*, *Kaempferia rotunda*, *Kaempferia galanga* and *Alpinia galanga* were found to come up well under deep shade (Anonymous, 1989).

It is reported from trials on harvesting of *Strobilanthes haenianus*, *Adhatoda vasica*, *Adhatoda beddomei*, *Plumbago rosea*, *Alpinia galanga* and

Kaempferia rotunda that the raising of these medicinal plants in mature rubber estate can fetch additional income.

2.5 Legumes as intercrops

Ayyangar (1942) found that intercropped legumes increased the available phosphorous, potassium and calcium in the soil. Tremendous potentialities and possibilities of intercropping with promising legumes exist in coconut plantations. Shade tolerant short duration crop of pulses such as horse gram, black gram and green gram are recommended for raising under coconut trees taking advantage of north east monsoon rains (Nair *et al.*, 1974).

Artificial shade of 40 to 50 per cent reduced sunlight and caused an yield reduction of 30 per cent compared to that in full sunlight for soyabeans and about 70 per cent for mungbeans (Catedral and Lantican, 1977). Almost all tropical grain legumes are very sensitive to the partial shade existing in coconut gardens (Nair, 1979).

Grain legumes are potential intercrops because of the relatively short duration and high protein content. Crops like black gram, horse gram, cowpea and groundnut were found to be successfully grown in coconut gardens (Nair, 1979). Zakra *et al.* (1986) suggested groundnut as a suitable intercrop in coconut garden.

2.6 Residual effect of intercropping on soil

Ayyangar (1942) found that intercropped legume increased the available phosphorous, potassium and calcium in the soil. Singh and Chatterji (1968) reported that nitrogen accumulated in the soil wherever legumes grow well. White *et al.* (1976) reported that total nitrogen content of the soil was increased by growing forage grasses. Skerman (1977) recorded more nitrogen fixation in shade than in open areas.

Pillai (1985) noted a reduction in soil pH due to intercropping. He also found a reduction in the available nitrogen content of the soil whereas the phosphorous and potassium content of the soil were not affected much by intercropping.

Bavappa *et al.* (1986) reported that there was a build up of phosphorous and potassium nutrients in the coconut and arecanut based high intensity multispecies cropping system. There was improved microbial activity in the systems and no serious disease and pest management problems were indicated due to high density cropping system approach.

2.7 Mycorrhizal association

It is well documented that the association of vesicular arbuscular mycorrhizae (VAM) improves the growth and general conditions of crop plants (Hayman, 1983). This has been demonstrated in many plant species (Bagyaraj and Manjunath, 1980; Sivaprasad *et al.*, 1984).

The mechanism of improved plant growth caused by mycorrhizal inoculation has been investigated by many workers. Greater soil exploration by mycorrhizal roots as a means of increased phosphorous uptake is well established. Other beneficial effects are their role in increasing photosynthetic efficiency, biological control of root pathogen, biological nitrogen fixation, phytohormone production and greater ability to withstand water stress conditions. (Varma, 1979; Sivaprasad and Rai, 1987).

Differences in response among plant species and cultivars due to host preference of VAM have been noticed by Moose (1975). But, growth depression and reduction in crop yield due to VAM association is rarely noticed (Hayman, 1974). The effectiveness of symbiosis between the VAM fungus, the microsymbiont of the system and the host roots is very much linked with the photosynthetic efficiency and the factors related to photosynthesis of the host plant (Sivaprasad and Rai, 1984). Association of vesicular-arbuscular mycorrhizae in a few medicinal plants including *Sida rhombifolia* and *Vernonia indica* was reported by Sulochana *et al.* (1991).

Chapter 3

MATERIALS AND METHODS

3. MATERIALS AND METHODS

The study titled 'Collection, description and performance evaluation of herbaceous medicinal leguminous plants of Kerala' was carried out at the Department of Horticulture, College of Agriculture, Vellayani during the period from June 1995 to January 1996. The details of the materials used and the techniques adopted during the course of investigation are presented in this chapter. The work was conducted in three phases.

3.1. PHASE I Collection of herbaceous leguminous medicinal plants from authentic sources.

Seeds of sixteen different species of herbaceous leguminous medicinal plants were collected from authentic sources. The list of collected species and their source is given in Table 1.

Table 1. List of herbaceous leguminous medicinal plant species collected

Sl. No.	Vernacular name (Malayalam)	Botanical name	Sub family	Source
1.	Chuvanna Kunni	*Abrus precatorius* Linn.	Fabaceae	Ayurvedic Research Institute, Poojappura.
2.	Vella Kunni	*Abrus precatorius* Linn.	,,	College of Horticulture, Vellanikkara.
3.	Kattuzhunnu	*Atylosia scarabaeoides* (L.) Benth.	”	Tropical Botanical Garden & Research Institute, Palode.
4.	Cheruthakara	*Cassia mimosoides* Linn.	Caesalpiniaceae	Ayurvedic Research Institute, Poojappura.
5.	Ponnaveeram	*Cassia occidentalis* Linn.	”	Ayurvedic Research Institute, Poojappura
6.	Ponnanthakara	*Cassia sophera* Linn.	”	Kerala Forest Research Institute, Peechi.
7.	Neela Sankupushpam	*Clitoria ternatea* Linn.	Fabaccae	College of Horticulture, Vellanikkara.
8.	Kilukki	*Crotalaria retusa* Linn.	”	Ayurvedic Research Institute, Poojappura.

9.	Kilukiluppa	*Crotalaria verrucosa* Linn.	Fabaccae	Ayurvedic Research Institute, Poojapura.
10.	Orila	*Desmodium gangeticum* (L) DC.	"	College of Horticulture, Vellanikkara.
11.	Thozhukanni	*Desmodium motorium* (Houtt.) Merr.	"	Tropical Botanical Garden and Research Institute, Palode.
12.	-----	*Desmodium triangulare* (Retz.) Merr.	"	- do -
13.	Cherupullati	*Indigofera linnaei* Ali.	"	Ayurvedic Research Institute, Poojappura.
14.	Neelayamari	*Indigofera tinctoria* Linn.	"	-- do --
15.	Naykorana	*Mucuna prurita* Hook.	"	College of Horticulture, Vellanikkara
16.	Moovila	*Pseudarthria viscida* (L) Wight & Arn.	"	Tropical Botanical Garden & Research Institute, Palode.

3.1.1 Seed germination studies

The viability of the seeds of the collected plant species was estimated as described below.One hundred seeds were surface sterilized using 0.1 per cent mercuric chloride for one minute followed by washing thrice with distilled water. Each species collected was represented by three replicates of hundred seeds each. Sterilized seeds were placed on moistened filter paper in petridishes. The seeds which failed to germinate in filter paper were placed in moist sterile sand petridishes, covered with aluminium foil and placed in darkness. Seeds were considered to have germinated when greenish structures of the radicle emerged out of the seed coat. Seed germination count was taken from the second day and the percentage of germination of each plant species was determined. The number of days taken for 50 per cent seed germination in each species was also recorded.

3.2 Phase II Preparation of descriptive blank and authentic herbarium.

Twelve different species of herbaceous leguminous medicinal plants with high germination rate and easy establishment were raised in the medicinal plant garden, of the Department of Horticulture, College of Agriculture, Vellayani for the preparation of descriptive blank and authentic herbarium. The data in the descriptive blank was computer programmed using 'FOXPRO' program in plant-wise as well as character-wise retrievable mode.

3.2.1 Preparation of descriptors

Descriptor of individual plant species was prepared based on the model set by the International Plant Genetic Resources Institute, Rome, Italy (Anonymous, 1982).

3.2.2 Preparation of authentic herbarium

Plant specimens were collected, pressed, dried and affixed along with a label on a mounting sheet made from long lasting white card sheet in uniform size of 28 x 42 cm. (Jain and Rao, 1977). Authentic herbarium was prepared for plants with accession numbers MP 2, 4, 5, 7, 8, 10, 17, 18, 19, 22, 24 and 30.

3.3 Phase III Cultural trial of selected species as intercrops in coconut garden vis-a-vis as pure crop in open

3.3.1 Experimental site

Two sets of experiments were conducted for the study, one under open conditions and the other under shaded conditions in a twenty five year old bearing coconut garden. Both the experiments were laid out at the College of Agriculture, Vellayani during June 1995 to January 1996. The location is situated at 8°5' North latitude, 77°1' East latitude and at an altitude of 29 m above the mean sea level. Soil of the experimental site is red loam belonging to Vellayani series. The area enjoys a humid tropical climate. The meteorological data during the crop period are presented in Appendix II.

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Plate 1. General view of the experimental site

a. under open condition
b. under shade as intercrop in a coconut garden

3.3.2 Sowing

The land was thoroughly prepared by digging and powdered cow dung was incorporated at the rate of 3 kg.per square metre. Seeds were sown in plots of size 3 x 3 m. Fifteen plants of each species were maintained in each plot. Open pandals were provided for giving support to those legumes with trailing habit. No chemical fertilizers were applied.

3.3.3 Growth observations

The following plant growth observations were taken at monthly intervals.

3.3.3.1 Plant height

This was measured from the soil surface to the tip of the plant.

3.3.3.2 Stem girth

Measurement taken around the stem at a height of 3.0 cm from the soil surface.

3.3.3.3 Number of branches

Number of branches produced at monthly intervals by five plants selected at random was recorded and the mean value was worked out.

3.3.3.4 Number of leaves

Number of leaves produced at monthly intervals by five plants selected at random was recorded and the mean value was worked out.

3.3.4 Harvest

The entire crop was harvested at the end of the sixth month of planting. Feasibility of vegetative propagation of the herbaceous leguminous medicinal plants by rooting of cuttings was also assessed. Cuttings 15-30 cm long with three to four nodes taken from the middle portion of the shoot were used for planting. Ten cuttings each of the plant species were placed in polybags filled with potting mixture in the ratio 1:1:1. The ability of the cuttings to root was noted after three weeks.

3.3.5 Biomass production

Five samples of each plant species were selected at random at the time of harvest. Root and shoot portions of the samples were packed separately in brown paper covers and the fresh weight was taken. The samples were then dried in a hot air oven at 60°C for five days until constant dry weights were obtained. The total dry matter (biomass) production in kilograms per hectare was worked out from the oven dry weight of the samples. The per day biomass productivity was also worked out by dividing the total biomass production by the duration (in days) of the cropping system.

3.3.6 Plant analysis

Analysis of plant samples collected from open and shaded conditions was carried out. The plant samples were dried in an oven at 70°C and ground to fine powder.

3.3.6.1 Total available nitrogen

This was determined by Microkjeldhal method (Jackson, 1958) and expressed as percentage.

3.3.6.2 Available phosphorous

This was determined colorimetrically using Bray I extractant and molybdophoric acid method in hydrochloric acid system (Jackson, 1958)

3.3.6.3 Potassium

The potassium content of the plant extract was determined flame photometrically, using neutral normal ammonium acetate extract (Jackson, 1958). The total uptake of nitrogen, phosphorous and potassium was worked out from the nutrient content and dry matter production.

3.3.6.4 Crude alkaloid content

The crude alkaloid content of the medicinally important plant parts was estimated gravimetrically by solvent extraction of the powdered material (Bentley, 1957).

Test for identification of alkaloids

The powdered plant sample was first treated with dilute ammonia solution to make the medium basic. Chloroform was added, the sample was filtered and filtrate treated with dilute hydrochloric acid. Wagner's reagent (solution of iodine in potassium iodine) or Hager's reagent (a saturated solution of picric acid) was added to the slightly acidic solution to precipitate most alkaloids. The precipitate formed may be amorphous or crystalline, yellow in colour for Hager's reagent and reddish brown for Wagner's reagent.

Extraction of alkaloids

The powdered material was moistened with water and mixed with lime. The solution was filtered and the alkaloids were extracted using organic solvent, ether. The concentrated organic liquid was then shaken with dilute sulphuric acid, when alkaloids formed insoluble salts. The solution was filtered and the precipitate was dried at 105°C in a hot air oven for one hour and the weight noted. This was repeated until constant weights were obtained.

3.3.6.5 Estimation of anthraquinone in *Indigofera tinctoria* Linn.

The anthraquinone content of the powdered plant samples of *Indigofera tinctoria* Linn. under open and shaded conditions was compared in a photoelectric colorimeter using a red filter (Trease and Evans, 1967). A standard curve was prepared using 0, 2, 4, 6, 8, 10, 20, 30 and 40 ppm concentration of indigocarmine.

Borntrager's test was used for the detection of anthraquinone. The powdered plant sample was macerated with an immiscible organic solvent, diethylether and after filtration caustic soda was added. A violet colour in the aqueous layer after shaking indicates the presence of free anthraquinone derivative. The coloured solution is read in a photoelectric colorimeter and the concentration is determined from the standard curve.

3.3.6.6 Estimation of glycosides in *Cassia mimosoides* Linn.

The procedure reported by Labadie (1969) for the bioassay of glycosides of Senna (*Cassia angustifolia* Linn.) was followed here.

To 5.0 g of the powdered plant sample (as against 0.015 g in Senna), 30 ml water was added, weighed, heated under reflux condenser in a water bath for 15 minutes, allowed to cool, weighed and the original weight was restored with water. The solution was centrifuged and 20 ml of the supernatant liquid was transferred to a 150 ml separating funnel. To this, 0.1 ml of hydrochloric acid was added and shaken with three 15 ml quantities of chloroform. The layers were allowed to separate and the chloroform layer was discarded. Sodiumhydrogencarbonate, 0.1 g was added and shaken for 3 minutes. The aqueous layer was centrifuged and 10 ml of the supernatant liquid was transferred to a 100 ml round bottomed flask with a ground glass neck. A 20 ml of 10.5 per cent solution (weight/volume) ferricchloride hexahydrate was added to this, mixed and heated under a reflux condenser in a water bath for 20 minutes. One ml of hydrochloric acid was added and heating continued for 20 minutes, shaking frequently until the precipitate is dissolved. The

mixture is cooled and transferred to a separating funnel and shaken with three 2.5 ml quantities of ether. The ether extracts were combined and washed with two 1.5 ml quantities of water. The ether extracts were diluted to 100 ml with ether, 10 ml was evaporated carefully to dryness and residue was dissolved in 10 ml of 0.5 per cent solution (weight/volume) of magnesiumacetate in methanol. The absorbance was measured at 515 nm.

3.3.7 Assessment of rhizobial association

At the time of flowering, five plants of each species were uprooted from open and shaded conditions and the following observations were made

3.3.7.1 Number of root nodules

The number of nodules produced in the entire root system of five plants was noted and the mean value was worked out.

3.3.7.2 Fresh weight of the nodules

The fresh weight of the nodules produced by five plants was noted and the mean value was worked out.

3.3.7.3 Dry weight of the nodules.

The nodules produced by five plants were shade-dried to a safe moisture level of 12 to 14 per cent. Their dry weight was noted and the mean value was worked out.

3.3.8 Mycorrhizal association

The method of Phillips and Hayman (1970) was used for observing vesicular arbuscular mycorrhizal infection in various root samples of plants grown under open and shaded conditions. A representative sample of the entire root system was obtained from four or five different portions of the root system and combined. The roots were washed thoroughly in four to five changes of tap water to remove soil and other particles. The terminal root portions were cut into small bits of 1-2 cm length and preserved in formalin-aceto-alcohol (FAA) killing and fixing solution. The standard FAA solution is made with ethyl alcohol, acetic acid and formaldehyde in the ratio 90:5:5 by volume.

Clearing and staining

Root specimens stored in FAA were washed in tap water and 10 per cent potassium hydroxide solution was added. The specimens were placed in pressure cooker at 90° C for one hour. The potassium hydroxide solution was poured off and the root bits were rinsed with at least three complete changes of tap water. The root bits were then soaked in one per cent hydrochloric acid for three to four minutes, solution was poured off and trypan blue stain was added.

Estimation of mycorrhizal association

Estimation of mycorrhizal association was done by slide ± method. Ten root bits were placed side by side on a glass slide. Each root bit was divided into

root bits were placed side by side on a glass slide. Each root bit was divided into four equal segments for recording the presence or absence of vescicular arbuscular mycorrhizae. Based on this + and - grades were given.

$$\text{Percentage of colonisation} = \frac{\text{Number of +signs x 100}}{\text{Total number of observations}}$$

The mean value thus obtained was taken as the mycorrhizal index.

Intensity of colonisation is a separate assessment of colonisation within the roots. An intensity of 1 (low) is assigned to roots with small colonisation sites widely scattered along the roots; Intensity of 2 (medium) represents larger colonisation sites more uniformly distributed through the colonised roots but rarely coalescing. An intensity of 3 (high)is given when the roots are almost solidly colonised with easily identified isolated patches of mycorrhizae.

3.3.9 Soil analysis

Soil samples were drawn individually from every plot of the leguminous medicinal plants in the coconut garden before the commencement of the experiment and after the harvest of the crops. Samples were taken at 0-15 cm depth, air dried and passed through a 2 mm sieve. The status of available nitrogen was estimated using composite samples. The alkaline permanganate method was used for determining the available nitrogen. (Subbiah and Asija, 1956).

3.3.10 Statistical analysis

Qualitative parameters as well as quantitative characters of the plant species under trial were recorded from ten sample plants of each species, taken at random in both open and shaded conditions. Pairwise comparison was made for each character adopting Student's 't' - test (Panse and Sukhatme, 1967).

Chapter 4

RESULTS

4. RESULTS

The results of the study on 'Collection, description and performance evaluation of herbaceous medicinal leguminous plants of Kerala' are presented in this chapter, phase wise. The Phase I consisted of collection of leguminous herbaceous medicinal plants from authentic sources. Phase II consisted of raising live plants in the medicinal plant garden of the Department of Horticulture, College of Agriculture, Vellayani. Also, preparation of detailed descriptive blank, of each species collected and preparation of authentic herbarium specimens were done in this phase. Phase III consisted of cultural trial of selected species as pure crop in open condition and as intercrop in coconut garden.

4.1 **Phase I** - Collection of herbaceous leguminous medicinal plants from authentic sources.

Sixteen different species of herbaceous leguminous medicinal plants of nine different genera were collected from authentic sources such as the Tropical Botanical Garden and Research Institute, Palode, Thiruvananthapuram; the Ayurvedic Research Institute, Poojappura, Thiruvananthapuram; the Kerala Forest Research Institute, Peechi, Thrissur; and the College of Horticulture, Vellanikkara, Thrissur. (Table 1.)

4.1.1 Seed germination

The results of seed germination studies of the sixteen species collected are presented in Table 2. The highest rate of germination (98 per cent) was recorded by *Mucuna prurita*. Eleven species recorded higher rate of seed germination (above 90 per cent) and they were subjected to field trials. Five species recorded poor rate of germination (< 50 per cent). The seeds of *Indigofera linnaei* recorded 36 per cent germination.

Based on higher rate of seed germination, eleven species were subjected to field trials. The species selected are listed in Table 3.

4.2 **Phase II** - Preparation of descriptive blank and authentic herbarium

Out of the sixteen species collected live plants could be raised for twelve species. They were subjected to detailed botanical studies and finally detailed descriptive blank for each species was prepared. The descriptive blanks are furnished as Appendix I along with their line drawings (Fig 8. to 19). The data in the descriptive blank was computer programmed using 'FOXPRO' program in plant-wise as well as character-wise retrievable mode.

Also, authentic herbaria of the twelve species were prepared and deposited in the Department of Horticulture, College of Agriculture, Vellayani (Nos MP: 2,4,5,8,10,17,18,19,20,22,24,30).

Table 2. Seed germination of herbaceous leguminous medicinal plants under different methods of incubation.

Method of incubation*	Accession number	Plant species	Germination (%)	Number of days taken for 50 per cent seed germination
Petridish with moistened filter paper	MP 18	*Abrus precatorius* (red)	90	33
- do -	MP 10	*Abrus precatorius* (white)	92	30
- do -	MP 19	*Atylosia scarabaeoides*	94	24
- do -	MP 2	*Cassia mimosoides*	95	27
- do -	MP 3	*Cassia occidentalis*	0	--
- do -	MP 25	*Cassia sophera*	0	--
- do -	MP 4	*Clitoria ternatea*	96	25
- do -	MP 21	*Crotalaria retusa*	0	--
- do -	MP 5	*Crotalaria verrucosa*	92	31
- do -	MP 23	*Desmodium motorium*	0	--
- do -	MP 7	*Indigofera linnaei*	36	--
- do -	MP 8	*Indigofera tinctoria*	92	27
- do -	MP 30	*Mucuna prurita*	98	14
- do -	MP 17	*Pseudarthria viscida*	94	33
Petridish with moistened sterile soil	MP 22	*Desmodium gangeticum*	92	23
- do -	MP 24	*Desmodium triangulare*	90	19

* Seeds pre-treated with 0.1 per cent mercuric chloride for 1 minute

Table 3. List of herbaceous leguminous medicinal plants selected for cultural trial

Sl. No.	Vernacular name (Malayalam)	Botanical name
1.	Chuvanna Kunni	*Abrus precatorius* Linn.
2.	Vella Kunni	*Abrus precatorius* Linn.
3.	Kattuzhunnu	*Atylosia scarabaeoides* (L.) Benth.
4.	Cheruthakara	*Cassia mimosoides* Linn.
5.	Neela Sankupushpam	*Clitoria ternatea* Linn.
6.	Kilukiluppa	*Crotalaria verrucosa* Linn.
7.	Orila	*Desmodium gangetium* (L.) DC.
8.	----	*Desmodium triangulare* (Retz.) Merr.
9.	Neelayamari	*Indigofera tinctoria* Linn.
10.	Naykorana	*Mucuna prurita* Hook.
11.	Moovila	*Pseudarthria viscida* (L.) Wight and Arn.

4.3. Phase III Cultural trial of selected species as intercrops in coconut garden vis-a-vis as pure crop in open.

4.3.1 Growth parameters

The data on growth parameters viz. plant height, stem girth, number of branches and number of leaves are given in Table 4.

4.3.1.1 Plant height

It is evident that the height of plants was significantly higher under open condition in *Abrus precatorius*, *Clitoria ternatea*, *Desmodium gangeticum* and *Atylosia scarabaeoides* than under shade. However, the plant height was on par under both conditions in *Mucuna prurita*, *Desmodium triangulare* and *Indigofera tinctoria*. It was significantly superior under shaded condition in *Pseudarthria viscida*, *Crotalaria verrucosa* and *Cassia mimosoides* than under open (Table 4).

A comparative presentation of plant height at harvest of the selected eleven species under open and shaded conditions is given in Fig. 1. Under both conditions, maximum plant height was recorded for *Mucuna prurita* (7.25 m). *Crotalaria verrucosa* recorded the minimum plant height (59.4 cm) under open condition and *Atylosia scarabaeoides* recorded minimum plant height (65.8 cm) under shade.

Table 4. Shoot growth parameters of selected herbaceous leguminous medicinal plants at harvest* under open and shaded conditions.

Sl. No.	Plant species	Plant height (cm)			Stem girth (mm.)			Number of leaves			Number of branches		
		Open	Shade	t value	Open	Shade	t value	Open	Shade	t value	Open	Shade	t value
1.	*Abrus precatorius* (red)	351.00	327.00	3.56 xx	30.00	25.00	6.71 xx	395.80	302.30	10.09 xx	27.80	25.00	2.78 x
2.	*Abrus precatorius* (white)	268.75	255.00	2.50 xx	32.50	22.75	6.17 xx	316.37	258.30	9.60 xx	27.50	18.50	5.69 xx
3.	*Atylosia scarabaeoides*	186.00	65.80	10.42 xx	48.50	5.00	29.0 xx	333.00	28.70	50.95 xx	42.60	6.10	14.10 xx
4.	*Cassia mimosoides*	70.50	121.60	16.35 xx	5.00	5.00	0.00	299.70	441.60	13.48 xx	17.70	41.80	18.32 xx
5.	*Chloris ternatea*	420.00	309.00	10.38 xx	76.50	41.60	19.35 xx	582.10	293.00	61.04 xx	52.30	27.60	17.74 xx
6.	*Crotalaria verrucosa*	59.40	69.00	5.58 xx	50.00	34.60	20.58 xx	210.20	98.80	24.05 xx	13.00	8.00	8.96 xx
7.	*Desmodium gangeticum*	141.70	90.80	12.41 xx	14.00	14.00	0.00	214.40	205.30	1.85	13.00	9.60	4.64 xx
8.	*Desmodium triangulare*	120.00	126.87	0.34	38.13	38.75	0.10	316.37	258.30	9.605 xx	11.37	0.50	4.89 xx
9.	*Indigofera tinctoria*	280.00	272.00	0.68	82.00	98.00	5.66 xx	619.10	622.80	0.26	14.80	14.80	0.00
10.	*Mucuna prurita*	720.00	725.00	0.83	90.20	92.40	0.83	728.00	730.00	0.90	72.00	74.50	1.04
11.	*Pseudarthria viscida*	83.80	110.00	7.69 xx	29.60	30.30	1.00	218.60	218.60	0.00	17.60	19.00	2.09

* 180 days after sowing

Mean of 10 observations
x Significant at 5 per cent
xx Significant at 1 per cent

4.3.1.2 Stem girth

There was no significant difference in the stem girth under open and shaded conditions in *Mucuna prurita*, *Desmodium gangeticum*, *Desmodium triangulare*, *Pseudarthria viscida* and *Cassia mimosoides*. It was greater under open condition than under shade for *Abrus precatorius*, *Clitoria ternatea*, *Crotalaria verrucosa* and *Atylosia scarabaeoides*. Shaded condition resulted in significantly greater stem girth in *Indigofera tinctoria*.

Under open condition, maximum stem girth was recorded by *Mucuna prurita* (90.2 mm) followed by *Indigofera tinctoria* (82.0 mm). Under shade maximum stem girth was recorded by *Indigofera tinctoria* (98.0 mm) and minimum by *Atylosia scarabaeoides* (5.0 mm) (Fig. 2).

4.3.1.3 Number of branches

More number of branches were produced under open condition compared to that under shade in *Abrus precatorius*, *Clitoria ternatea*, *Desmodium gangeticum*, *Desmodium triangulare*, *Crotalaria verrucosa* and *Atylosia scarabaeoides* (Table 4). However, there was no significant difference in *Mucuna prurita*, *Pseudarthria viscida* and *Indigofera tinctoria* under both conditions. In *Cassia mimosoides*, number of branches were greater under shade.

Fig. 1. Plant height of selected herbaceous leguminous medicinal plants at harvest* under open and shaded conditions

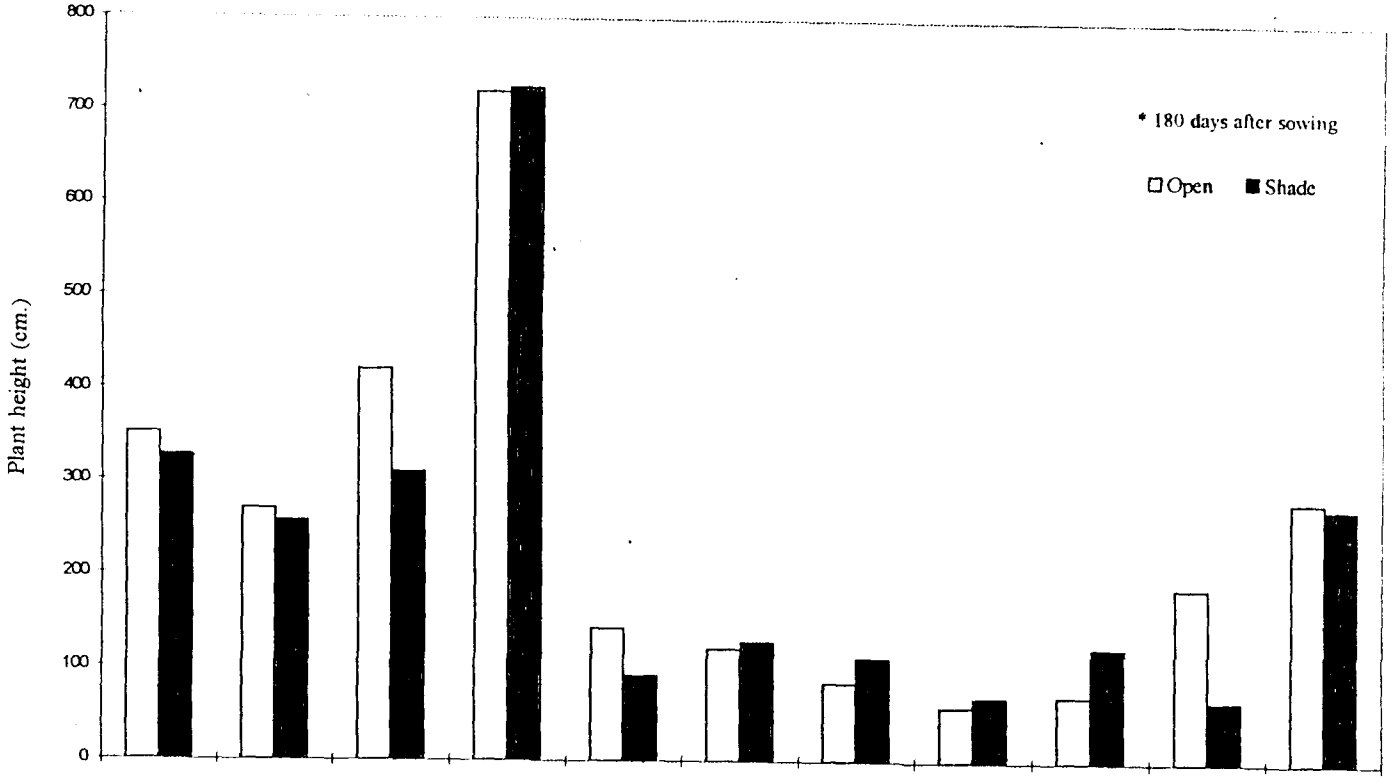
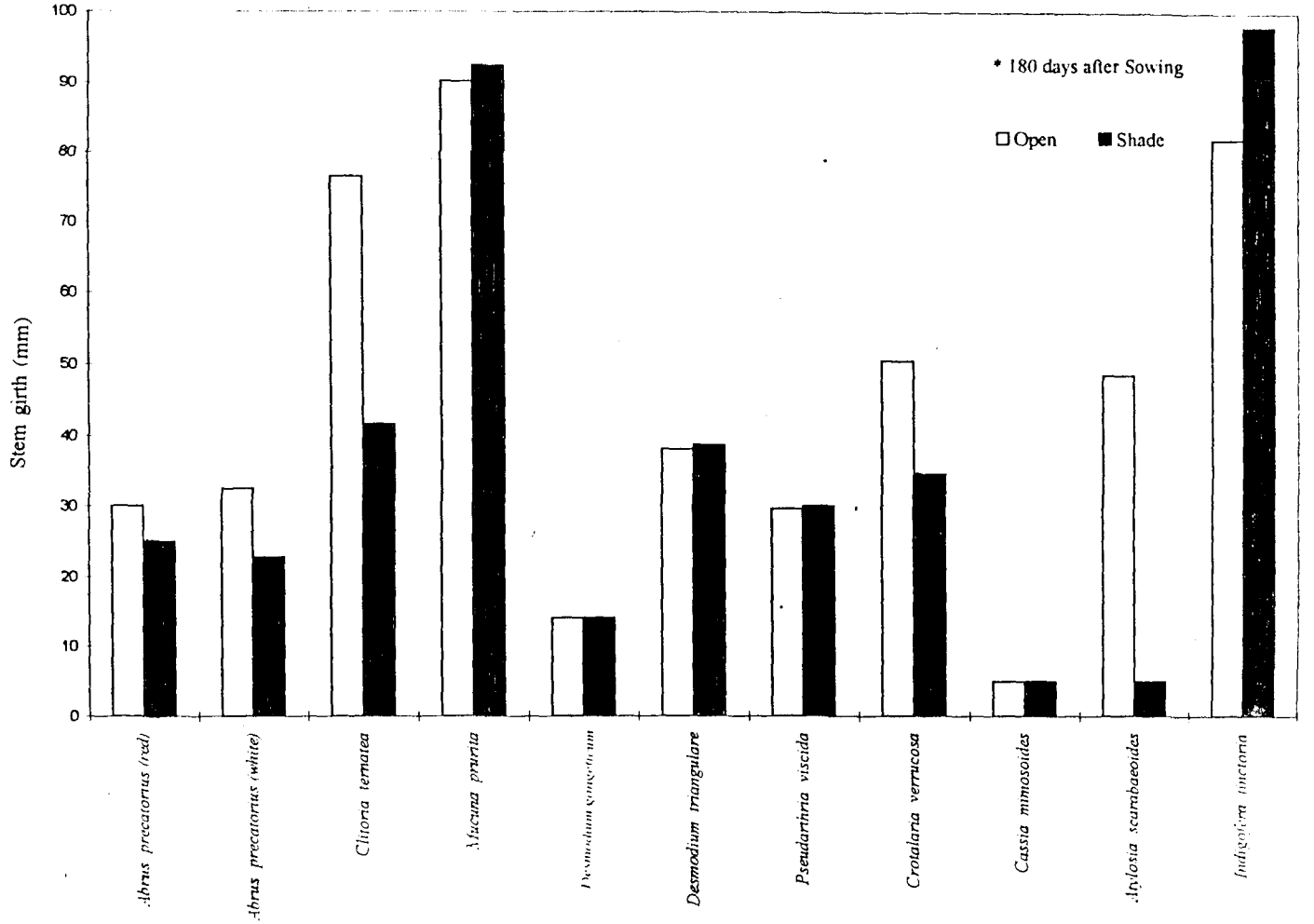


Fig. 2. Stem girth of selected herbaceous leguminous medicinal plants at harvest* under open and shaded conditions



At harvest, under both conditions *Mucuna prurita* produced maximum number of branches (74) and minimum number of branches was produced by *Desmodium triangulare* (Fig. 3).

4.3.1.4 Number of leaves

Number of leaves produced were greater under open condition than under shade in *Abrus precatorius*, *Clitoria ternatea*, *Desmodium triangulare*, *Crotalaria verrucosa* and *Atylosia scarabaeoides*, whereas no significant difference was observed in *Mucuna prurita* and *Indigofera tinctoria* under both conditions. Shaded condition favoured more leaf production in *Cassia mimosoides* (Table 4).

Mucuna prurita produced maximum number of leaves (730) under both conditions followed by *Indigofera tinctoria* (620). Minimum leaf number was recorded in *Desmodium gangeticum* (214) under open condition. In shade, minimum number of leaves (29) was produced by *Atylosia scarabaeoides* (Fig. 4).

4.3.1.5 Root Characters

Observations on the length of root, girth of tap root and number of lateral roots under open and shaded conditions are given in Table 5.

Root length was significantly superior in open condition for *Clitoria ternatea* and *Atylosia scarabaeoides* than under shade. It was significantly superior

Table 5. Root growth parameters of selected herbaceous leguminous medicinal plants at harvest* under open and shaded conditions

Sl. No.	Plant species	Root length (cm.)			Tap root girth (cm.)			Number of lateral roots		
		Open	Shade	t value	Open	Shade	t value	Open	Shade	t value
1.	*Abrus precatorius* (red)	32.75	34.85	1.53	3.12	3.06	0.38	9.20	10.20	1.08
2.	*Abrus precatorius* (white)	31.05	30.40	0.53	2.91	2.87	0.37	8.70	9.40	0.75
3.	*Atylosia scarabaeoides*	24.00	13.45	8.32 xx	2.60	1.37	5.59 xx	8.20	2.20	8.12 xx
4.	*Cassia mimosoides*	21.65	24.20	3.40 xx	2.74	2.89	0.82	5.90	6.60	0.99
5.	*Clitoria ternatea*	35.80	36.10	0.17	4.18	4.20	0.06	10.30	10.40	0.08
6.	*Crotalaria verrucosa*	38.95	38.00	0.71	4.93	4.16	2.98 xx	13.00	13.40	0.27
7.	*Desmodium gangeticum*	29.90	29.00	0.62	4.16	4.08	0.42	11.20	9.80	1.57
8.	*Desmodium triangulare*	29.75	29.00	0.58	5.24	5.21	0.10	7.80	8.40	0.62
9.	*Indigofera tinctoria*	32.85	32.90	0.06	5.93	5.80	0.52	12.10	12.10	0.00
10.	*Mucuna prurita*	81.70	82.50	1.02	5.23	5.37	0.57	10.30	10.40	0.08
11.	*Pseudarthria viscida*	36.21	35.75	0.29	3.75	3.42	1.09	13.60	13.00	0.58

* 180 days after sowing

Mean of 10 observations
x Significant at 5 per cent
xx Significant at 1 per cent

Fig. 3. Number of branches of selected herbaceous leguminous medicinal plants at harvest* under open and shaded conditions

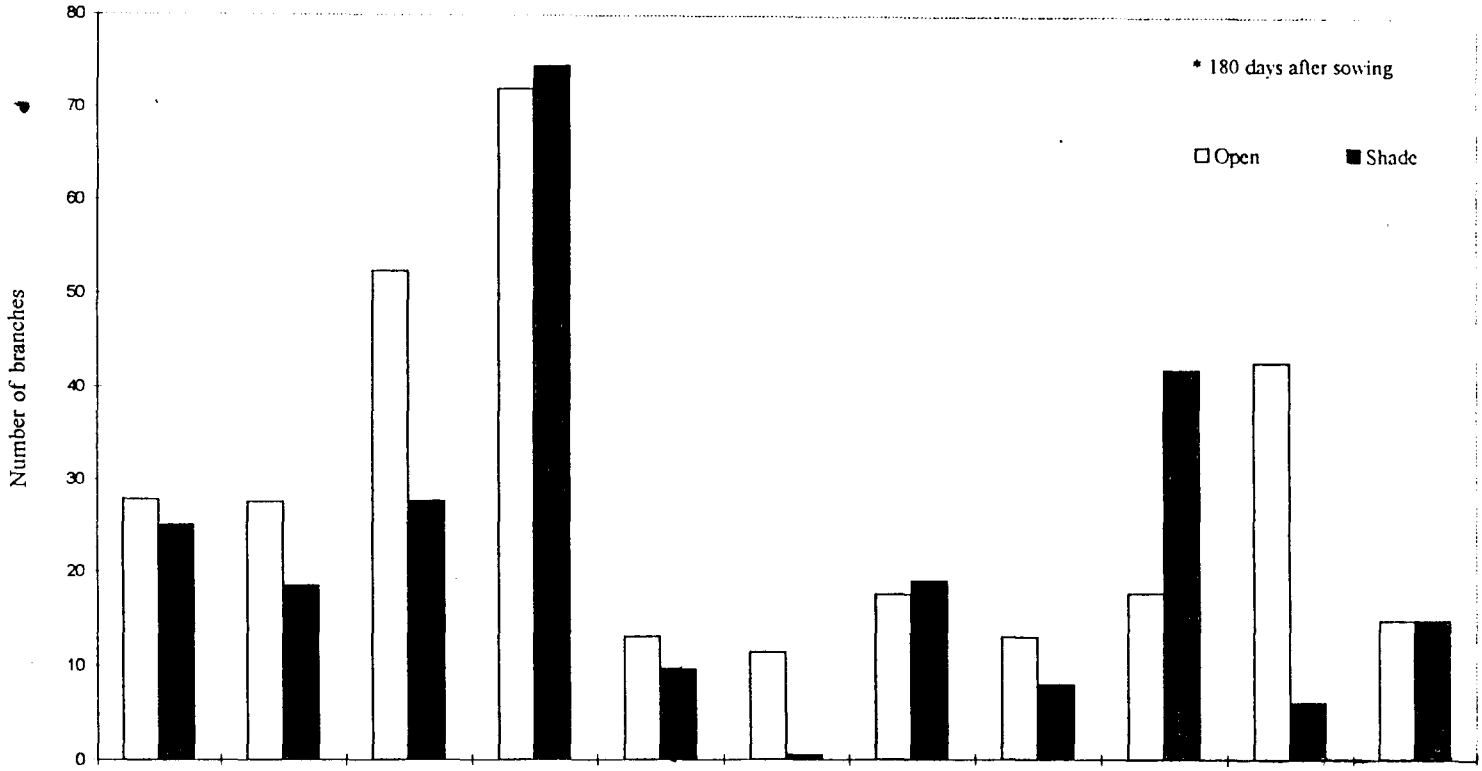


Fig. 4. Number of leaves of selected herbaceous leguminous medicinal plants at harvest* under open and shaded conditions

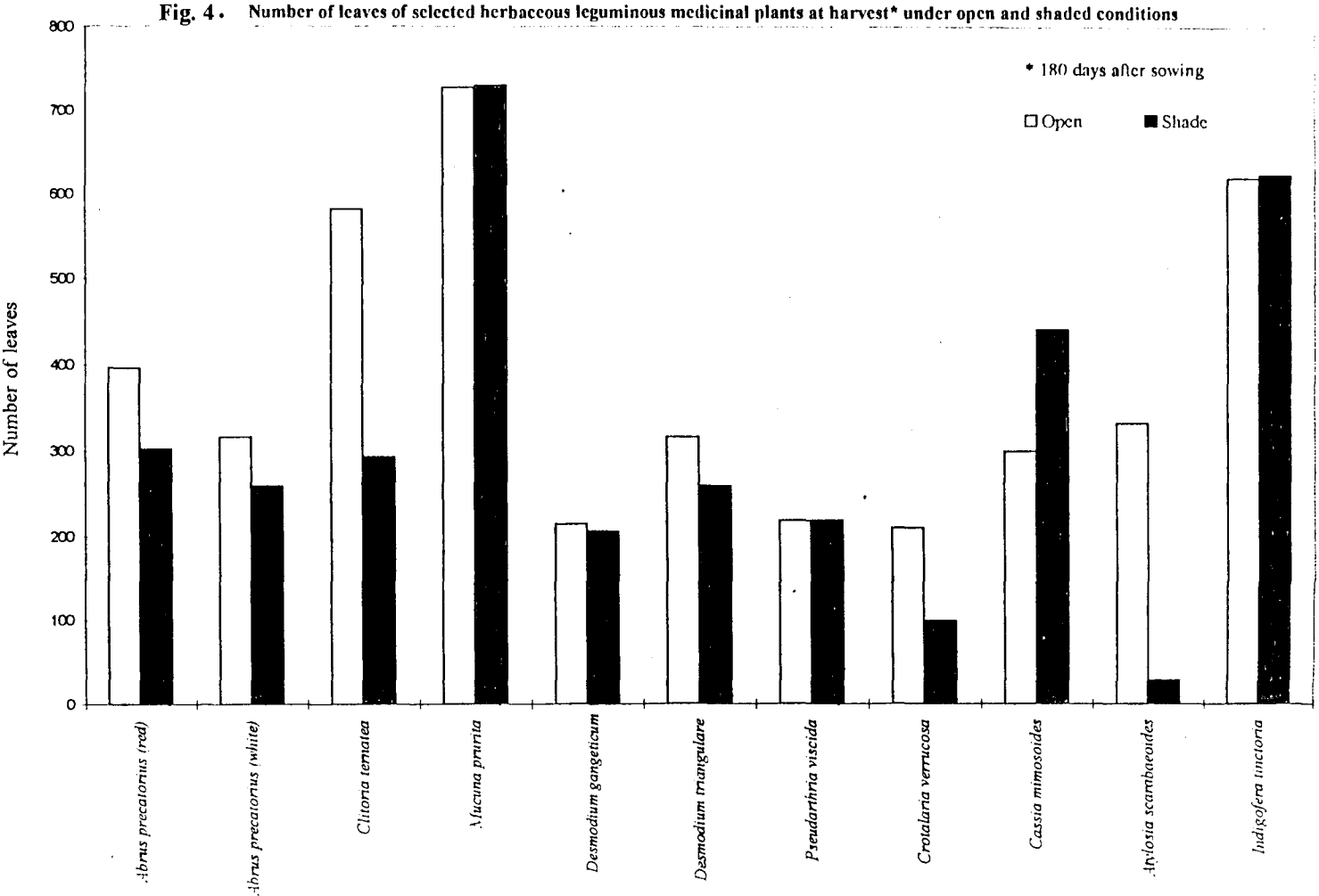
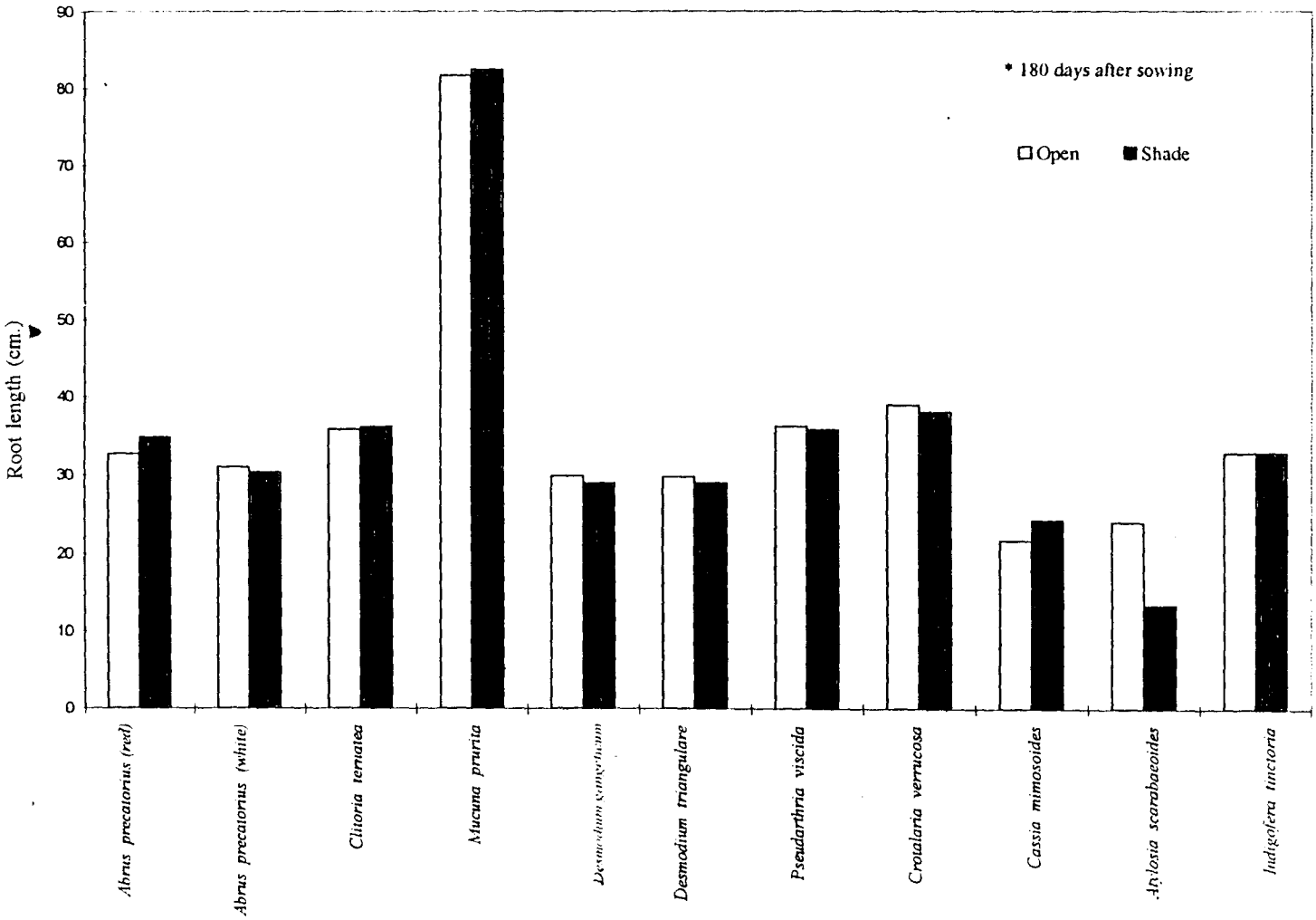


Fig. 5. Root length of selected herbaceous leguminous medicinal plants at harvest* under open and shaded conditions



under shade in coconut gardens in *Cassia mimosoides* and for all other species the lenth of root were on par. Root length was maximum in *Mucuna prurita* (82 cm) under both conditions. It was least in *Cassia mimosoides* (21.6 cm) under open condition and in *Atylosia scarabaeoides* (13.45 cm) under shade (Fig. 5).

Significantly superior tap root girth was observed under open condition in *Crotalaria verrucosa* and *Atylosia scarabaeoides* than under shade. There was no significant difference under both conditions in other species. Tap root girth was maximum in *Indigofera tinctoria* (5.9 cm) followed by *Mucuna prurita* (5.3 cm) and *Desmodium triangulare* (5.2 cm).

Clitoria ternatea and *Atylosia scarabaeoides* produced significantly more number of lateral roots in open condition than under shade. The number of roots was on par under both conditions for all other species. Lateral root production was maximum for *Pseudarthria viscida* (13.3) and *Crotalaria verrucosa* (13.2) followed by *Indigofera tinctoria* (12.1). *Cassia mimosoides* produced minimum number of lateral roots (5.9) under open condition. Under shade, minimum number of lateral roots was produced by *Atylosia scarabaeoides* (2.2).

4.3.2 Yield Parameters

The data on yield parameters at harvest viz. the shoot yield, root yield, pod yield, biomass yield and the content of active chemical principle in the medicinally important plant part under open and shaded conditions are presented in Tables 6 to 10.

4.3.2.1 Shoot yield

The fresh weight and dry weight of shoot were significantly superior under open conditions than under shade for *Abrus precatorius*, *Clitoria ternatea* and *Atylosia scarabaeoides*. It was greater under shaded conditions than under open in *Mucuna prurita* and *Cassia mimosoides*. For all other species the shoot yield was on par under both conditions (Table 6).

Dry weight of shoot was maximum for *Mucuna prurita* under both condition. (588.5 g/plant in open and 657 g/plant in shade). It was minimum for *Cassia mimosoides* (27.5 g/plant) under open condition. *Atylosia scarabaeoides* recorded minimum dry weight of shoot (6 g/plant) under shade.

4.3.2.2 Root yield

The data on fresh weight and dry weight of roots show that they were significantly superior under open condition in *Clitoria ternatea*, *Desmodium triangulare*, *Crotalaria verrucosa* and *Atylosia scarabaeoides* than under shade. There was no significant difference in the fresh and dry root weight under both conditions in other species (Table 7).

4.3.2.3 Pod yield

The yield of pods, in terms of fresh weight and dry weight was

Table 6. Shoot yield of selected herbaceous leguminous medicinal plants at harvest* under open and shaded conditions

Sl. No.	Plant species	Fresh yield (g/plant)			Dry yield (g/plant)		
		Open	Shade	t value	Open	Shade	t value
1.	*Abrus precatorius* (red)	255.2	204.0	4.43 xx	159.5	103.5	14.59 xx
2.	*Abrus precatorius* (white)	199.0	200.0	0.11	93.5	95.5	0.38
3.	*Atylosia scarabaeoides*	154.0	27.5	9.43 xx	90.0	6.0	22.56 xx
4.	*Cassia mimosoides*	78.5	86.5	2.24 xx	27.5	48.5	6.52 xx
5.	*Clitoria ternatea*	444.0	219.5	5.46 xx	243.0	93.5	12.13 xx
6.	*Crotalaria verrucosa*	140.5	127.0	1.05	48.5	39.5	1.85
7.	*Desmodium gangeticum*	69.5	58.5	1.52	37.0	33.0	1.11
8.	*Desmodium triangulare*	146.0	104.0	2.02	43.5	45.0	0.35
9.	*Indigofera tinctoria*	448.5	379.5	1.27	199.0	181.0	0.76
10.	*Mucuna prurita*	1245.0	1390.0	1.54	588.5	657.0	2.64 xx
11.	*Pseudarthria viscida*	147.0	121.5	1.62	62.5	58.2	2.02

* 180 days after sowing

Mean of 10 observations
x Significant at 5 per cent
xx Significant at 1 per cent

Table 7. Root yield of selected herbaceous leguminous medicinal plants at harvest* under open and shaded conditions

Sl. No.	Plant species	Fresh yield (g/plant)			Dry yield (g/plant)		
		Open	Shade	t value	Open	Shade	t value
1.	*Abrus precatorius* (red)	30.0	35.5	1.38	16.0	18.5	0.94
2.	*Abrus precatorius* (white)	32.0	37.0	1.03	15.3	17.5	1.27
3.	*Atylosia scarabaeoides*	10.0	4.9	3.80 xx	3.2	1.4	3.82 xx
4.	*Cassia mimosoides*	20.0	24.5	1.68	4.0	5.2	1.04
5.	*Clitoria ternatea*	32.8	37.0	1.03	15.0	10.5	3.48 xx
6.	*Crotalaria verrucosa*	30.5	19.5	3.96 xx	18.5	10.5	3.48 xx
7.	*Desmodium gangeticum*	28.5	22.0	2.31 x	14.0	12.5	0.67
8.	*Desmodium triangulare*	49.0	31.0	4.17 xx	25.0	15.0	3.87 xx
9.	*Indigofera tinctoria*	54.5	42.5	1.21	26.0	22.0	1.43
10.	*Mucuna prurita*	50.0	48.5	0.45	17.0	18.0	0.38
11.	*Pseudarthria viscida*	26.5	26.5	0.00	17.5	15.0	0.87

* 180 days after sowing

Mean of 10 observations
x Significant at 5 per cent
xx Significant at 1 per cent

significantly superior under open condition compared to that under shade for *Abrus precatorius*, *Clitoria ternatea* and *Atylosia scarabaeoides*. No significant difference was observed for other species under both conditions (Table 8).

Under both conditions, *Mucuna prurita* recorded maximum dry weight of pods (283.5 g/plant in open and 285 g/plant in shade). *Desmodium gangeticum* recorded minimum pod yield (7.5g/plant) under open conditions. *Atylosia scarabaeoides* did not produce flowers and pods under shade. No pods were produced under both conditions in *Desmodium triangulare* till the harvest.

4.3.2.4 Biomass yield

The data on biomass yield of the different herbaceous leguminous medicinal plant species are presented in Table 9 and Fig. 6. The biomass yield is significantly superior under open condition in *Abrus precatorius* (red), *Clitoria ternatea*, *Crotalaria verrucosa* and *Atylosia scarabaeoides* than under shade. However, shaded condition resulted in greater biomass yield in *Mucuna prurita* (18765 kg/ha) and *Cassia mimosoides* (1884.2 kg/ ha). No significant difference in biomass yield was noticed under both conditions in *Desmodium gangeticum*, *Desmodium triangulare*, *Abrus precatorius* (white), *Pseudarthria viscida* and *Indigofera tinctoria*.

Mucuna prurita recorded maximum biomass yield under both conditions (16832.9 kg/ha in open and 18765 kg/ha in shade). It was minimum under open condition for *Cassia mimosoides* (1079 kg/ha). Under shade, *Atylosia scarabaeoides* recorded minimum biomass yield (217.1 kg/ha).

Table 8. Pod yield of selected herbaceous leguminous medicinal plants at harvest* under open and shaded conditions

Sl. No.	Plant species	Fresh yield (g/plant)			Dry yield (g/plant)		
		Open	Shade	t value	Open	Shade	t value
1.	*Abrus precatorius* (red)	222.0	170.5	9.26 xx	93.0	60.5	6.13 xx
2.	*Abrus precatorius* (white)	86.5	68.5	3.86 xx	32.0	36.7	1.84
3.	*Atylosia scarabaeoides*	62.0	0.0	8.13 xx	19.5	0.0	8.51 xx
4.	*Cassia mimosoides*	39.0	32.0	1.71	21.0	20.0	0.80
5.	*Clitoria ternatea*	398.0	129.0	13.21 xx	274.5	93.5	14.74 xx
6.	*Crotalaria verrucosa*	23.5	28.0	0.89	58.1	9.4	1.00
7.	*Desmodium gangeticum*	16.5	16.0	0.21	7.5	8.0	0.36
8.	*Desmodium triangulare*	--	--	--	--	--	--
9.	*Indigofera tinctoria*	162.0	146.5	0.85	64.5	59.0	1.24
10.	*Mucuna prurita*	453.5	459.5	0.10	283.5	285.0	0.07
11.	*Pseudarthria viscida*	28.3	28.0	0.03	8.0	11.0	2.32

* 180 days after sowing
-- did not produce pods till harvest

Mean of 10 observations
x Significant at 5 per cent
xx Significant at 1 per cent

Table 9. Biomass yield of selected herbaceous leguminous medicinal plants at harvest* under open and shaded conditions

Sl. No.	Plant species	Biomass yield (kg/ha)			Biomass productivity (kg/ha/day)	
		Open	Shade	t value	Open	Shade
1.	*Abrus precatorius* (red)	4878.9	3391.6	11.697 xx	23.232	16.150
2.	*Abrus precatorius* (white)	3024.6	3141.4	0.690	14.402	14.959
3.	*Atylosia scarabaeoides*	2604.9	217.1	23.286 xx	12.404	1.033
4.	*Cassia mimosoides*	1079.2	1884.2	6.164 xx	8.472	5.162
5.	*Clitoria ternatea*	7172.4	2890.8	13.250 xx	34.154	13.761
6.	*Crotalaria verrucosa*	1890.4	1390.0	3.310 xx	9.010	6.619
7.	*Desmodium gangeticum*	1417.8	1264.9	1.148	6.751	6.020
8.	*Desmodium triangulare*	1904.3	1668.0	1.484	9.141	7.940
9.	*Indigofera tinctoria*	6268.9	5204.4	2.156	29.850	24.800
10.	*Mucuna prurita*	16832.9	18765.5	2.607 xx	80.156	89.350
11.	*Pseudarthria viscida*	2224.0	1954.1	1.236	10.590	9.304

* 180 days after sowing

Mean of 10 observations

xx Significant at 1 per cent

4.3.2.5 Chemical ingredients

Chemical analysis of the plants under study revealed that there is no significant difference in the content of chemical ingredients in the medicinally important plant parts under both conditions (Table 10). However, the values were higher under shade in *Mucuna prurita* (1.59 %), *Desmodium gangeticum* (0.45 %) and *Crotalaria verrucosa* (0.54 %) than in open condition. The observations were on par under both conditions in *Clitoria ternatea*, *Pseudarthria viscida*, *Cassia mimosoides* and *Indigofera tinctoria*. In *Abrus precatorius*, *Desmodium triangulare* and *Atylosia scarabaeoides*, the content of active chemical principle was higher under open condition compared to that under shade.

4.3.3 Nodulation characteristics

The data on root nodule formation viz, number of nodules, nodule fresh weight and nodule dry weight of the different plant species under open and shaded conditions is presented in Table 11. The data revealed that the ability for nodulation varies with plant species. The number of nodules was significantly higher under open condition than under shade in all plant species except *in Abrus precatorius*, *Mucuna prurita* and *Desmodium triangulare*. No nodulation could be detected in *Cassia mimosoides* under both conditions.

The fresh weight of the nodules was significantly greater under open condition than under shade in all plant species except in *Abrus precatorius* and

Table 10. Content of active chemical principle in medicinally important plant part of selected herbaceous leguminous medicinal plants at harvest* under open and shaded conditions

Sl. No.	Plant species	Plant part analysed	Active chemical principle (%) Open	Shade	Z value
1.	*Abrus precatorius* (red)	seed	0.82[a]	0.80[a]	0.0158
2.	*Abrus precatorius* (white)	seed	0.76[a]	0.60[a]	0.1377
3.	*Atylosia scarabaeoides*	whole plant	0.12[a]	0.04[a]	0.2000
4.	*Cassia mimosoides*	leaf	traces[b]	traces[b]	0.0000
5.	*Clitoria ternatea*	pod	0.02[a]	0.02[a]	0.0000
6.	*Crotalaria verrucosa*	leaf	0.52[a]	0.54[a]	0.0190
7.	*Desmodium gangeticum*	root	0.42[a]	0.46[a]	0.4270
8.	*Desmodium triangulare*	leaf	0.63[a]	0.60[a]	0.0270
9.	*Indigofera tinctoria*	leaf	21 ppm[c]	20 ppm[c]	0.1750
10.	*Mucuna prurita*	seed	1.52[a]	1.59[a]	0.0400
11.	*Pseudarthria viscida*	root	0.40[a]	0.40[a]	0.0000

* 180 days after sowing

a : alkaloid

b : glycoside

c : indigotin and other colouring matters

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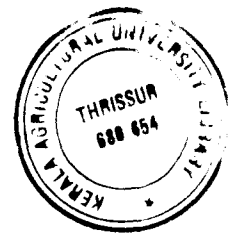


Mucuna prurita (Table 11).

There was no significant difference in the dry weight of nodules under open and shaded conditions in *Mucuna prurita*, *Desmodium gangeticum*, *Desmodium triangulare*, *Crotalaria verrucosa* and *Indigofera tinctoria* . However, significant difference was noticed for other species under both conditions (Table 11).

4.3.4 Mycorrhizal association

The percentage and intensity of mycorrhizal association in the roots of the different medicinal plant species are given in Table 12. From the data, it can be concluded that the extent of mycorrhizal association varies with plant species. The percentage of mycorrhizal association under shaded condition is less in all plant species compared to that under open condition. Significant differences was observed in *Clitoria ternatea*, *Desmodium triangulare* and *Atylosia scarabaeoides*. Maximum mycorrhizal association was recorded in *Clitoria ternatea* (79.16 per cent in open and 62.4 per cent in shade) and minimum in *Mucuna prurita* (15.62 per cent in open and 8.6 per cent in shade).

4.3.5 Nutrient uptake

The data on the uptake of nitrogen,phosphorous and potassium by the eleven different species of herbaceous leguminous medicinal plants is presented in Table 13.

Table 11. Root nodule formation in selected herbaceous leguminous medicinal plants at harvest* under open and shaded conditions

Sl. No.	Plant species	Number			Fresh weight (g)			Dry weight (g)		
		Open	Shade	t value	Open	Shade	t value	Open	Shade	t value
1.	*Abrus precatorius* (red)	83.00	75.5	3.503 xx	1.800	1.500	2.590 x	0.850	0.700	3.000 xx
2.	*Abrus precatorius* (white)	60.00	55.5	1.566	1.225	0.812	3.122 xx	0.625	0.325	3.064 xx
3.	*Atylosia scarabaeoides*	44.50	12.2	10.060 xx	1.125	0.455	10.060 xx	0.750	0.200	7.450 xx
4.	*Cassia mimosoides*	--	--	--	--	--	--	--	--	--
5.	*Clitoria ternatea*	223.25	141.5	15.590 xx	2.505	1.880	2.920 xx	2.125	1.400	11.520 xx
6.	*Crotalaria verrucosa*	96.75	77.0	6.621 xx	3.800	3.200	3.674 xx	2.650	2.450	1.999
7.	*Desmodium gangeticum*	45.00	38.0	3.655 xx	1.175	0.962	2.534 xx	0.500	0.475	0.397
8.	*Desmodium triangulare*	53.50	49.0	1.236	1.480	1.205	4.299 xx	0.725	0.600	1.986
9.	*Indigofera tinctoria*	135.00	119.5	3.661 xx	2.750	2.125	9.026 xx	1.950	1.700	3.273 xx
10.	*Mucuna prurita*	105.25	113.5	2.063	1.597	1.580	1.023	1.175	1.080	1.656
11.	*Pseudarthria viscida*	56.75	36.2	8.640 xx	1.337	0.850	6.530 xx	0.725	0.400	6.789 xx

* 180 days after soiwing
-- did not produce nodules

Mean of 5 observations
x Significant at 5 per cent
xx Significant at 1 per cent

Table 12. Mycorrhizal association of selected herbaceous leguminous medicinal plants at harvest* under open and shaded conditions

Sl. No.	Plant species	Open		Shade		Z value
		%	Intensity	%	Intensity	
1.	*Abrus precatorius* (red)	47.22	medium	34.09	low	1.890
2.	*Abrus precatorius* (white)	45.00	medium	34.09	low	1.570
3.	*Atylosia scarabaeoides*	52.08	medium	29.70	low	3.210 xx
4.	*Cassia mimosoides*	36.50	low	24.20	low	1.891
5.	*Clitoria ternatea*	79.16	high	62.40	high	2.605 xx
6.	*Crotalaria verrucosa*	40.38	medium	31.60	medium	1.293
7.	*Desmodium gangeticum*	22.72	low	12.76	low	1.843
8.	*Desmodium triangulare*	29.16	low	14.30	low	2.547 xx
9.	*Indigofera tinctoria*	30.00	low	21.60	low	1.357
10.	*Mucuna prurita*	15.62	low	8.60	low	1.521
11.	*Pseudarthria viscida*	22.72	low	12.60	low	1.876

* 180 days after sowing

xx Significant at 1 per cent

Table 13. Nutrient uptake (kg/ha) of selected herbaceous leguminous medicinal plants at harvest* under open and shaded conditions

Sl. No.	Plant species	N			P			K		
		Open	Shade	t value	Open	Shade	t value	Open	Shade	t value
1.	*Abrus precatorius* (red)	78.50	50.74	4.830 xx	10.970	6.42	5.08 xx	20.83	19.77	1.310
2.	*Abrus precatorius* (white)	50.79	54.49	0.616	6.190	6.90	0.91	19.19	17.47	0.730
3.	*Atylosia scarabaeoides*	3.98	0.26	12.060 xx	3.836	0.29	18.71 xx	5.70	0.39	19.410 xx
4.	*Cassia mimosoides*	11.61	11.53	0.050	1.650	4.86	8.22 xx	18.76	14.9	0.780
5.	*Chloris ternatea*	141.57	31.96	14.310 xx	21.250	12.29	5.08 xx	123.36	78.02	3.960 xx
6.	*Crotalaria verrucosa*	18.76	15.48	1.270	10.02	7.50	17.20 xx	16.34	14.18	1.820
7.	*Desmodium gangeticum*	19.19	17.13	0.677	3.540	1.96	3.04	14.15	12.72	0.467
8.	*Desmodium triangulare*	18.29	19.19	0.391	3.170	3.13	4.20 xx	16.85	14.16	1.390
9.	*Indigofera tinctoria*	143.38	93.02	2.710	17.830	14.87	1.09	108.96	96.10	1.66
10.	*Mucuna prurita*	220.11	188.64	2.120	40.450	35.91	1.87	116.32	123.96	2.230
11.	*Pseudarthria viscida*	20.93	20.77	0.077	3.230	5.20	6.40 xx	17.03	15.56	1.672

* 180 days after sowing

Mean of 5 observations
xx Significant at 1 per cent

Fig. 6. Biomass production of selected herbaceous leguminous medicinal plants at harvest* under open and shaded conditions

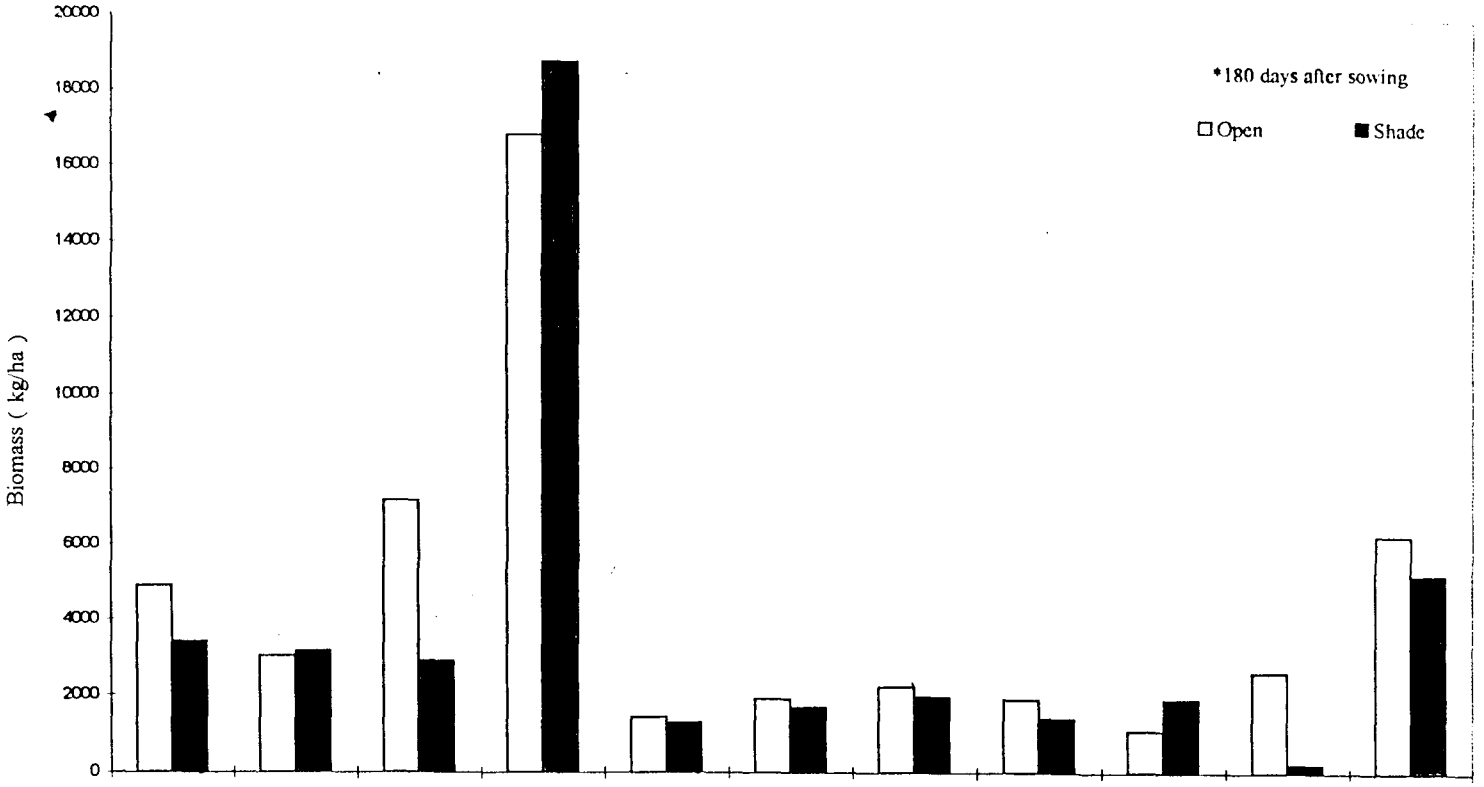
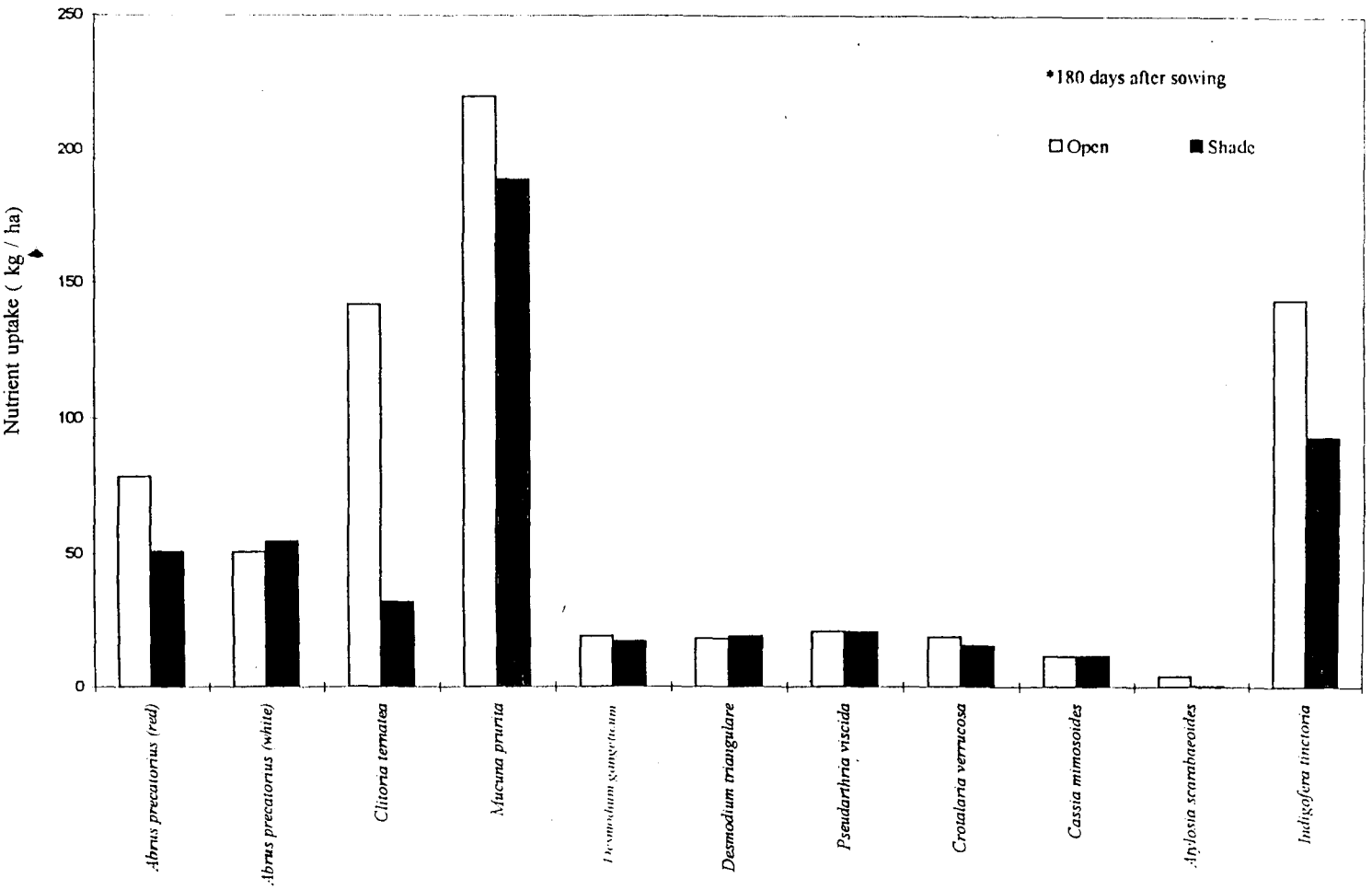


Fig. 7. Nitrogen uptake of selected herbaceous leguminous medicinal plants at harvest* under open and shaded conditions



The uptake of nitrogen under open condition was significantly superior in *Abrus precatorius*, *Clitoria ternatea* and *Atylosia scarabaeoides* than under shade. However, no significant difference was noticed for other legumes. Maximum nitrogen uptake under both conditions was recorded by *Mucuna prurita* (220.1 kg/ha in open and 188.64 kg/ha in shade). The nitrogen uptake was minimum under both conditions for *Atylosia scarabaeoides* (3.98 kg/ha in open and 0.261 kg/ha in shade) (Fig. 7).

The uptake of phosphorous was significantly higher under open condition in *Abrus precatorius*, *Clitoria ternatea*, *Desmodium triangulare*, *Crotalaria verrucosa* and *Atylosia scarabaeoides* than under shade. Shaded condition favoured better phosphorous uptake in *Pseudarthria viscida* and *Cassia mimosoides*. Maximum phosphorus uptake was recorded by *Mucuna prurita* (40.45 kg/ha in open and 35.91 kg/ha in shade). It was minimum for *Cassia mimosoides* (1.65 kg/ha) under open condition and *Atylosia scarabaeoides* (0.29 kg/ha) under shade (Table 13).

Potassium uptake was significantly higher under open condition in *Clitoria ternatea* and *Atylosia scarabaeoides* than under shade. There was no significant difference for other species under both conditions. Under open condition, potassium uptake was maximum for *Clitoria ternatea* (123.36 kg/ha) and minimum for *Desmodium gangeticum* (14.15 kg/ha). In coconut gardens, however, it was maximum for *Mucuna prurita* (123.96 kg/ha) and minimum for *Atylosia*

Table 14 . Soil nitrogen status in the plots of selected herbaceous leguminous medicinal plants at harvest in coconut garden**

Sl. No.	Plant species	Nitrogen content (kg/ha)	Difference* (kg/ha)
1.	*Abrus precatorius* (red)	302.0	+ 4.0
2.	*Abrus precatorius* (white)	299.0	+ 1.0
3.	*Atylosia scarabaeoides*	306.0	+ 8.0
4.	*Cassia mimosoides*	302.0	+ 4.0
5.	*Clitoria ternatea*	368.0	+ 70.0
6.	*Crotalaria verrucosa*	360.0	+ 62.0
7.	*Desmodium gangeticum*	300.0	+ 2.0
8.	*Desmodium triangulare*	302.0	+ 4.0
9.	*Indigofera tinctoria*	355.0	+ 57.0
10.	*Mucuna prurita*	358.0	+ 60.0
11.	*Pseudarthria viscida*	304.0	+ 6.0

* Initial mean soil nitrogen content of the plots = 298 kg/ha

** Soil of the experimental site is red loam belonging to Vellayani series

scarabaeoides (0.396 kg/ha) (Table 13).

4.3.6 Nutrient (nitrogen) fixation

The post-harvest soil analysis revealed that *Clitoria ternatea* is most effective in enriching soil nitrogen (368 kg/ha) (Table 14). The capacity is almost similar in *Mucuna prurita* (358 kg/ha), *Crotalaria verrucosa* (360 kg/ha) and *Indigofera tinctoria* (355 kg/ha). Other intercropped leguminous medicinal plants did not show much difference in the soil nitrogen content before and after the cropping.

4.3.7 Feasibility of vegetative propagation

Feasibility of vegetative propagation in the eleven different herbaceous leguminous medicinal plant species was studied by planting their stem cuttings in polybags filled with potting mixture. The cuttings produced roots and got established in *Clitoria ternatea* and *Crotalaria verrucosa*. The cuttings failed to root in all other species.

Chapter 5

DISCUSSION

5. DISCUSSION

The present study of collecting, describing and evaluating the performance of selected herbaceous medicinal leguminous plants of Kerala under open and shaded conditions was carried out at the College of Agriculture, Vellayani from June 1995 to January 1996. The study aimed at assessing the feasibility of raising herbaceous leguminous medicinal plants as intercrops in coconut garden. The results of the study are discussed in this chapter.

5.1 Seed germination

Of the sixteen different species of herbaceous leguminous medicinal plants collected from different sources, the seeds of eleven plant species were found to have high germination capacity (>90%), under laboratory conditions (Table 2). The high rate of germination was due to good seed viability and favourable conditions of incubation in the laboratory. In *Desmodium gangeticum* and *Desmodium triangulare* high germination rate was noticed only when they were incubated in darkness. This may be due to the etiolation effect on seed. Poor germination rate in other five plant species may be due to seed dormancy.

5.2 Growth parameters

5.2.1 Plant height

Considerable variation was noticed in plant height between the species both under shade in a coconut garden and under open condition (Table 4). This may be attributed to the inherent character of the plant species concerned, as growth parameters are purely functions of the genetic make up under identical conditions of growth.Plant height was significantly superior under open condition in *Abrus precatorius*, *Clitoria ternatea*, *Desmodium gangeticum* and *Atylosia scarabaeoides* compared to that under shaded condition. The primary factor likely to limit growth and productivity of crops under shade in a coconut garden is the low light intensity, if water and nutrients are available in adequate quantities. Reduction in plant height of these species under shade in coconut garden may be due to the physiological and ecological influence, especially light, which limits growth of crops in mixtures (Blackman and Black, 1959). Existence of a tight competition for eco-physiological requirements like water, nutrients and light might have resulted in an unfavourable situation for rapid vegetative growth, there by causing a reduction in plant height (Anilkumar, 1984).

In *Pseudarthria viscida* , *Crotalaria verrucosa* and *Cassia mimosoides* plant height was significantly superior under shaded condition . However, in *Mucuna prurita*, *Desmodium triangulare* and *Indigofera tinctoria* there was no

significant difference in plant height under open and shaded conditions. This may be explained as due to the inherent ability of the legumes to tolerate the partial shade prevailing in the coconut gardens (Nair *et al.*, 1991).

5.2.2 Stem girth

There was no significant difference in the stem girth under open and shaded conditions in *Mucuna prurita*, *Desmodium gangeticum*, *Desmodium triangulare*, *Pseudarthria viscida*, and *Cassia mimosoides* (Table 4). This may be due to their identical rate of growth under the two conditions. However, in *Abrus precatorius*, *Clitoria ternatea*, *Crotalaria verrucosa* and *Atylosia scarabaeoides*, the vegetative growth was greater under open condition and consequently the cambium might have been more active forming a thicker stem. Similar trend was noticed in tapioca under pure cropping system by Anilkumar (1984). Increased stem girth (98.0 mm) under shaded condition in *Indigofera tinctoria* may be due to its vigorous nature of growth in coconut garden.

5.2.3 Number of branches and leaves

The number of branches and leaves is usually related to the height of the plants (George, 1981). *Mucuna prurita* recorded the maximum height at all stages of growth under both conditions of light and hence the number of branches and leaves produced by this legume was also maximum (Table 4; Fig. 3&4). The vine of *Mucuna prurita* was longer and more aggressive than the other legumes. This peculiar character would have helped it for

greater utilization of the environmental resources and increased the total number of branches and leaves. Similar results were obtained by George (1981) for velvet bean in maize-legume mixed cropping system in coconut garden. Minimum plant height at harvest (59.4 cm in open and 69.0 cm in shade) was recorded in *Crotalaria verrucosa* and therefore, the number of branches and leaves produced by this legume was the least.

Greater number of branches and leaves were produced under open condition in *Abrus precatorius*, *Clitoria ternatea*, *Desmodium triangulare*, *Crotalaria verrucosa* and *Atylosia scarabaeoides* compared to that under shade. This may be due to the zero competition for light, space, water or nutrients in a pure cropping system resulting in higher production of leaves and branches. Prabhakar *et al.* (1979) obtained higher leaf number in plots of cassava where no intercrop was raised.

Under shade, greater number of branches (42) and leaves (442) were recorded only in *Cassia mimosoides*. This may be due to the inherent ability of the legume for efficient growth and photosynthesis under shaded conditions. In all other species, no significant difference was observed in the number of branches and leaves produced under open and shaded conditions. In these species, it may be noted that there was no significant difference in plant height as well.

5.2.4 Root characters

The length of taproot and the number of lateral roots produced at harvest were significantly superior under open condition for *Clitoria ternatea* and *Atylosia*

scarabaeoides (Table 5). This might be due to more vigorous and faster growth rate of these species under open condition when compared to that under shade in coconut garden. No significant difference was noticed in these characters in the other species where root formation might have completed well before the commencement of interference from the main crop. Hence, it is reasonable to conclude that growing herbaceous medicinal leguminous plant species as intercrop in coconut garden has no effect on the number and length of roots produced. Similar conclusion were made by (Anilkumar, 1984) in tapioca based inter cropping system.

Girth of the tap root was significantly superior under open condition in *Crotalaria verrucosa* (4.93 cm) and *Atylosia scarabaeoides* (2.6 cm) than under shade . This might be due to a variety of factors like lesser competition for nutrients and the root distribution character of these species which would have provided favourable condition for thickening of roots.

Shaded condition favoured to achieve significantly greater length of roots in *Cassia mimosoides* (24.2 cm). This may be due to the inherent adaptability of the legume to tolerate the partial shade prevailing in the coconut garden. Variation in root characters between the legumes may be due to the characteristic genetic make up of each plant concerned.

5.3 Yield characters

5.3.1 Shoot yield

Shoot yield or green matter yield is mainly a function of vegetative growth, by virtue of the inherent genetic nature of each plant species. Therefore, the superiority of *Mucuna prurita* over other legumes can be explained as a natural phenomenon. The uptake of nutrients by *Mucuna prurita* was also higher which promoted better growth and consequently the green matter yield. Singh and Relwani (1978) reported increased green matter yield for velvet bean intercropped with maize due to its vigorous vegetative growth and increased nutrient uptake.

Fresh weight and dry weight of the shoot were significantly superior under open condition for *Abrus precatorius*, *Clitoria ternatea* and *Atylosia scarabaeoides* (Table 6). This is due to their better vegetative growth, in terms of plant height, number of branches and number of leaves under open condition . *Cassia mimosoides* exhibited vigorous vegetative growth under shade and so the fresh and dry weights of its shoot were significantly superior under shaded condition .

It is reasonable to presume that under uniform conditions of growth, the dry matter accumulation is more or less similar to that of green matter output. This explains why the fresh weight and dry weight of the shoot follow the same pattern under open and shaded conditions.

5.3.2 Root yield

Under open condition, *Clitoria ternatea* and *Atylosia scarabaeoides* produced greater number of lateral roots (10.3 and 8.2) and recorded greater root length (35.8 cm and 24.0 cm). Girth of the tap root was significantly superior for *Crotalaria verrucosa* (4.93 cm) and *Atylosia scarabaeoides* (2.6 cm) under open condition . In *Desmodium triangulare*, a higher value was recorded under both open and shaded conditions (5.225 cm). This, perhaps, may be the reason for the significantly higher root yield (fresh as well as dry yield) under open condition for *Clitoria ternatea*, *Atylosia scarabaeoides*, *Crotalaria verrucosa* and *Desmodium triangulare* (Table 7).

Mucuna prurita, *Indigofera tinctoria* and *Desmodium triangulare* produced maximum fresh weight and dry weight of roots under both conditions due to the characteristically thick roots that they produce. The thin slender roots produced by *Atylosia scarabaeoides* compared to other legumes, may be attributed as the reason for minimum root fresh weight and dry weight in this leguminous medicinal plant.

5.3.3 Pod yield

Yield of pods, fresh weight and dry weight, were significantly superior under open condition for *Abrus precatorius*, *Clitoria ternatea* and *Atylosia scarabaeoides* (Table 8). This may due to the more efficient and profuse flowering under open condition.

Pod yield, fresh and dry weight were highest in *Mucuna prurita* (456 g/ plant and 283 g/plant respectively). This is due to the big sized pods that the crop produces. *Desmodium gangeticum* produces thin, papery light pods and hence fresh and dry weight of the pods were the least under both open and shaded conditions.

5.3.4 Biomass yield

The highest biomass yield was produced by *Mucuna prurita* (18765.5 kg/ha) and *Cassia mimosoides* (1884.2 kg/ha) under shaded condition . This may be attributed to the high shade tolerance exhibited by these crops (Nelliat and Krishnaji, 1976; Varghese, 1976; Pillai, 1985; Pillai *et al.*, 1985).

The inherent ability of the herbaceous leguminous medicinal plants to tolerate shade may be attributed as the reason for the absence of any significant difference in biomass yield by *Desmodium gangeticum*, *Desmodium triangulare*, *Pseudarthria viscida* and *Indigofera tinctoria*. The poor biomass production of *Clitoria ternatea*, *Abrus precatorius* and *Crotalaria verrucosa* in coconut garden was due to their less vigorous nature of growth habit in shade. The aggressive growth of *Mucuna prurita* explains its higher biomass production under shaded condition (Table 9).

5.3.5 Chemical ingredients

Chemical analysis of medicinally important plant parts of the medicinal plant species under study revealed that there is no significant difference in the content of chemical ingredients in the plant parts irrespective of the fact whether they were raised under open or shaded conditions (Table 10). This indicates that raising these plant species as intercrops in coconut garden will not adversely affect the content of chemical ingredients in the plant parts.

Higher content of chemical ingredients were obtained under shaded condition in *Mucuna prurita*, *Desmodium gangeticum* and *Crotalaria verrucosa* when compared to open condition. The biosynthesis of secondary metabolites, though controlled genetically, is affected strongly by environmental influences, of which stress due to water and light are more important (Milka, 1962). The alkaloid content in many species was found to be higher when they were under water stress (Trease and Evans, 1972; Waller and Nowacki, 1978).

5.4 Nodulation characteristics

The herbaceous leguminous medicinal plants included in the present study were found to differ considerably in their ability to produce nodules (Table 11). The leguminous medicinal plant species included in the study are classified as belonging to different genotypes. The legume genotypes differ widely in their inherent capacity to form nodules in symbiosis with the respective microsymbiont

(Erdman, 1947). An efficient native strain of rhizobium in the soil cannot nodulate uniformly all the legumes under study since there exist genotype-rhizobial strain interaction (Dinchev, 1961 and Sen, 1964). The absence of sufficient number of infective rhizobial strains will also lead to poor nodulation. Hence, the variation in nodulation among the different plant species could be attributed to factors like inherent ability of genotype, genotype-strain interaction and the lack of sufficient population of desirable, infective native strain of rhizobia in the soil.

All the nodule characters namely, number of nodules, fresh weight and dry weight of nodules were higher in *Clitoria ternatea* than other plant species. This may be due to the inherent ability of the plant to form nodules and its effective symbiotic association with the desirable, infective strain of inoculam in the native soil. No nodules could be detected in the roots of *Cassia mimosoides* under open and shaded conditions. This suggests that the plant requires highly specific strain of rhizobia for nodulation which is absent in the soil. Here, artificial inoculation with suitable strains is necessary.

All the nodule characters showed lesser values in coconut garden than under open conditions. The number of nodules and their fresh weight were significantly superior under open conditions for all legumes except *Abrus precatorius*, *Mucuna prurita* and *Desmodium triangulare*. This may be due to the fact that under open conditions, there is better photosynthesis and increased availability of photosynthates for nodulation and nitrogen fixation. It is established that for effective rhizobium-legume symbiosis an effective photosynthetic system is essential (Sivaprasad and Rai, 1984).

5.5 Mycorrhizal association

The ability to harbour vesicular arbuscular mycorrhizae (VAM) varies with plant species (Table 12). The difference in response due to host preference of VAM was noticed by Mosse (1975).

Vesicular arbuscular mycorrhizal fungus, the microsymbiont of the system, solely depends upon the host photosynthate to meet its carbon requirement. Hence, the effectiveness of symbiosis is very much linked with the photosynthetic efficiency and the factors related to photosynthesis of the host plant (Sivaprasad and Rai, 1984). The present study shows that the percentage of mycorrhizal association under shaded condition in coconut garden is less than that in open. Under shaded condition, the photosynthetic rate of the different medicinal plant species might have been affected and perhaps, the microsymbionts have become a parasite of host photosynthate. The lesser mycorrhizal association under shaded conditions may be attributed to the poor rate of photosynthesis coupled with the drain of photosynthates by VAM fungus under those conditions (Sivaprasad *et al.*, 1987). Therefore, it is essential to identify the right combination of the plant species and vesicular arbuscular mycorrhizal fungus suited to open and shaded conditions to achieve the full potential of the symbiotic system.

5.6 Nutrient uptake

The data on the uptake of nutrients by the different leguminous medicinal plants under open and shaded conditions is given in Table 12. The differences in the nutrient uptake by the different plant species can be justified by the difference in the biomass production of these species.

The higher uptake of nutrients under open condition by *Abrus precatorius*, *Clitoria ternatea*, *Crotalaria verrucosa* and *Atylosia scarabaeoides* may be due to their better vegetative growth and higher dry matter production under these conditions.

Cassia mimosoides showed better vegetative growth in coconut gardens. Therefore, the biomass production and nutrient uptake by this species was significantly superior to that under open condition . There are similar reports of increased nitrogen uptake under shaded conditions by Skerman (1977).

There was no significant difference in the uptake of nutrients by *Mucuna prurita*, *Desmodium gangeticum*, *Desmodium triangulare*, *Pseudarthria viscida* and *Indigofera tinctoria* under open and shaded conditions. This may be due to the absence of any significant difference in the dry matter production by these species under both conditions. This reveals the feasibility of raising these plant species as intercrops in coconut gardens.

5.7 Nutrient (nitrogen) fixation

Clitoria ternatea seems to be more effective in enriching the soil nitrogen content than the other leguminous species studied (Table 14). The quality is also exhibited by *Mucuna prurita*, *Indigofera tinctoria* and *Crotalaria verrucosa*. However, the other species under study could not enhance the soil nitrogen content appreciably.

Clitoria ternatea increased the soil nitrogen content by 70 kg per hectare. This may be due to its high inherent nodulating ability producing maximum number of nodules (Table 11). Majority of these nodules would have returned in the organic form to the soil medium (Mirchandani and Misra, 1957). Both these processes would account for the superiority of *Clitoria ternatea* in enriching the soil nitrogen.

Mucuna prurita, *Indigofera tinctoria* and *Crotalaria verrucosa* appear to be on par with *Clitoria ternatea* though the number of nodules produced was less (Table 11). It could be reasonably presumed that in these plant species all the nodules produced were effective in enriching soil nitrogen.

In case of other species, the contribution of soil nitrogen either through the recognised phenomenon of nodule sloughing or excretion of fixed nitrogen, do not appear to be effective. However, they have not depleted the soil nitrogen in spite of their standing in the field during the growth phase studied (Table 14). In

fact, they have exhibited a tendency to contribute slightly towards the increase in soil nitrogen content. This proves that legumes are "nitrogen savers" and exert minimum draught on the soil nitrogen (Buckman and Brady, 1960).

From the trend of the data on nitrogen status of the soil before and after the growth of the legume, it may be concluded that growing a legume and its subsequent removal would necessarily contribute towards enrichment of soil nitrogen reserve. Also, there was no depletion in soil nitrogen when leguminous medicinal plants were grown (Table 14). It is obvious that legumes are to be preferred to non legumes for sustained maintenance of soil nitrogen. Hence their merited place in any proper cropping pattern or intercropping system.

5.8 Feasibility of vegetative propagation

The present study revealed that of the eleven different species investigated, vegetative propagation by stem cutting was possible only in *Clitoria ternatea* and *Crotalaria verrucosa*. In all other species, seeds serve as the main mode of propagation. This result confirms with the findings of Philip *et al.* (1991). *In vitro* propagation technique, if standardised, will be helpful for the rapid multiplication and production of uniform quality planting materials for commercial cultivation of these crops.

5.9 Prospects and future lines of work

The increasing awareness among the public for use of the drugs of plant origin has necessitated the large scale cultivation of medicinal plants, both as pure crop and as intercrop in major plantations like coconut and rubber. Leguminous medicinal plants, have the dual potential of enriching the soil fertility by nitrogen fixation and at the same time , contribute a share to the farmers' income by selling the medicinally important plant parts. The scientific cultivation of medicinal plants would, thus, pave the way to better economy of crude drug production, both quantitatively and qualitatively.

One of the major problems in the cultivation of medicinal plants is the non availability of good quality planting materials. Future lines of work should aim at the standardisation of *in vitro* techniques for large scale multiplication and production of good quality planting materials for commercial cultivation. Standardisation of suitable agronomic practices for major medicinal plants, as pure crop and under different shade and crop combination situations is also necessary. Attempts are also to be made for the release of suitable varieties under open and shaded conditions, for which exhaustive germplasm collection and breeding programmes are to be initiated.

Chapter 6

SUMMARY

6. SUMMARY

A study on 'Collection, description and performance evaluation of herbaceous medicinal leguminous plants of Kerala' was carried out at the Department of Horticulture, College of Agriculture, Vellayani from June 1995 to January 1996. The experiments were conducted in three phases. The results of the various experiments are summarised in this chapter, phase wise.

Phase I

Seeds of sixteen different species of herbaceous leguminous medicinal plants were collected from authentic sources. The viability and rate of germination of the seeds were estimated. Seeds of *Mucuna prurita* recorded the highest rate of germination (98 per cent).

Phase II

Twelve different species with high rate of seed germination were raised and grown till flowering and podset. Detailed computerised descriptive blank, supplemented with line drawings and authentic herbarium, were prepared for each species.

Phase III

Cultural trials were carried out using eleven selected species of herbaceous medicinal leguminous plants as pure crop in open and as intercrop under shade in a twenty five year old coconut garden. Growth and yield parameters of each species were studied and recorded under both the conditions of light. The salient findings of the study are given below.

Plant height was significantly superior under shaded condition in *Pseudarthria viscida* (110 cm) and *Crotalaria verrucosa* (69 cm) than under open condition. It was comparable under both conditions in *Mucuna prurita*, *Desmodium triangulare* and *Indigofera tinctoria*.

Stem girth was significantly superior under shaded condition in *Indigofera tinctoria* (98 mm).

Cassia mimosoides produced more number of branches (42) and leaves (442) in shade than under open condition. However, no significant difference was noticed under both conditions in *Mucuna prurita*, *Pseudarthria viscida* and *Indigofera tinctoria*.

Root length and number of lateral roots were more under open condition in *Clitoria ternatea* and *Atylosia scarabaeoides*. For all other species, these were

comparable under both conditions. The girth of tap root was more under open condition in *Crotalaria verrucosa* (4.93 cm) and A*tylosia scarabaeoides* (2.6 cm) when compared to that under shade.

Shoot yield and pod yield were significantly superior under open condition in *Abrus precatorius*, *Clitoria ternatea* and *Atylosia scarabaeoides*. However, in *Mucuna prurita* and *Cassia mimosoides* higher yield was obtained when they were grown under shade. Shoot and pod yields were comparable in other species under both conditions of light.

The yield of roots was significantly greater under open condition than under shade in *Clitoria ternatea*, *Desmodium triangulare*, *Crotalaria verrucosa* and *Atylosia scarabaeoides*. For all other species, the root yield was on par under both conditions of light.

There was no significant difference in the content of the chemically active principle in the medicinally important part of the different plant species grown under both conditions of light.

The biomass yield was significantly superior under shaded condition in *Mucuna prurita* (18765.5 kg/ha) and *Cassia mimosoides* (1884.3 kg/ha) than under open condition. But in *Abrus precatorius*, *Clitoria ternatea*, *Crotalaria verrucosa* and *Atylosia scarabaeoides*, higher yield was obtained when they were grown under open condition. No significant difference was noticed for other species under both conditions of light.

The number and fresh weight of root nodules were significantly higher under open condition than under shade in all plant species except in *Abrus precatorius* and *Mucuna prurita*. No nodules could be detected in *Cassia mimosoides* under both conditions of light.

The percentage of mycorrhizal association under shaded condition was less in all the plant species studied compared to that under open condition.

The uptake of nutrients was greater under open condition in *Abrus precatorius*, *Clitoria ternatea*, *Atylosia scarabaeoides* and *Crotalaria verrucosa* than under shade. Shaded condition favoured increased phosphorous uptake in *Pseudarthria viscida* and *Cassia mimosoides*. There was no significant difference in nutrient uptake in other species under both conditions of light.

Clitoria ternatea was found to be most effective in enriching soil by nitrogen fixation. The capacity in comparable in *Mucuna prurita*, *Crotalaria verrucosa* and *Indigofera tinctoria*.

Of the eleven different species studied, vegetative propagation by rooting of stem cuttings was feasible only in *Clitoria ternatea* and *Crotalaria verrucosa*.

It may be concluded that of the eleven different species of herbaceous leguminous medicinal plants studied, *Abrus precatorius*, *Clitoria ternatea*, *Atylosia scarabaeoides*, *Crotalaria verrucosa* and *Desmodium triangulare* showed better

performance when raised as pure crop in open condition. However, the content of active chemical principle in the medicinally important plant part of these species showed no significant difference under both conditions. Growth and yield were significantly superior under shaded condition or were comparable under both conditions in *Mucuna prurita*, *Indigofera tinctoria*, *Cassia mimosoides*, *Desmodium gangeticum* and *Pseudarthria viscida*. This indicates the feasibility of raising these plant species as intercrops in coconut garden.

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* Original not seen

APPENDICES

APPENDIX - I DESCRIPTORS

Abrus precatorius Linn.

Atylosia scarabaeoides (L.) Benth.

Clitoria ternatea Linn.

Crotalaria verrucosa Linn.

Cassia mimosoides Linn.

171178

Plate 2. Herbaceous medicinal leguminous plant species selected for cultural trial (Contd.)

Desmodium triangulare (Retz.) Merr.

Indigofera tinctoria Linn.

Mucuna prurita Hook.

Pseudarthira viscida (L.) Wight & Arn.

Desmodium gangeticum (L.) DC.

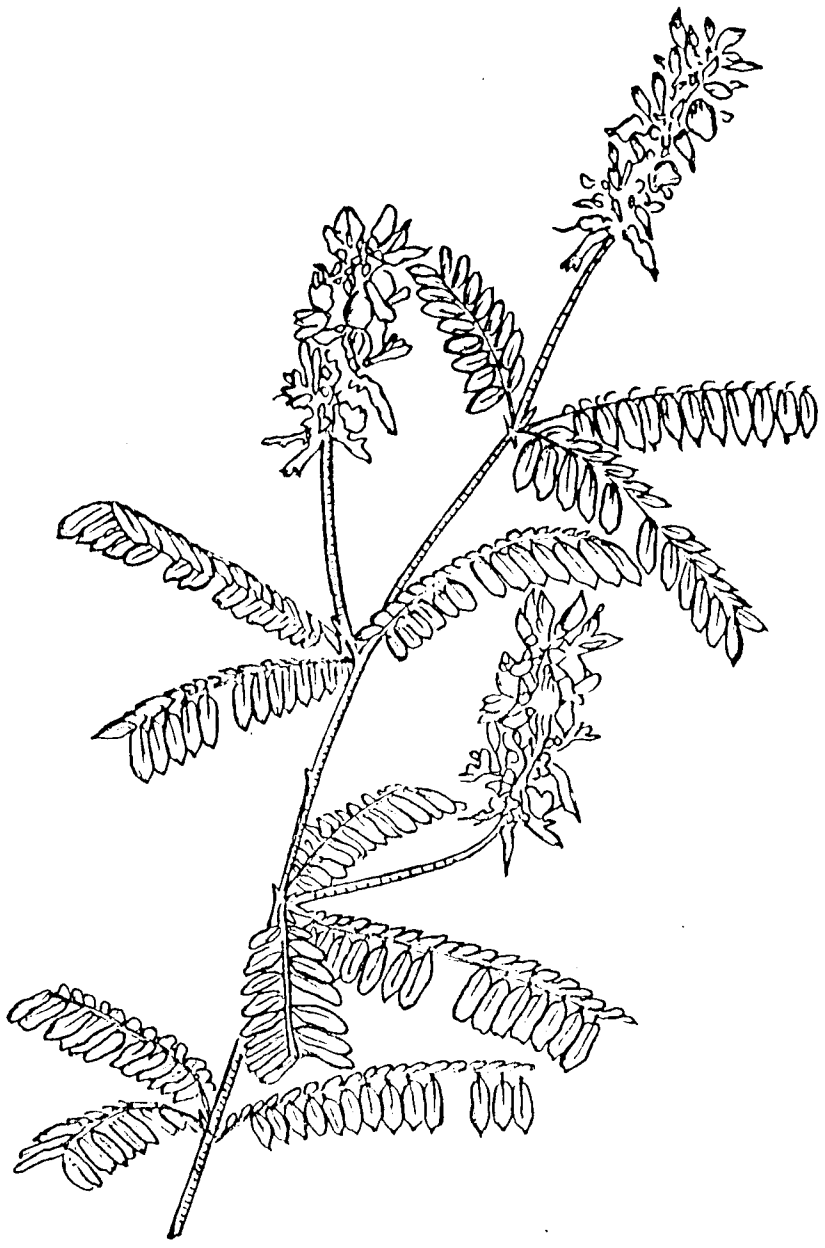
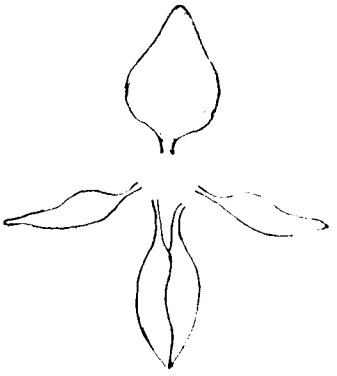


Fig. 8. *ABRUS PRECATORIUS Linn.* (red)

DESCRIPTORS

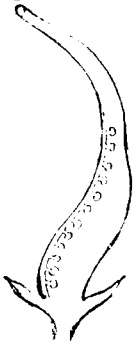
L.S.of flower (3x)

Corolla

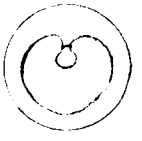


Androecium

Gynoecium

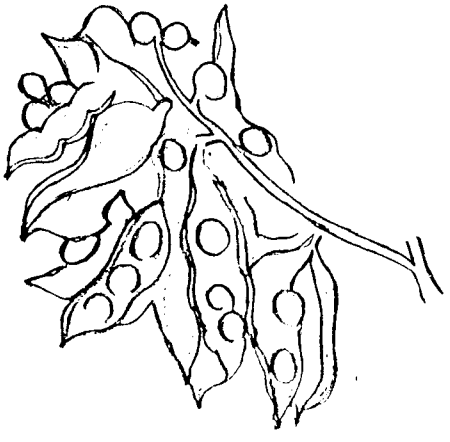


C.S.of ovary



Floral Formula - ♀ K(5), C 1+2+(2), A (9), G 1

Fruit



Seeds

PASSPORT

1. ACCESSION DATA

1.1	Acession number	:	MP-18
1.2	Donor name	:	Dr. S. Rajeshekharan, Prof.& Head, Dept. of Ethnobotany, TBGRI, Palode.
1.3	Scientific name	:	*Abrus precatorius* Linn
1.4	Acquisition date	:	24th May 1995

2. COLLECTION DATA

2.1	Collecting institute	:	Tropical Botanical Garden and Research Institute, Palode
2.2	Country of collection	:	India
2.3	State	:	Kerala
2.4	Collection source	:	Institute
2.5	Local/vernacular name	:	Chuvanna Kunni
2.6.	No: of plants/seeds sampled	:	300 seeds
2.7	Photograph Was a photograph taken of the accession or environment at collection?:		No
2.8	Herbarium sample taken	:	No
2.9	Growth habit	:	semi erect
2.10	If under cultivation	:	1. Monoculture ✓ 2. Mixed with other crops
2.11	Topography	:	plain level
2.12	Health condition of material	:	healthy

3. PLANT DATA

3.1 General characters

3.1.1	Growth pattern (Plant type)	:	decidious, indeterminate, dextrose climber with slender, flexible and tough branches.
3.1.2	Sowing date	:	22nd June 1995
3.1.3	Emerging cotyledon colour	:	green
3.1.4	Hypocotyl colour	:	white
3.1.5	Plant pigmentation	:	stem and leaves pale green
3.1.6	Ramification index	:	long internodes on main stems, with numerous lateral branches.
3.1.7	Branch orientation	:	many lateral branches, long and twining over the support.
3.1.8	Plant hairiness (hairs on stem, leaves, pods etc.)	:	lightly pubescent, leaves glabrous above and thinly adpressed silky beneath when mature
3.1.9	Growth habit	:	semi erect
3.1.10	No: of primary branches	:	25 - 27
3.1.11	Plant height	:	3.51 m
3.1.12	Main stem girth	:	3 cm
3.1.13	Plant canopy height (canopy height at the end of flowering)	:	3.5 m

3.2 Leaf characters

3.2.1	No: of leaves	:	395 leaves (at harvest)
3.2.2	No: of leaflets/leaf	:	34-36
3.2.3	Leaflet length	:	7.5 - 23 mm
3.2.4	Leaflet width	:	3.8 - 6 mm

3.2.5	Leaf area	:	29.85 cm2
3.2.6	Vein colour of fully developed primary leaves	:	green
3.2.7	Leaf anthocyanin	:	absent
3.2.8	Leaf colour	:	pale green
3.2.9	Intensity of leaf green colour	:	pale green
3.2.10	Leaf hairiness	:	glabrous above, thinly adpressed silky beneath when mature
3.2.11	Leaf shape	:	long paripinnate, 5 - 10 cm long
3.2.12	Leaf persistence	:	all leaves persistent

3.3. Inflorescence characters

3.3.1	No: of nodes on main stem from base to first inflorescence	:	11-15 nodes
3.3.2	Colour of flower standard	:	pink
3.3.3	Colour of wings	:	pink
3.3.4	Colour of keel	:	pink
3.3.5	Flower bud size	:	medium
3.3.6	Flower buds per inflorescence	:	78 - 86
3.3.7	Length of inflorescence	:	6 - 9 cm
3.3.8	Length of pedicel	:	1.5 - 3 cm
3.3.9	Flower colour	:	pink
3.3.10	Node no: at harvest on main stem	:	170 - 182 nodes

3.4 Pod characters

3.4.1	Pod colour	:	brown
3.4.2	Pod length	:	2.5 - 4.3 cm
3.4.3	Pod curvature	:	slightly curved
3.4.4	No: of pods/plant	:	300
3.4.5	No: of locules/pod	:	5
3.4.6	Pod width	:	1 - 1.25 cm

3.4.7	Pod beak length	:	5 - 6 mm
3.4.8	Pod beak position	:	marginal
3.4.9	Pod beak orientation	:	upward
3.4.10	Pod pubescence	:	slighly pubescent
3.4.11	Pod dehiscence	:	non shattering
3.4.12	Orientation of pod bearing racemes	:	upright
3.4.13	Position of pod bearing racemes	:	concentrated in middle

3.5 Seed characters

3.5.1	Colour of seed	:	Orangish red seed with black circular end or scarlet red with a black spot at hilum
3.5.2	No: of seeds/pod	:	3 - 6
3.5.3.	Seed shape	:	ovoid
3.5.4	Seed length	:	7.5 mm
3.5.5	Seed width	:	1 cm
3.5.6	Seed weight	:	11.5-13.5 g/100 seeds
3.5.7	Apparent seed veining	:	absent
3.5.8	Seed volume	:	12 ml/100 seeds

3.6. Root characters

3.6.1	Root length	:	32 - 35 cm
3.6.2	Tap root girth	:	3.1 cm
3.6.3	No: of lateral roots (primary)	:	9-10
3.6.4	Root fresh weight	:	30 g
3.6.5	Root dry weight	:	16 g

3.7	Days to maturity	:	151 days
3.8	Days to flowering	:	75 days
3.9	Duration of flowering	:	56 days
3.10	Days to first mature pods	:	122 days

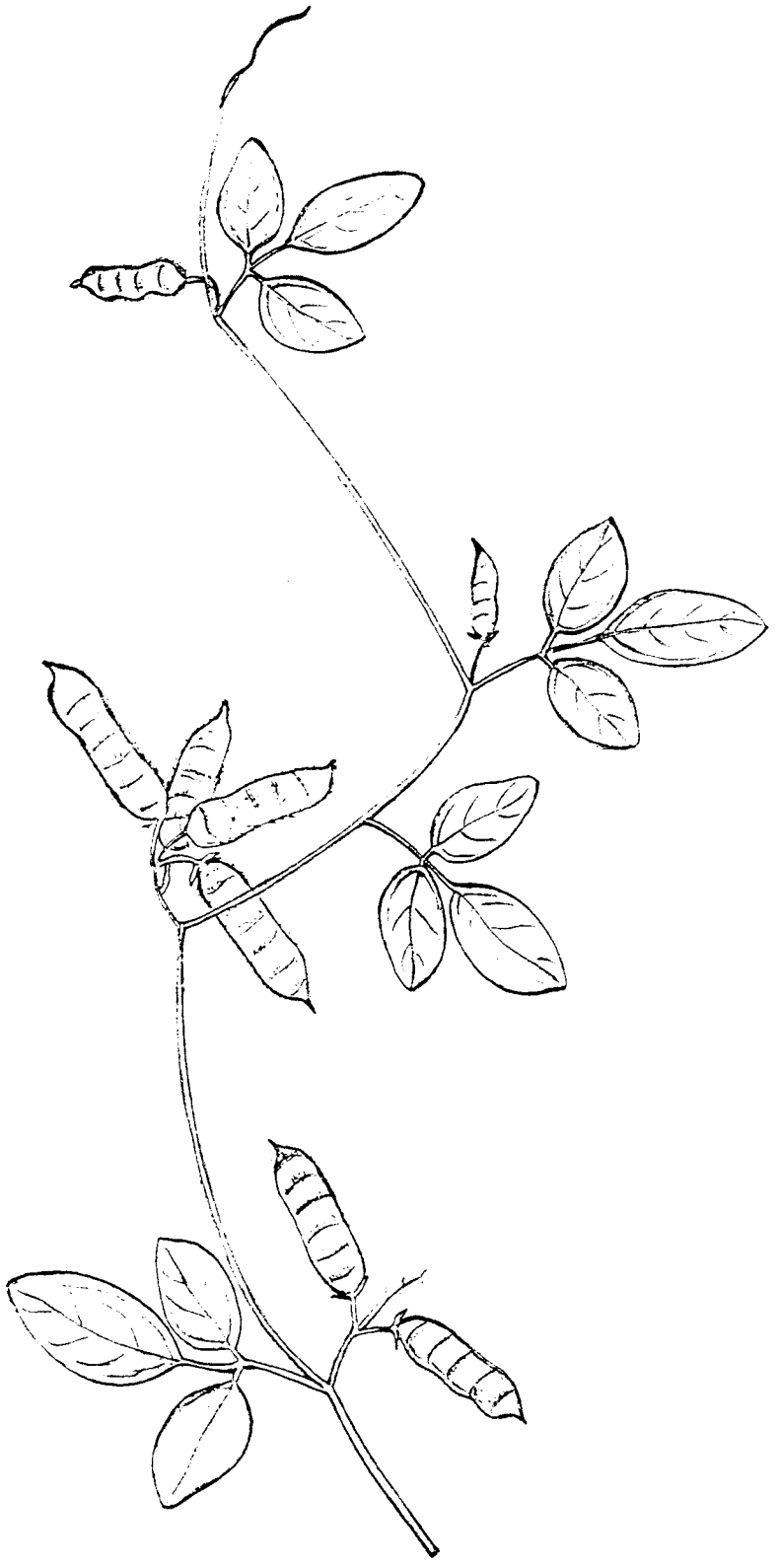
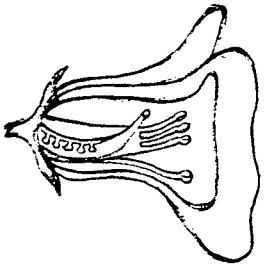


Fig. 10.

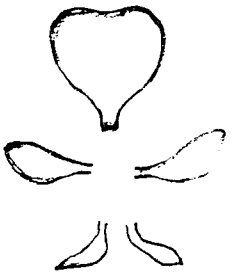
ATYLOSIA SCARABAEOIDES (L.) Benth.

DESCRIPTORS

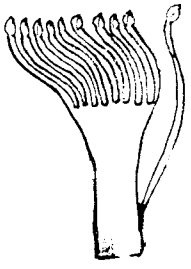
L.S.of flower (3x)



Corolla

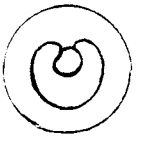


Androecium



Gynoecium

C.S.of ovary



Floral Formula - ♀ K(5), C 1+2+2, A(9)+1, <u>G 1</u>

Fruit

Seeds

PASSPORT

1. ACCESSION DATA

1.1	Acession number	:	MP-19
1.2	Donor Name	:	Dr. S. Rajashekharan, Prof.& Head,Dept. of Ethnobotany, TBGRI, Palode.
1.3	Scientific name	:	*Atylosia scarabaeoides* (L.) Benth
1.4	Acquisition date	:	20th May 1995

2. COLLECTION DATA

2.1	Collecting institute	:	Tropical Botanical Garden and . Research Institute, Palode Thiruvananthapuram
2.2	Country of collection	:	India
2.3	State	:	Kerala
2.4.	Collection source	:	Institute
2.5	Local/Vernacular name	:	Kattuzhunnu
2.6	No: of plants/seeds sampled	:	1000 seeds
2.7	Photograph Was a photograph taken of the accession or environment at collection ?	:	No
2.8	Herbarium sample taken	:	No
2.9	Growth habit	:	spreading
2.10	If under cultivation	:	1. Monoculture ✓ 2. Mixed with other crops
2.11	Topography	:	plain level
2.12	Health condition of material	:	healthy

3. PLANT DATA

3.1 General characters

3.1.1	Growth pattern (Plant type)	:	indeterminate with moderate climbing ability and pods distributed evenly up the plant
3.1.2	Sowing date	:	22nd June 1995
3.1.3	Emerging cotyledon colour	:	very pale green
3.1.4	Hypocotyl colour	:	white
3.1.5	Plant pigmentation	:	stem and leaves green
3.1.6	Ramification index	:	short internodes on main stem, numerous lateral branches
3.1.7	Branch orientation	:	first lateral branches long and spreading over ground
3.1.8	Plant hairiness (hairs on stem, leaves, pods etc)	:	stem, leaves and pods pubescent
3.1.9	Growth habit	:	spreading
3.1.10	No: of primary branches	:	35 - 46
3.1.11	Plant height	:	1.86 m
3.1.12	Main stem girth	:	4.5 - 4.8 cm
3.1.13	Plant canopy height (canopy height at the end of flowering)	:	1.8 cm

3.2 Leaf characters

3.2.1	No: of leaves	:	315 - 330
3.2.2	No: of leaflets/leaf	:	3
3.2.3	Leaflet length	:	terminal leaflet - 4 - 5.5 cm lateral leaflet - 1.8 - 2.5 cm
3.2.4	Leaflet width	:	terminal leaflet - 2.0 - 3 cm lateral leaflet - 1.5 cm

3.2.5	Leaf area	:	10.62 cm^2
3.2.6	Vein colour of fully developed primary leaves	:	green
3.2.7	Leaf anthocyanin	:	absent
3.2.8	Leaf colour	:	medium green
3.2.9	Intensity of leaf green colour	:	medium green
3.2.10	Leaf hairiness	:	leaves glabrous or pubescent
3.2.11	Leaf shape	:	leaves oblong or obovate
3.2.12	Leaf persistence	:	all leaves persistent

3.3 Inflorescence characters

3.3.1	No: of nodes on main stem from base to first inflorescence	:	18 - 22 nodes
3.3.2	Colour of flower standard	:	yellow
3.3.3	Colour of wings	:	yellow
3.3.4	Colour of keel	:	yellow
3.3.5	Flower bud size	:	small
3.3.6	Flower buds per inflorescence	:	2 - 6
3.3.7	Length of inflorescence	:	8.1mm
3.3.8	Length of pedicel	:	1 - 2 mm
3.3.9	Flower colour	:	yellow
3.3.10	Node no: at harvest on main stem	:	56 - 62

3.4 Pod characters

3.4.1	Pod colour	:	brown
3.4.2	Pod length	:	2 - 3.2 cm
3.4.3	Pod curvature	:	linear, straight or slightly curved, apiculate
3.4.4	No. of pods / plant	:	106
3.4.5	No: of locules/pod	:	5 - 6
3.4.6	Pod width	:	6 - 7 mm
3.4.7	Pod beak length	:	2 mm from end of last locule

3.4.8	Pod beak position	:	marginal
3.4.9	Pod beak orientation	:	straight
3.4.10	Pod pubescence	:	pubescent
3.4.11	Pod dehiscence	:	non shattering
3.4.12	Orientation of pod bearing racemes	:	prostrate
3.4.13	Position of pod bearing raceme	:	concentrated in middle

3.5 Seed characters

3.5.1	Colour of seed	:	brownish black
3.5.2	No: of seeds/pod	:	4 - 5
3.5.3	Seed shape	:	rounded
3.5.4	Seed length	:	3 mm
3.5.5	Seed width	:	4 mm
3.5.6	Seed weight	:	1.25 g/100 seeds
3.5.7	Apparent seed veining	:	absent
3.5.8	Seed volume	:	1.4 ml/100 seeds

3.6 Root characters

3.6.1	Root length	:	24 cm
3.6.2	Tap root girth	:	1.3 - 2.6 cm
3.6.3	No: of lateral roots (primary)	:	8 - 10
3.6.4	Root fresh weight	:	8 - 10 g
3.6.5	Root dry weight	:	1.4 - 3.2 g

3.7	Days to maturity	:	161 days
3.8	Days to flowering	:	127 days
3.9	Duration of flowering	:	53 days
3.10	Days to first mature pods	:	159 days

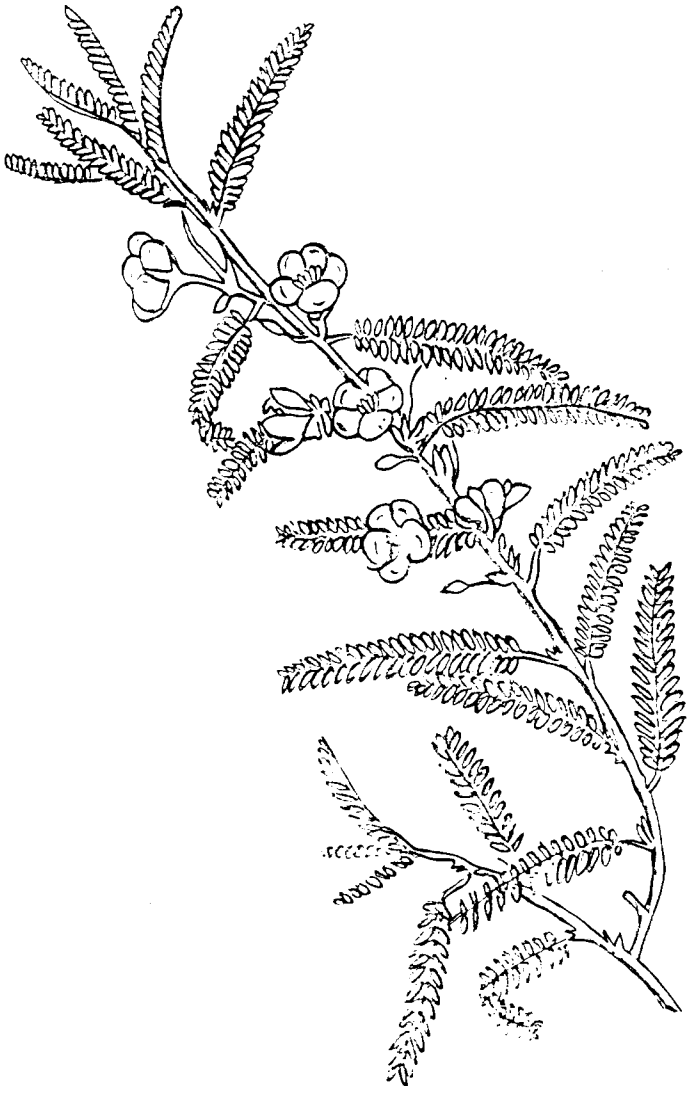
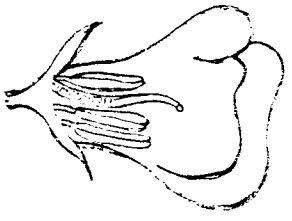


Fig. 11. ***CASSIA MIMOSOIDES Linn.***

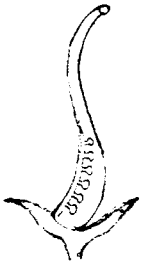
DESCRIPTORS

Flower

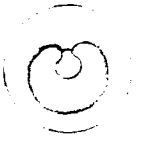
L.S.of flower (3x)



Gynoecium



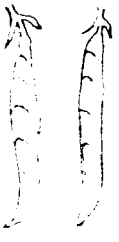
C.S.of ovary



Androecium

Floral Formula - ♂♀ K5, C5, A10, G 1

Fruit



Seeds

PASSPORT

1. ACCESSION DATA

1.1	Accession number	:	MP 2
1.2	Donor name	:	Prof. Lakshmi Bahuleyan Dept.of Pharmacognosy, Ayurvedic Research Institute, Poojapura, Thiruvananthapuram.
1.3	Scientific name	:	*Cassia mimosoides* Linn
1.4	Acquisition date	:	6th March 1995

2. COLLECTION DATA

2.1	Collecting institute	:	Ayurvedic Research Institute, Poojappura, Thiruvananthapuram
2.2	Country of collection	:	India
2.3	State	:	Kerala
2.4	Collection source	:	Institute
2.5	Local/Vernacular name	:	Cheruthakara/Parachunda
2.6	No: of plants/seeds sampled	:	750 - 1000 seeds
2.7	Photograph Was a photograph taken ofthe accession or environment at collection?	:	No
2.8	Herbarium sample taken	:	No
2.9	Growth habit	:	prostrate
2.10	If under cultivation	:	1. Monoculture ✓ 2. Mixed with charactersother crops
2.11	Topography	:	plain level
2.12	Health condition of material	:	healthy

3. PLANT DATA

3.1 General characters

3.1.1	Growth pattern (Plant type)	:	diffuse perennial, usually erect, sometimes spreading
3.1.2	Sowing date	:	22nd June 1995
3.1.3	Emerging cotyledon colour	:	very pale green
3.1.4	Hypocotyl colour	:	white
3.1.5	Plant pigmentation	:	stem and leaves green
3.1.6	Ramification index	:	short internodes on main stem, with numerous lateral branches
3.1.7	Branch orientation	:	first lateral branches long and spreading over ground
3.1.8	Plant hairiness (hairs on stem, leaves, pods etc.)	:	stem and branches terete, more or less hairy
3.1.9	Growth habit	:	prostrate
3.1.10	No: of primary branches	:	41
3.1.11	Plant height	:	115 - 120 cm
3.1.12	Main stem girth	:	5 mm
3.1.13	Plant canopy height (canopy height at the end of flowering)	:	128 cm

3.2 Leaf characters

3.2.1	No: of leaves	:	440-450 leaves
3.2.2	No: of leaflets/leaf	:	24
3.2.3	Leaflet length	:	4 - 6 mm
3.2.5	Leaf area	:	2.83 cm^2
3.2.6	Vein colour of fully developed primary leaves	:	green

3.2.7	Leaf anthocyanin	:	slightly present
3.2.8	Leaf colour	:	medium green
3.2.9	Intensity of leaf green colour	:	medium green
3.2.10	Leaf hairiness	:	leaves glabrous or pubescent with a flat sessile gland on the very short petiole
3.2.11	Leaf shape	:	oblong or obovate, 3.8 - 6 cm long
3.2.12	Leaf persistence	:	all leaves persistent

3.3 Infloresecence characters

3.3.1	No: of nodes on main stem from base to first inflorescence	:	9 - 15
3.3.2	Colour of flower standard	:	yellow
3.3.3	Colour of wings	:	yellow
3.3.4	Colour of keel	:	yellow
3.3.5	Flower bud size	:	small
3.3.6	Flower buds per inflorescence	:	solitary or 2 - 3 together
3.3.7	Length of inflorescence	:	1.5 - 2.5 cm
3.3.8	Length of pedicel	:	1.3 - 2.5 cm (unequal pedicels)
3.3.9	Flower colour	:	yellow
3.3.10	Node no: at harvest on main stem	:	38 - 46

3.4 Pod characters

3.4.1	Pod colour	:	brown
3.4.2	Pod length	:	2.5 - 3.8 cm
3.4.3	Pod curvature	:	straight
3.4.4	No: of pods/plant	:	146
3.4.5	No: of locules/pod	:	11 - 13
3.4.6	Pod width	:	0.4 cm
3.4.7	Pod beak length	:	1 - 2 cm
3.4.8	Pod beak position	:	marginal

3.4.9	Pod beak orientation	:	straight
3.4.10	Pod pubescence	:	glabrous
3.4.11	Pod dehiscence	:	nonshattering
3.4.12	Orientation of pod bearing racemes	:	upright
3.4.13	Position of pod bearing racemes	:	even distribution throughout

3.5	Seed characters		
3.5.1	Colour of seed	:	brown, shiny
3.5.2	No: of seeds/pod	:	15 - 25
3.5.3	Seed shape	:	obliquely ovoid, compressed
3.5.4	Seed length	:	3 mm
3.5.5	Seed width	:	4 mm
3.5.6	Seed weight	:	1.25 g / 100 seeds
3.5.7	Apparent seed veining	:	absent
3.5.8	Seed volume	:	1.4 ml / 100 seeds

3.6	Root characters		
3.6.1	Root length	:	21 - 24 cm
3.6.2	Tap root girth	:	2.7 - 2.8 mm
3.6.3	No: of lateral roots (primary)	:	6 - 10
3.6.4	Root fresh weight	:	21 - 26 g
3.6.5	Root dry weight	:	5 - 7 g

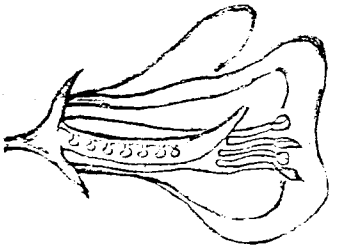
3.7	Days to maturity	:	145 days
3.8	Days to flowering	:	112 days
3.9	Duration of flowering	:	56 days
3.10	Days to first mature pods	:	130 days

Fig. 13.

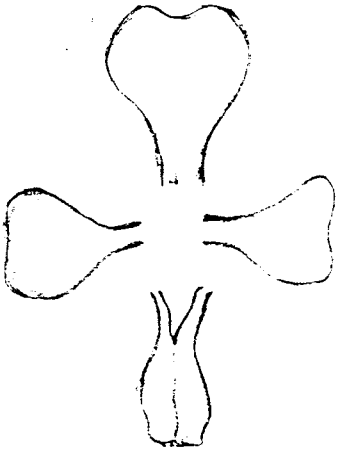
CROTALARIA VERRUCOSA Linn.

DESCRIPTORS

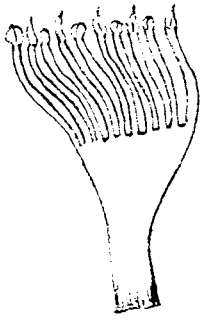
L.S.of flower (3x)



Corolla



Androecium

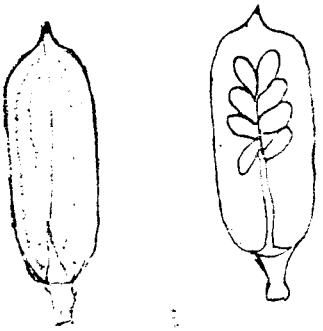


Gynoecium

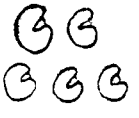
C.S.of ovary

Floral Formula - ♂♀ K (5), C 1+2+(2), A(10), G 1

Fruit



Seeds



PASSPORT

1. ACCESSION DATA

1.1	Accession Number	:	MP 5
1.2	Donor Name	:	Prof: Lakshmi Bahuleyan Dept.of Pharmacognosy, Ayurvedic Research Institute, Poojappura Thiruvananthapuram
1.3	Sceintific name	:	*Crotalaria verrucosa* Linn
1.4	Acquisition date	:	6th March 1995

2. COLLECTION DATA

2.1	Collection institute	:	Ayurvedic Research Institute, Poojappura, Thiruvananthapuram
2.2	Country of collection	:	India
2.3	State	:	Kerala
2.4	Collection source	:	Insititute
2.5	Local/Vernacular name	:	Kilukiluppa
2.6	No: of plants/seeds sampled	:	500-600 seeds
2.7	Photography Was a photograph taken of the accession or environement at collection?	:	No
2.8	Herbarium sample taken	:	No
2.9	Growth habit	:	erect
2.10	If under cultivation	:	1. Monoculture ✓ 2. Mixed with other crops
2.11	Topography	:	plain level
2.12	Health condition of material	:	healthy

3. PLANT DATA

3.1 General characters

3.1.1	Growth pattern (Plant type)	:	indeterminate bush with erect branches
3.1.2	Sowing date	:	22nd June 1995
3.1.3	Emerging cotyledon colour	:	green
3.1.4	Hypocotyl colour	:	green
3.1.5	Plant pigmentation	:	stem and leaves green
3.1.6	Ramification index	:	short internodes on main stem with numerous lateral branches.
3.1.7	Branch orientation	:	short & erect lateral branches
3.1.8	Plant hairiness (hairs on stem, leaves, pods etc)	:	at first pubescent, afterwards glabrescent
3.1.9	Growth habit	:	erect
3.1.10	No: of primary branches	:	8 - 13
3.1.11	Plant height	:	59 - 69 cm
3.1.12	Main stem girth	:	34 - 50 mm
3.1.13	Plant canopy height (canopy height at the end of flowering)	:	68 cm

3.2 Leaf characters

3.2.1	No: of leaves	:	205 - 210
3.2.2	No: of leaflets/leaf	:	1
3.2.3	Leaflet length	:	5 - 15 cm
3.2.4	Leaflet width	:	3 - 7.5 cm
3.2.5	Leaf area	:	31.87 cm^2
3.2.6	Vein colour of fully developed primary leaves	:	green
3.2.7	Leaf anthocyanin	:	absent

3.2.8	Leaf colour	:	dark green
3.2.9	Intensity of leaf green colour	:	dark green
3.2.10	Leaf hairiness	:	subglabrous above more or less downy and paler beneath.
3.2.11	Leaf shape	:	ovate-rhomboid or ovate deltoid, obtuse or occassionally acute at the apex, tapering to the base.
3.2.12	Leaf persistence	:	all leaves persistent

3.3 Inflorescence characters

3.3.1	No: of nodes on main stem from base to first inflorescence	:	11 - 15
3.3.2	Colour of flower standard	:	yellow
3.3.3	Colour of wings	:	yellow
3.3.4	Colour of keel	:	yellow
3.3.5	Flower bud size	:	medium
3.3.6	Flower buds per inflorescence	:	12 - 20
3.3.7	Length of inflorescence	:	15 - 20 cm
3.3.8	Length of pedicel	:	4.5 mm
3.3.9	Flower colour	:	yellow
3.3.10	Node no: at harvest on main stem	:	36 - 42

3.4 Pod characters

3.4.1	Pod colour	:	brown
3.4.2	Pod length	:	2.5 - 3.8 cm
3.4.3	Pod curvature	:	staight
3.4.4	No: of pods/plant	:	74 - 78
3.4.5	No: of locules/pod	:	3 - 4
3.4.6	Pod width	:	1 - 2 cm
3.4.7	Pod beak length	:	5 - 8 mm

3.4.8	Pod beak position	:	marginal
3.4.9	Pod beak orientation	:	downward
3.4.10	Pod pubescence	:	glabrous
3.4.11	Pod dehiscence	:	nonshattering
3.4.12	Orientation of pod bearing racemes	:	upward
3.4.13	Position of pod bearing racemes	:	concentrated on top

3.5 Seed characters

3.5.1	Colour of seed	:	brown
3.5.2	No: of seeds/pod	:	10-15
3.5.3	Seed shape	:	kidney shaped
3.5.4	Seed length	:	3 mm
3.5.5	Seed width	:	3 - 4 mm
3.5.6	Seed weight	:	1.92 g/ 100 seeds
3.5.7	Apparent seed veining	:	present
3.5.8	Seed volume	:	2 ml/100 seeds

3.6 Root characters

3.6.1	Root length	:	38 cm
3.6.2	Tap root girth	:	4.1 - 4.9 cm
3.6.3	No: of lateral roots (primary)	:	13 - 15
3.6.4	Root fresh weight	:	30 g
3.6.5	Root dry weight	:	16 - 18 g

3.7	Days to maturity	:	181 days
3.8	Days to flowering	:	142 days
3.9	Duration of flowering	:	43 days
3.10	Days to first mature pods	:	169 days

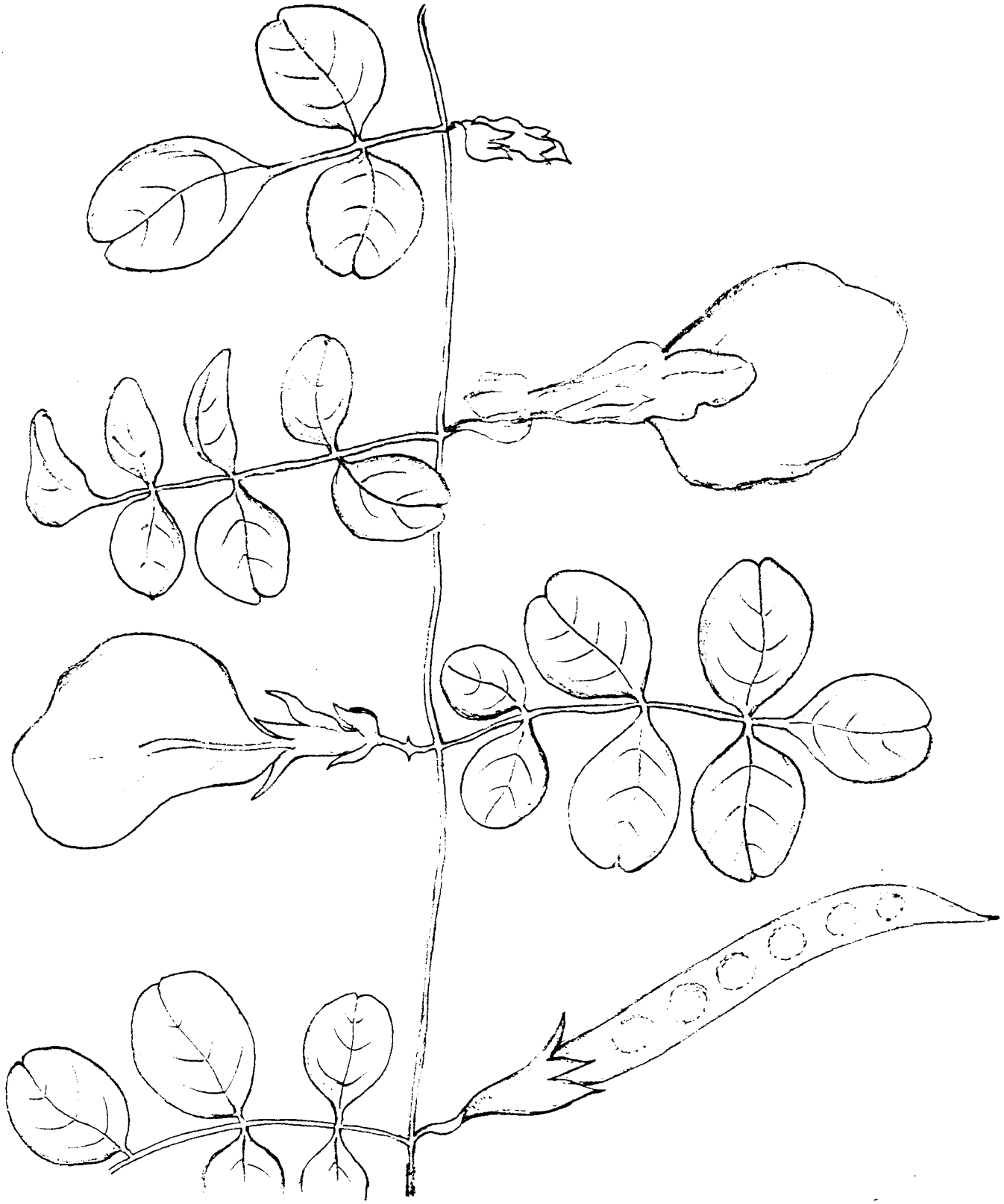
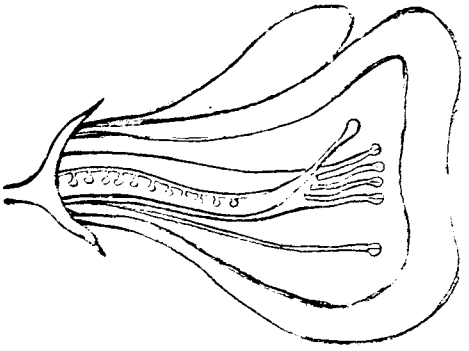


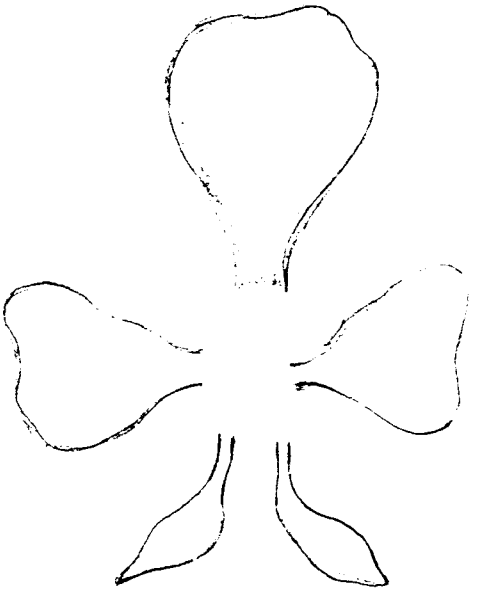
Fig. 12. ***CLITORIA TERNATEA Linn.***

DESCRIPTORS

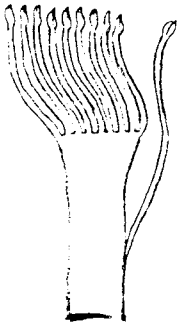
Corolla

L.S.of Flower (2x)



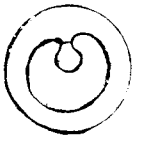


Androecium



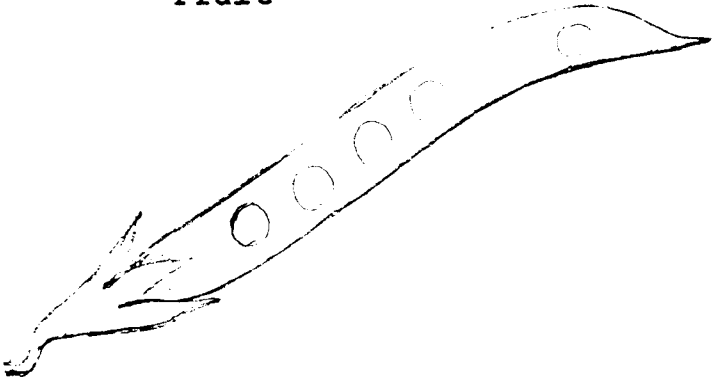
Gynoecium

C.S.of ovary



Floral Formula - ♀ K(5), C 1+2+2, A(9) + 1, <u>G 1</u>

Fruit



Seeds

PASSPORT

1. ACCESSION DATA

1.1	Accession number	:	MP-4
1.2	Donor name	:	Prof. Lakshmi Bahuleyan, Dept. of Pharmacognosy, Ayurvedic Research Institute, Poojappura, Thiruvananthapuram
1.3	Scientific name	:	*Clitoria ternatea* Linn
1.4	Acquisition date	:	6th March 1995

2. COLLECTION DATA

2.1	Collecting institute	:	Ayurvedic Research Institute, Poojappura Thiruvananthapuram
2.2	Country of collection	:	India
2.3	State	:	Kerala
2.4	Collection source	:	Institute
2.5	Local/Vernacular name	:	Sankupushpam or Sankupushpi
2.6	No: of plants/seeds sampled	:	500 seeds
2.7	Photograph Was a photograph taken of the accession or environment at collection?	:	No
2.8	Herbarium sample taken	:	No
2.9	Growth habit	:	semi spreading
2.10	If under cultivation	:	1. Monoculture ✓ 2. Mixed with Other crops
2.11	Topography	:	plain level
2.12.	Health condition of material	:	healthy

3. PLANT DATA

3.1 General Characters

3.1.1	Growth pattern (Plant type)	:	indeterminate with moderate climbing ability of main stem and branches and pods distributed evenly up the plant
3.1.2	Sowing date	:	22nd June 1995
3.1.3	Emerging cotyledon colour	:	very pale green
3.1.4	Hypocotyl colour	:	green
3.1.5	Plant pigmentation	:	stem and leaves green
3.1.6	Ramification index	:	short internodes on main stem with numerous lateral branches.
3.1.7	Branch orientation	:	many long lateral branches twining over the support
3.1.8	Plant hairiness (hairs on stem, leaves,pods etc)	:	plant more or less pubescent
3.1.9	Growth habit	:	semi spreading
3.1.10	No: of primary branches	:	52
3.1.11	Plant height	:	4.2 m
3.1.12	Main stem girth	:	7.7 cm
3.1.13	Plant canopy height (canopy height at the end of flowering)	:	4.2 m

3.2 Leaf characters

3.2.1	No: of leaves	:	582 (at harvest)
3.2.2	No: of leaflets/leaf	:	5 - 7
3.2.3	Leaflet length	:	2.5 - 5 cm
3.2.4	Leaflet width	:	2 - 3.2 cm
3.2.5	Leaf area	:	60.22 cm^2

3.2.6	Vein colour of fully developed primary leaves	:	pale green
3.2.7	Leaf anthocyanin	:	absent
3.2.8	Leaf colour	:	pale green
3.2.9	Intensity of leaf green colour	:	pale green
3.2.10	Leaf hairiness	:	more or less pubescent
3.2.11	Leaf shape	:	imparipinnate, petiroles 2 - 2.5 cm long, stipules 4 mm long, linear, acute
3.2.12	Leaf persistence	:	more than 50 % of the leaves are persistent.

3.3 Inflorescence characters

3.3.1	No: of nodes on main stem from base to first inflorescence	:	7 - 10 nodes
3.3.2	Colour of flower standard	:	blue
3.3.3	Colour of wings	:	blue
3.3.4	Colour of keel	:	blue
3.3.5	Flower bud size	:	large
3.3.6	Flower buds per inflorescence	:	1
3.3.7	Length of inflorescence	:	3.5 - 5 cm
3.3.8	Length of pedicel	:	8 - 13 mm
3.3.9	Flower colour	:	dark blue or violet on top& sides, middle & basal part has yellowish white tinge
3.3.10	Node no: at harvest on main stem	:	56 - 62 nodes

3.4 Pod characters

3.4.1	Pod colour	:	creamish brown
3.4.2	Pod length	:	5 - 10 cm
3.4.3	Pod curvature	:	flattened, nearly straight
3.4.4	No: of pods/plant	:	123

3.4.5	No: of locules/pod	:	11
3.4.6	Pod width	:	8 - 13 mm
3.4.7	Pod beak length	:	1 - 1.2 cm
3.4.8	Pod beak position	:	non marginal
3.4.9	Pod beak orientation	:	straight
3.4.10	Pod pubescence	:	glabrous
3.4.11	Pod dehiscence	:	nonshattering
3.4.12	Orientation of pod bearing racemes	:	prostrate
3.4.13	Position of pod bearing racemes	:	even distribution throughout

3.5 Seed characters

3.5.1	Colour of seed	:	greyish or brownish black or yellowish brown
3.5.2	No: of seeds/pod	:	6 - 10
3.5.3	Seed shape	:	trunchate / fastigate
3.5.4	Seed length	:	5.7 mm
3.5.5	Seed width	:	1-1.2 cm
3.5.6	Seed weight	:	5.5 - 6.5 g/100 seeds
3.5.7	Apparent seed veining	:	present
3.5.8	Seed volume	:	7 ml/100 seeds

3.6 Root characters

3.6.1	Root length	:	35.8 cm
3.6.2	Tap root girth	:	4.18 cm
3.6.3	No: of lateral roots (primary)	:	10 - 11
3.6.4	Root fresh weight	:	32.8 g
3.6.5	Root dry weight	:	15 g

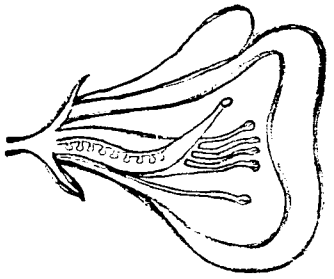
3.7	Days to maturity	:	143 days
3.8	Days to flowering	:	62 days
3.9	Duration of flowering	:	66 days
3.10.	Days to first mature pods	:	104 days

Fig. 14.

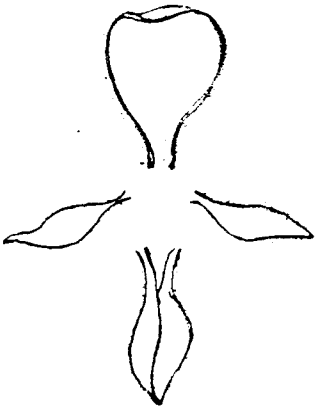
DESMODIUM GANGETICUM (L.)DC.

DESCRIPTORS

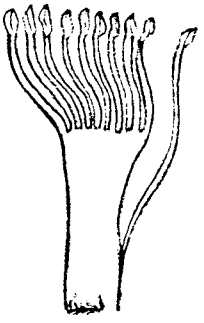
L.S.of flower (4x)



Corolla

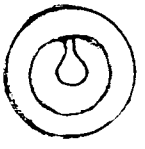


Androecium



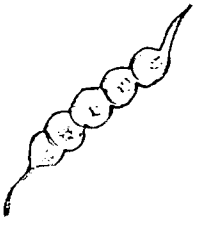
Gynoecium

C.S.of ovary



Floral Formula - ♂♀ K(5), C 1+2+(2), A(9) + 1, <u>G 1</u>

Fruit



Seeds

PASSPORT

1. ACCESSION DATA

1.1	Accession number	:	MP-22
1.2	Donor name	:	Dr. S.Rajashekharan Professor and Head, Dept. of Ethnobotany, TBGRI, Palode
1.3	Scientific name	:	*Desmodium gangeticum* (L.) DC.
1.4	Acquisition date	:	24th May 1995.

2. COLLECTION DATA

2.1	Collecting institute	:	Tropical Botanical Garden& Research Institute, Palode, Thiruvananthapuram
2.2	Country of collection	:	India
2.3.	State	:	Kerala
2.4	Collection source	:	Institute
2.5.	Local/Vernacular name	:	Orila
2.6	No: of plants/seeds sampled	:	500 seeds
2.7	Photograph Was a photograph taken of the accession or environment at collection?	:	No
2.8	Herbarium sample taken	:	No
2.9	Growth habit	:	semi erect
2.10	If under cultivation	:	1. Monoculture ✓ 2. Mixed with other crops
2.11	Topography	:	plain level
2.12	Health condition of material	:	healthy

3. PLANT DATA

3.1 General characters

3.1.1	Growth pattern (Plant type)	:	undershrub
3.1.2	Sowing date	:	22nd June 1995
3.1.3	Emerging cotyledon colour	:	white
3.1.4	Hypocotyl colour	:	white
3.1.5	Plant pigmentation	:	stem and leaves pale green
3.1.6	Ramification index	:	short internodes on main stem with few lateral branches
3.1.7	Branch orientation	:	short and erect lateral branches
3.1.8	Plant hairiness (hairs on stem, leaves, pods etc)	:	glabrescent clothed with appressed white hairs
3.1.9	Growth habit	:	semi erect
3.1.10	No: of primary branches	:	9 - 13
3.1.11	Plant height	:	1.4 m
3.1.12	Main stem girth	:	14 mm
3.1.13	Plant canopy/height (canopy height at the end of flowering)	:	1.4 m

3.2. Leaf characters

3.2.1	No: of leaves	:	205 - 214
3.2.2	No: of leaflets/leaf	:	1
3.2.3	Leaflet length	:	9 - 12.5 cm
3.2.4	Leaflet width	:	3.5 - 6.3 cm
3.2.5	Leaf area	:	45.62 cm^2
3.2.6	Vein colour of fully developed primary leaves	:	green
3.2.7	Leaf anthocyanin	:	absent

3.2.8	Leaf colour	:	medium green
3.2.9	Intensity of leaf green colour	:	medium green
3.2.10	Leaf hairiness	:	glabrous above and clothed with dense soft whitish appressed hairs beneath.
3.2.11	Leaf shape	:	leaves ovate-oblong, acute & slightly acuminate, margins waved
3.2.12	Leaf persistence	:	all leaves persistent

3.3 Inflorescence characters

3.3.1	No: of nodes on main stem from base to first inflorescence	:	4 - 6 nodes
3.3.2	Colour of flower standard	:	violet / white
3.3.3	Colour of wings	:	violet / white
3.3.4	Colour of keel	:	violet / white
3.3.5	Flower bud size	:	small
3.3.6	Flower buds per inflorescence	:	40 - 48
3.3.7	Length of inflorescence	:	15 - 30 cm
3.3.8	Length of pedicel	:	4 - 6 cm
3.3.9	Flower colour	:	violet /white
3.3.10	Node no: at harvest on main stem	:	21 - 25 nodes

3.4. Pod characters

3.4.1	Pod colour	:	brownish or greenish brown
3.4.2	Pod length	:	12 - 20 mm
3.4.3	Pod curvature	:	subfalcate, deeply indented on the lower edge & slightly indented in upper edge
3.4.4	No: of pods/plant	:	296
3.4.5	No: of locules/pod	:	4 - 8
3.4.6	Pod width	:	2 mm
3.4.7	Pod beak length	:	

3.4.8	Pod beak position	:	
3.4.9	Pod beak orientation	:	straight
3.4.10	Pod pubescence	:	glabrous
3.4.11	Pod dehiscence	:	shattering
3.4.12	Orientation of pod bearing racemes	:	upright
3.4.13	Position of pod bearing racemes	:	concentrated on top

3.5 Seed characters

3.5.1	Colour of seed	:	brownish to grey
3.5.2	No. of seeds/pod	:	6 - 8
3.5.3	Seed shape	:	rounded or globose
3.5.4	Seed length	:	1 mm
3.5.5	Seed width	:	0.5 - 2 mm
3.5.6	Seed weight	:	220 mg/100 seeds
3.5.7	Apparent seed veining	:	absent
3.5.8	Seed volume	:	1ml / 100 seeds

3.6 Root characters

3.6.1	Root length	:	29 cm
3.6.2	Tap root girth	:	4.1 cm
3.6.3	No: of lateral roots (primary)	:	9 - 11
3.6.4	Root Fresh weight	:	22 - 28 g
3.6.5	Root dry weight	:	12 - 14 g

3.7	Days to maturity	:	138 days
3.8	Days to flowering	:	99 days
3.9	Duration of flowering	:	56 days
3.10	Days to first mature pods	:	133 days

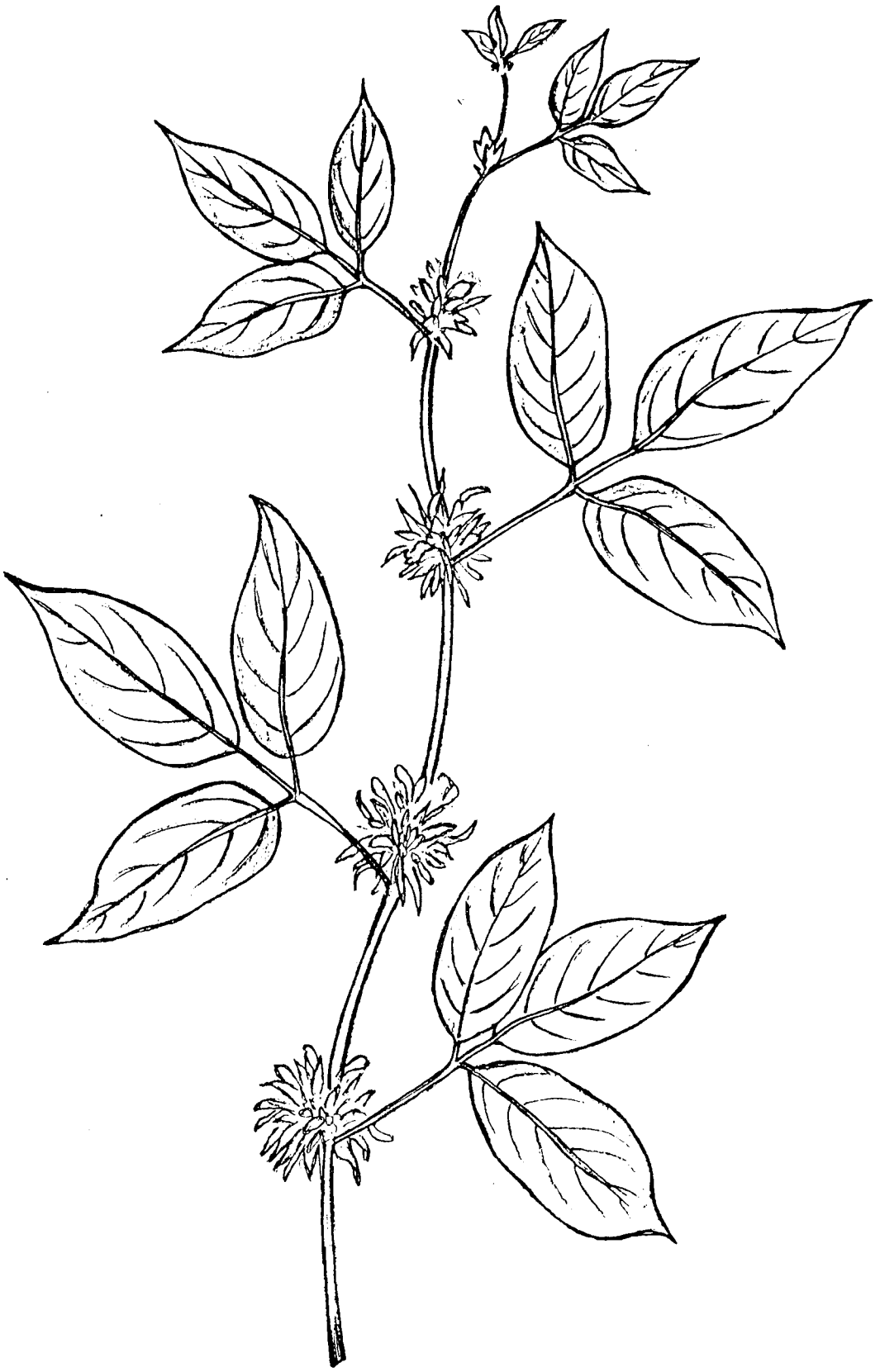
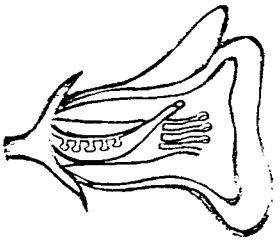


Fig. 15.

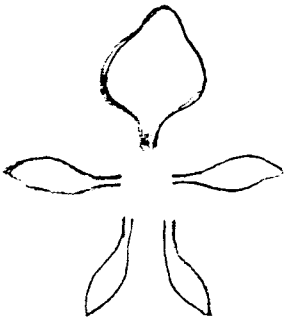
DESMODIUM TRIANGULARE (Retz.) Merr

DESCRIPTORS

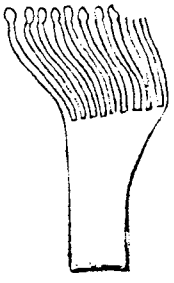
L.S.of flower (3x)



Corolla



Androecium



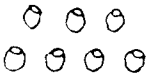
Gynoecium

C.S.of ovary

Floral Formula - ♀ K(5), C 1+2+2, A(8+2 staminodes), G 1

Fruit

Seeds



PASSPORT

1. ACCESSION DATA

1.1	Accession number	:	MP-24
1.2	Donor name	:	Dr. S. Rajeshekharan, Prof.& Head, Dept. of Ethnobotany, TBGRI, Palode.
1.3	Sceintific name	:	*Desmodium triangulare* (Retz.)Merr.
1.4	Acquisition date	:	24th May 1995

2 COLLECTION DATA

2.1	Collection institute	:	Tropical Botanical Garden and Research Institute, Palode, Thiruvananthapuram
2.2	Country of collection	:	India
2.3	State	:	Kerala
2.4	Collection source	:	Institute
2.5	Local/Vernacular name	:	---
2.6	No: of.plants/seeds smapled	:	500 - 750 seeds
2.7	Photograph Was a photograph taken of the accession or environment at collection?	:	No
2.8	Herbarium sample taken	:	No
2.9	Growth habit	:	semi erect
2.10	If under cultivation	:	1. Monoculture ✓ 2. Mixed with other crops
2.11	Topography	:	plain level
2.12	Health condition of material	:	healthy

2. PLANT DATA

3.1 General characters

3.1.1	Growth pattern (Plant type)	:	determinate bush with prostrate branches
3.1.2	Sowing date	:	22 June 1995
3.1.3	Emerging cotyledon colour	:	white
3.1.4	Hypocotyl colour	:	white
3.1.5	Plant pigmentation	:	stem and leaves pale green
3.1.6	Ramification index	:	short internodes on main stem with numerous lateral branches.
3.1.7	Branch orientation	:	short and prostrate lateral branches
3.1.8	Plant hairiness (hairs on stem, leaves, pods etc)	:	sparsely hirsute with white spreading hairs
3.1.9	Growth habit	:	semierect
3.1.10	No: of primary branches	:	11 - 13
3.1.11	Plant height	:	120 - 126 cm
3.1.12	Main stem girth	:	3.8 cm
3.1.13.	Plant canopy height (canopy height at the endof flowering)	:	1.25 m

3.2 Leaf characters

3.2.1	No: of leaves	:	310 - 316 leaves
3.2.2	No: of leaflets/leaf	:	3
3.2.3	Leaflet length	:	5 - 6 mm
3.2.4	Leaflet width	:	4 - 5 mm
3.2.5	Leaf area	:	53.56 cm^2
3.2.6	Vein colour of fully developed primary leaves	:	green
3.2.7	Leaf anthocyanin	:	absent
3.2.8	Leaf colour	:	medium green

3.2.9	Intensity of leaf green colour	:	medium green
3.2.10	Leaf hairiness	:	glabrous above, more or less hairy beneath
3.2.11	Leaf shape	:	leaflets membraneous, obovate, cuneate, trunchate or emarginate, rarely rounded
3.2.12	Leaf persistence	:	all leaves persistent

3.3 Inflorescence characters

3.3.1	No: of nodes of main stem from base to first inflorescence	:	8 - 9 nodes
3.3.2	Colour of flower standard	:	white
3.3.3	Colour of wings	:	white
3.3.4	Colour of keel	:	white
3.3.5	Flower bud size	:	small
3.3.6	Flower buds per inflorescence	:	1 - 5
3.3.7	Length of inflorescence	:	8 - 10 mm
3.3.8	Length of pedicel	:	6 mm
3.3.9	Flower colour	:	white, occasionally pink
3.3.10	Node no : at harvest on main stem	:	15 nodes

3.4 Pod characters

3.4.1	Pod colour	:	pale brown or greyish brown
3.4.2	Pod length	:	10 - 15 mm
3.4.3	Pod curvature	:	upper edge straight, lower indented
3.4.4	No: of pods/plants	:	30 - 35
3.4.5	No: of locules/pod	:	3 - 4
3.4.6	Pod width	:	3 - 4 mm
3.4.7	Pod beak length	:	1 mm
3.4.8	Pod beak position	:	marginal
3.4.9	Pod beak orientation	:	straight
3.4.10	Pod pubescence	:	pubescent

3.4.11	Pod dehiscence	:	non shattering
3.4.12	Orientation of pod bearing racemes	:	prostrate
3.4.13	Position of pod bearing racemes	:	even distribution throughout

3.5 Seed characters

3.5.1	Colour of seed	:	yellowish brown
3.5.2	No: of seeds/pod	:	3 - 5
3.5.3	Seed shape	:	oval
3.5.4	Seed length	:	2 mm
3.5.5	Seed width	:	3 - 4 mm
3.5.6	Seed weight	:	860 mg/100 seeds
3.5.7	Apparent seed veining	:	absent
3.5.8	Seed volume	:	1.5 ml/100 seeds

3.6 Root characters

3.6.1	Root length	:	29 cm
3.6.2	Tap root girth	:	5.2 cm
3.6.3	No. of lateral roots (primary)	:	7 - 8
3.6.4	Root fresh weright	:	31 - 49 g
3.6.5	Root dry weight	:	15 - 25 g

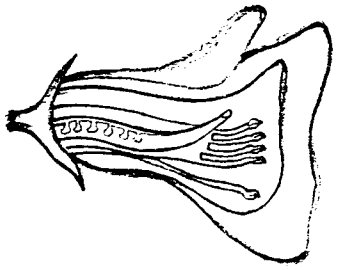
3.7	Days to maturity	:	168 days
3.8	Days to flowering	:	116 days
3.9	Duration of flowering	:	58 days
3.10	Days to first mature pods	:	142 days

Fig. 17.

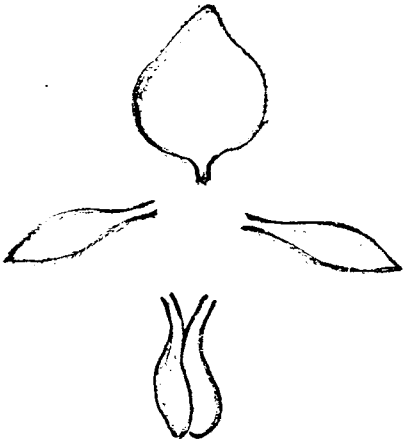
INDIGOFERA LINNAEI Ali

DESCRIPTORS

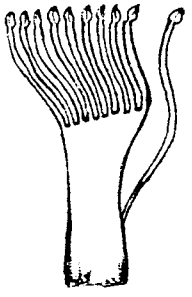
L.S.of flower (4x)



Corolla



Androecium



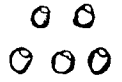
Gynoecium

C.S.of ovary

Floral Formula - ♀ K 5, C 1+2+(2), A(9)+1, G 1

Fruit

Seeds



PASSPORT

1. ACCESSION DATA

1.1	Accession number	:	MP-7
1.2	Donor name	:	Prof. Lekshmi Bahuleyan, Dept.of Pharmacognosy, Ayurvedic Research Institute, Poojappura, Thiruvananthapuram
1.3	Scientific name	:	*Indigofera linnaei* Ali
1.4	Acquisition date	:	6th March 1995

2. COLLECTION DATA

2.1	Collecting institute	:	Ayurvedic Research Institute, Poojappura, Thiruvananthapuram
2.2	Country of collection	:	India
2.3	State	:	Kerala
2.4	Collection source	:	Institute
2.5	Local/Vernacular name	:	Cherupullati
2.6	No: of plants/seeds sampled	:	200 seeds
2.7	Photograph Was a photograph taken of the accession or environment at collection?	:	No
2.8	Herbarium sample taken	:	No
2.9	Growth habit	:	trailing & prostrate
2.10	If under cultivation	:	1. Monoculture ✓ 2. Mixed with other crops
2.11	Topography	:	plain level
2.12	Health condition of material	:	healthy

3. PLANT DATA

3.1 General characters

3.1.1	Growth pattern (Plant type)	:	trailing, prostrate much branched annual or biennial
3.1.2	Sowing date	:	22nd June 1995
3.1.3	Emerging cotyledon colour	:	green
3.1.4	Hypocotyl colour	:	white
3.1.5	Plant pigmentation	:	stem and leaves green
3.1.6	Ramification index	:	short internodes on main stem, with numerous branches
3.1.7	Branch orientation	:	lateral branches long and spreading over ground
3.1.8	Plant hairiness (hairs on stem, leaves, pods etc)	:	sparsely cloth with white appressed hairs
3.1.9	Growth habit	:	prostrate & trailing
3.1.10	No: of primary branches	:	38
3.1.11	Plant height	:	121-125 cm
3.1.12	Main stem girth	:	5 mm
3.1.13	Plant canopy height (canopy height at the end of flowering	:	125 cm

3.2 Leaf characters

3.2.1	No: of leaves	:	480-500 leaves
3.2.2	No: of leaflets/leaf	:	7 - 9
3.2.3	Leaflet length	:	4 - 5 mm
3.2.4	Leaflet width	:	1.2 - 1.4 mm
3.2.5	Leaf area	:	3.2 cm^2
3.2.6	Vein colour of fully developed primary leaves	:	green

3.2.7	Leaf anthocyanin	:	absent
3.2.8	Leaf colour	:	dark green
3.2.9	Intensity of leaf green colour	:	dark green
3.2.10	Leaf hairiness	:	moderately pubescent
3.2.11	Leaf shape	:	ovate, long cuspidate
3.2.12	Leaf persistence	:	all leaves persistent

3.3 Inflorescence characters

3.3.1	No: of nodes on main stem from base to first inflorescence	:	9 - 12
3.3.2	Colour of flower standard	:	pink
3.3.3	Colour of wings	:	pink
3.3.4	Colour of keel	:	pink
3.3.5	Flower bud size	:	small
3.3.6	Flower buds per inflorescence	:	8 - 10
3.3.7	Length of inflorescence	:	1.2 cm
3.3.8	Length of pedicel	:	2.5 mm
3.3.9	Flower colour	:	pink
3.3.10	Node no: at harvest on main stem	:	35 - 40

3.4 Pod characters

3.4.1	Pod colour	:	brown
3.4.2	Pod length	:	3 - 4 mm
3.4.3	Pod curvature	:	straight
3.4.4	No: of pods/plant	:	165
3.4.5	No: of locules/pod	:	10 - 12
3.4.6	Pod width	:	0.2 cm
3.4.7	Pod beak length	:	1 mm
3.4.8	Pod beak position	:	marginal
3.4.9	Pod beak orientation	:	straight

3.4.10	Pod pubescence	:	pubescent
3.4.11	Pod dehiscence	:	non shattering
3.4.12	Orientation of pod bearing racemes	:	upright
3.4.13	Position of pod bearing racemes	:	even distribution throughout

3.5 Seed characters

3.5.1	Colour of seed	:	brown
3.5.2	No: of seeds/ pod	:	10 - 12
3.5.3	Seed shape	:	globose
3.5.4	Seed length	:	2 mm
3.5.5	Seed width	:	1 mm
3.5.6	Seed weight	:	1 g/100 seeds
3.5.7	Apparent seed veining	:	absent
3.5.8	Seed volume	:	1.2 ml / 100seeds

3.6 Root characters

3.6.1	Root length	:	30 m
3.6.2	Tap root girth	:	2.5 cm
3.6.3	No: of lateral roots (primary)	:	7 - 9
3.6.4	Root fresh weight	:	18 - 20 g
3.6.5	Root dry weight	:	5 - 7 g

3.7	Days to maturity	:	160 days
3.8	Days to flowering	:	120 days
3.9	Duration of flowering	:	60 days
3.10	Days to first mature pods	:	142 days.

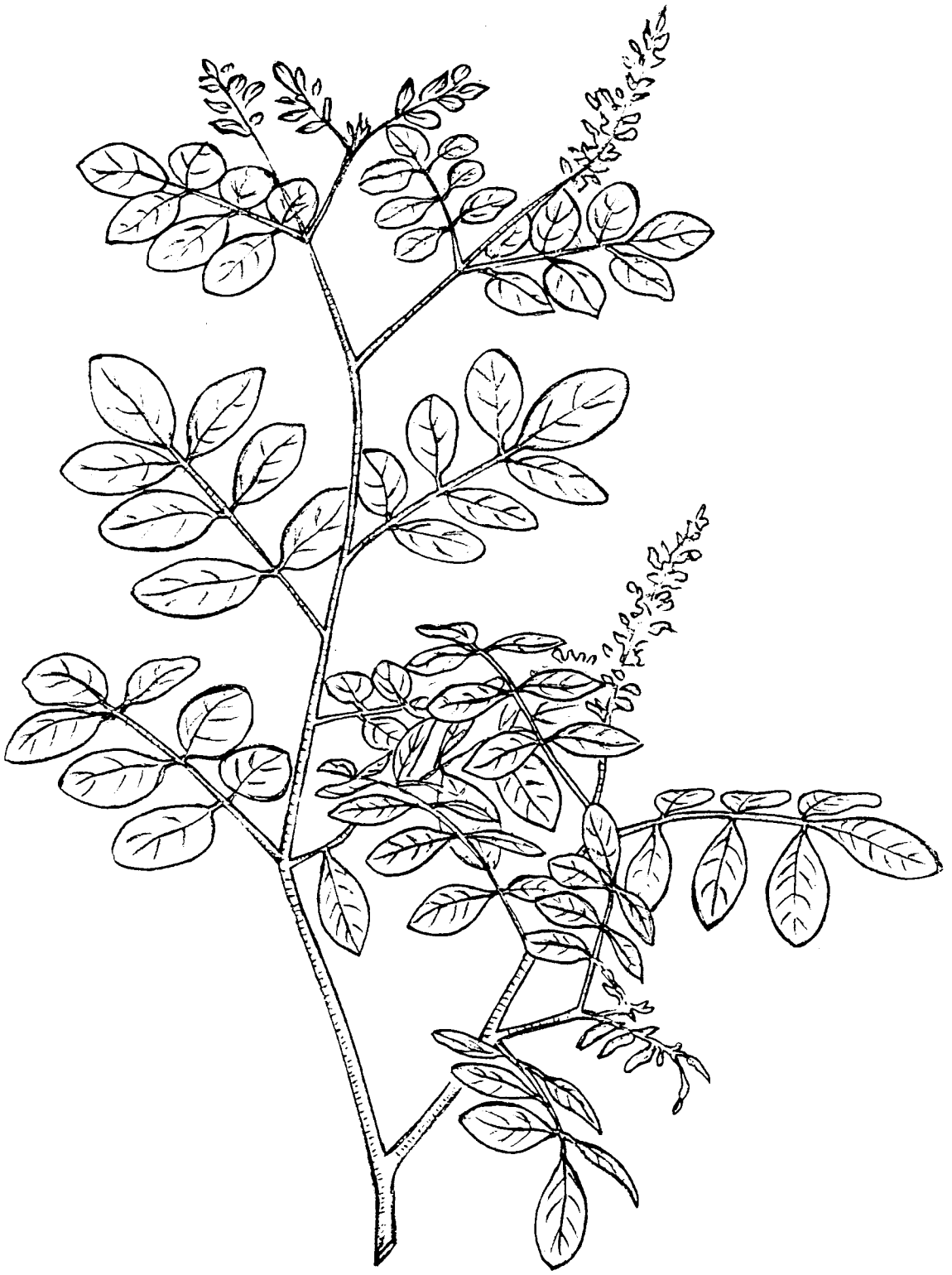
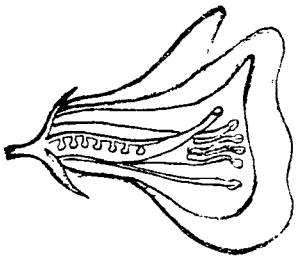


Fig. 16.

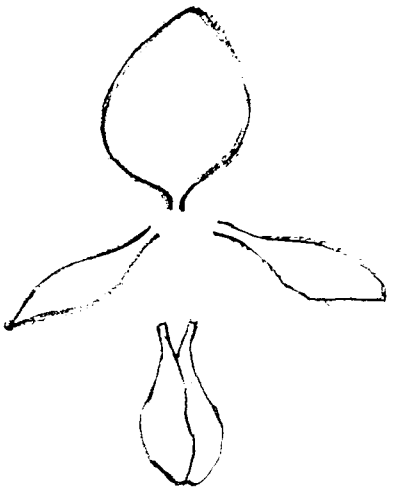
INDIGOFERA TINCTORIA Linn.

DESCRIPTORS

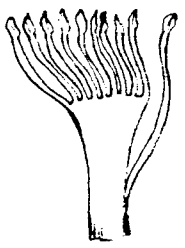
L.S.of flower (4x)



Corolla

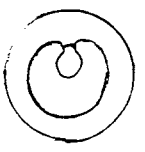


Androecium



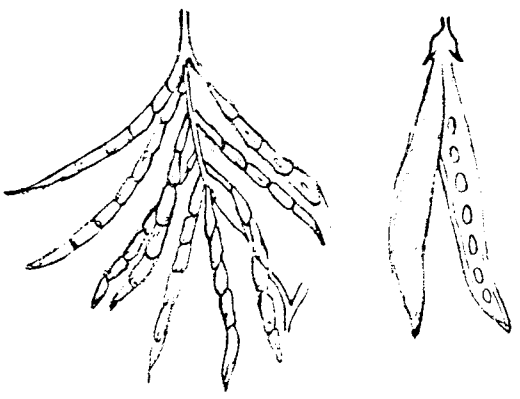
Gynoecium

C.S.of ovary

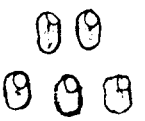


Floral Formula - ♂♀ K5, C 1+2+(2), A(9)+1, G 1

Fruit



Seeds



PASSPORT

1. ACCESSION DATA

1.1	Acession number	:	MP-8
1.2	Donor name	:	Prof. Lakshmi Bahuleyan, Dept.of Pharmacognosy, Ayurvedic Research Institute Poojappura, Thiruvananthapuram
1.3	Scientific name	:	*Indigofera tinctoria* Linn
1.4	Acquisition date	:	6th March 1995

2. COLLECTION DATA

2.1	Collecting institute	:	Ayurvedic Research Institute, Poojappura, Thiruvananthapuram
2.2	Country of collection	:	India
2.3	State	:	Kerala
2.4	Collection source	:	Institute
2.5	Local/Vernacular name	:	Neelayamari
2.6	No: of plants/seeds sampled	:	800 - 1000 seeds
2.7	Photograph Was aphotograph taken of the accession or environment at collection ?	:	No
2.8	Herbarium sample taken	:	No
2.9	Growth habit	:	erect
2.10	If under cultivation	:	1. Monoculture 2. Mixed with other crops
2.11	Topography	:	Plain level
2.12	Health condition of material	:	Healthy

3. PLANT DATA

3.1 General characters

3.1.1	Growth pattern(Plant type)	:	shrub, branches terete, more or less angular
3.1.2	Sowing date	:	22nd June 1995
3.1.3	Emerging cotyledon colour	:	very pale green
3.1.4	Hypocotyl colour	:	green
3.1.5	Plant pigmentation	:	slightly silvery
3.1.6	Ramification index	:	short internodes on main stem with numerous lateral branches
3.1.7	Branch orientation	:	short and erect lateral branches
3.1.8	Plant hairiness (hairs on stem, leaves, pods etc.)	:	branches with fine appressed hairs
3.1.9	Growth habit	:	erect
3.1.10	No: of primary branches	:	14 - 18
3.1.11	Plant height	:	2.7 - 3.8 m
3.1.12	Main stem girth	:	8.2 - 9.8 cm
3.1.13	Plant canopy height (canopy height at the end of flowering)	:	3.8 - 4 m

3.2 Leaf characters

3.2.1	No: of leaves	:	620 - 650
3.2.2	No: of leaflets/leaf	:	14 - 16
3.2.3	Leaflet length	:	1.2 - 2.5 cm
3.2.4	Leaflet width	:	0.6 - 1.2 cm
3.2.5	Leaf area	:	16.4 cm^2
3.2.6	Vein colour of fully developed primary leaves	:	green
3.2.7	Leaf anthocyanin	:	absent

3.2.8	Leaf colour	:	medium green
3.2.9	Intensity of leaf green colour	:	medium green
3.2.10	Leaf hairiness	:	glabrous above or rarely so, thinly clothed with appressed hairs beneath
3.2.11	Leaf shape	:	leaflets oblong or oblanceolate, rounded, apiculate
3.2.12	Leaf persistence	:	all leaves persistent

3.3 Inflorescence characters

3.3.1	No: of nodes on main stem from base to first inflorescence	:	4 - 6 nodes
3.3.2	Colour of flower standard	:	pink
3.3.3	Colour of wings	:	pink
3.3.4	Colour of keel	:	pink
3.3.5	Flower bud size	:	small
3.3.6	Flower buds per inflorescence	:	numerous
3.3.7	Length of inflorescence	:	5 - 10 cm
3.3.8	Length of pedicel	:	1 - 2 cm
3.3.9	Flower colour	:	pink
3.3.10	Node no: at harvest on main stem	:	30 - 42 nodes

3.4 Pod characters

3.4.1	Pod colour	:	dark brown
3.4.2	Pod length	:	1 - 2.5 cm
3.4.3	Pod curvature	:	curved
3.4.4	No: of pods/plant	:	420 - 432
3.4.5	No: of locules/pod	:	8 - 10
3.4.6	Pod width	:	2 - 3 mm
3.4.7	Pod beak length	:	1 - 2 mm
3.4.8	Pod beak position	:	marginal

3.4.9	Pod beak orientation	:	downward
3.4.10	Pod pubescence	:	glabrous
3.4.11	Pod dehiscence	:	non shattering
3.4.12	Orientation of pod bearing racemes	:	upright
3.4.13	Position of pod bearing racemes	:	even distribution throughout

3.5 Seed characters

3.5.1	Colour of seed	:	yellowish brown
3.5.2	No: of seeds/pod	:	8 - 12
3.5.3	Seed shape	:	small, ovoid
3.5.4	Seed length	:	2 mm
3.5.5	Seed width	:	2 - 3 mm
3.5.6	Seed weight	:	1.15 g/ 100seeds
3.5.7	Apparent seed veining	:	present
3.5.8	Seed volume	:	1 ml/100 seeds

3.6 Root characters

3.6.1	Root length	:	32 cm
3.6.2	Tap Root girth	:	5.8 - 5.9 cm
3.6.3	No: of lateral roots (primary)	:	12 - 14
3.6.4	Root fresh weight	:	42 - 54 g
3.6.5	Root dry weight	:	22 - 26 g

3.7	Days to maturity	:	148 days
3.8	Days to flowering	:	78 days
3.9	Duration of flowering	:	67 days
3.10	Days to first mature pods	:	112 days

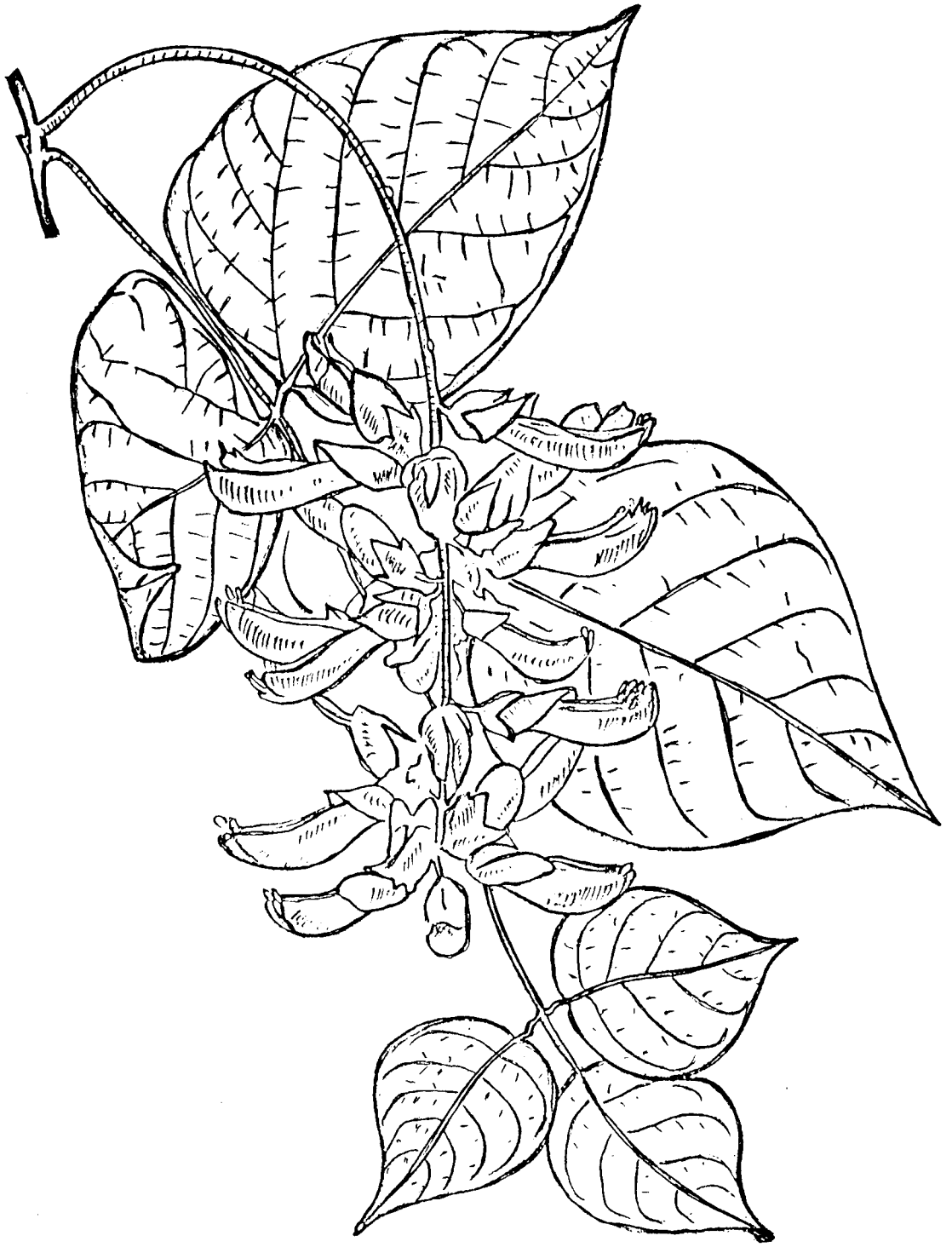
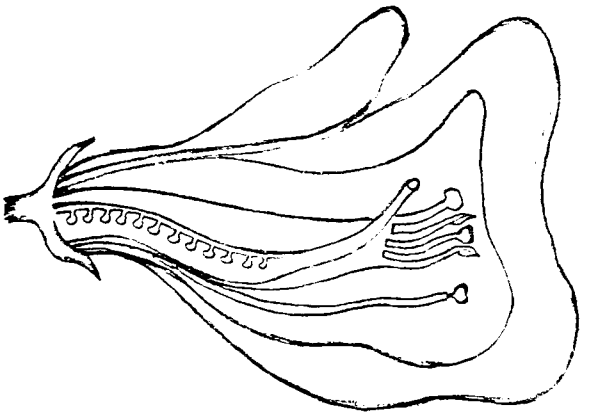


Fig. 18.

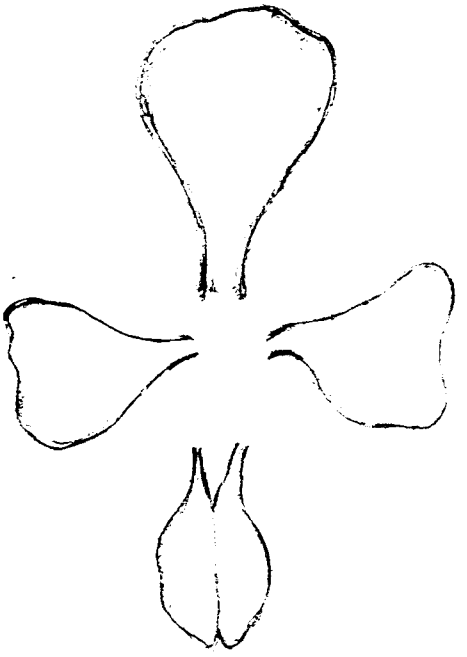
MUCUNA PRURITA Hook

DESCRIPTORS

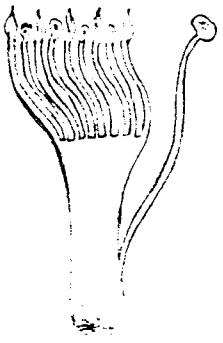
L.S.of flower (2x)



Corolla



Androecium

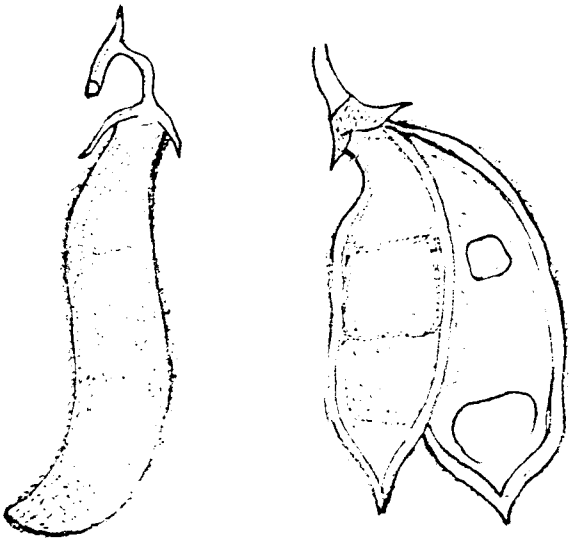


Gynoecium

C.S.of ovary

Floral Formula - ♂ K(5), C 1+2+(2), A(9)+1, <u>G 1</u>

Fruit



Seeds

PASSPORT

1. ACCESSION DATA

1.1	Accession number	:	MP-30
1.2	Donor name	:	Dr. B.R. Reghunath, Associate Professor, Dept. of Horticulture, College of Agri. Vellayani
1.3	Scientific name	:	*Mucuna prurita* Hook
1.4	Acquisition date	:	20th June 1995

2. COLLECTION DATA

2.1	Collecting institute	:	College of Horticulture, Vellanikkara, Thrissur
2.2	Country of collection	:	India
2.3	State	:	Kerala
2.4	Collection source	:	Institute
2.5	Local/Vernacular name	:	Naykorana
2.6	No: of plants/seeds sampled	:	50 seeds
2.7	Photograph Was a photograph taken of the accession or environment at collection?	:	No
2.8	Herbarium sample taken	:	No
2.9	Growth habit: spreading		
2.10	If under cultivation	:	1. Monoculture ✓ 2. Mixed with other crops.
2.11	Topography	:	plain level
2.12	Health condition of material	:	healthy

3. PLANT DATA

3.1 General Characters

3.1.1	Growth pattern (Plant type)	:	indeterminate, aggressive annual climber
3.1.2	Sowing date	:	22nd June 1995
3.1.3	Emerging cotyledon colour	:	green
3.1.4	Hypocotyl colour	:	white
3.1.5	Plant pigmentation	:	stem and leaves green
3.1.6	Ramification index	:	long internodes on main stem with numerous lateral branches.
3.1.7	Branch orientation	:	many lateral branches, long and twining over the support
3.1.8	Plant hairiness (hairs on stem, leaves, pods etc)	:	more or less hairy at first, at length glabrescent
3.1.9	Growth habit	:	spreading
3.1.10	No: of primary branches	:	56 - 58
3.1.11	Plant height	:	5.2 - 5.3 m
3.1.12	Main stem girth	:	7.3 - 7.6 cm
3.1.13	Plant canopy height(canopy height at the end of flowering)	:	5.3 m

3.2 Leaf characters

3.2.1	No: of leaves	:	540 - 550
3.2.2	No: of leaflets/leaf	:	3
3.2.3	Leaflet length	:	7.5 - 12.5 cm
3.2.4	Leaflet width	:	5 - 7.5 cm
3.2.5	Leaf area	:	283.38 cm^2
3.2.6	Vein colour of fully developed primary leaves	:	green

3.2.7	Leaf anthocyanin	:	absent
3.2.8	Leaf colour	:	medium green
3.2.9	Intensity of leaf green colour	:	medium green
3.2.10	Leaf hairiness	:	pubescent above, densely clothed with silvery grey hairs beneath
3.2.11	Leaf shape	:	terminal leaflets slightly smaller, rhomboid ovate with cuneate base, lateral leaflets with trunchate base, all leaves subcute and mucronate
3.2.12	Leaf persistence	:	25% of leaves dropped

3.3 Inflorescence characters

3.3.1.	No: of nodes on main stem from base to first inflorescence	:	20 - 24 nodes
3.3.2	Colour of flower standard	:	purple
3.3.3	Colour of wings	:	purple
3.3.4	Colour of keel	:	purple
3.3.5	Flower bud size	:	large
3.3.6.	Flower buds per inflorescence	:	45 - 50
3.3.7	Length of inflorescence	:	15 - 30 cm
3.3.8	Length of pedicel	:	3 - 6 cm
3.3.9	Flower colour	:	purple
3.3.10	Node no: at harvest on main stem	:	85 nodes

3.4 Pod characters

3.3.1	Pod colour	:	pale brown first, later turn steel grey
3.4.2	Pod length	:	5 - 7.5 cm
3.4.4	No. of pods/plant	:	118
3.4.3	Pod curvature	:	falcately curved on both ends, somewhat like the letter 'S'

3.4.5	No: of locules/pod	:	6
3.4.6	Pod width	:	1.2 cm
3.4.7	Pod beak length	:	4 - 5 mm
3.4.8	Pod beak position	:	marginal
3.4.9	Pod beak orientation	:	downward
3.4.10	Pod pubescence	:	pubescent
3.4.11	Pod dehiscence	:	non shattering
3.4.12	Orientation of pod bearing racemes	:	downward
3.4.13	Position of pod bearing racemes	:	even distribution throughout

3.5 Seed characters

3.5.1	Colour of seed	:	black
3.5.2	No: of seeds/pod	:	5 - 6 seeds
3.5.3	Seed shape	:	big seeds, trunchate fastigate
3.5.4	Seed length	:	1.5 cm
3.5.5	Seed width	:	2.5 cm
3.5.6	Seed weight	:	2.5 g/ seed
3.5.7	Apparent seed veining	:	absent
3.5.8	Seed volume	:	50 ml / 100 seeds

3.6 Root characters

3.6.1	Root length	:	81 - 82 cm
3.6.2	Tap root girth	:	5.2 - 5.3 cm
3.6.3	No: of lateral roots (primary)	:	10
3.6.4	Root fresh weight	:	48 - 50 g
3.6.5	Root dry weight	:	17 - 18 g

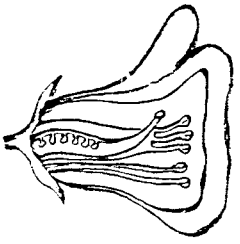
3.7	Days to maturity	:	151 days
3.8	Days to flowering	:	115 days
3.9	Duration of flowring	:	31 days
3.10	Days to first mature pods	:	135 days

Fig. 19.

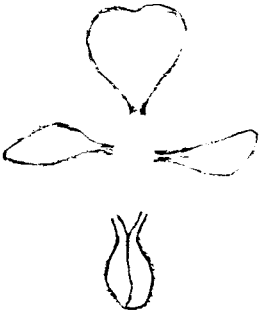
PSEUDARTHRIA VISCIDA (L.) Wight & Arn.

DESCRIPTORS

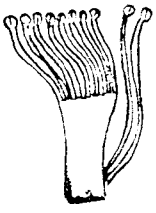
L.S.of flower (3x)



Corolla

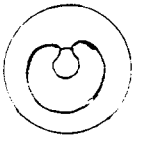


Androecium



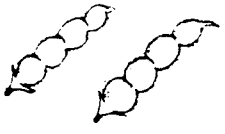
Gynoecium

C.S.of ovary

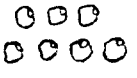


Floral Formula - ♀ K(5), C 1+2+(2), A(8)+2, <u>G 1</u>

Fruit



Seeds



PASSPORT

1. ACESSION DATA

1.1	Acession number	:	MP17
1.2	Donor name	:	Dr. G.Sreekantan Nair, Prof.& Head, Dept.of Horticulture, College of Agriculture, Vellayani
1.3	Scientific name	:	*Pseudarthria viscida* (L) Wight & Arn
1.4	Acquisition date	:	3rd May 1995

2. COLLECTION DATA

2.1	Collecting institute	:	College of Horticulture, Vellanikkara, Thrissur
2.2	Country of collection	:	India
2.3	State	:	Kerala
2.4	Collection source	:	Institute
2.5	Local/Vernacular name	:	Moovila
2.6	No: of plants/seeds sampled	:	500 seeds
2.7	Photograph Was a phtograph taken of the accession or environment at collection?	:	No
2.8	Herbarium sample taken	:	No
2.9	Growth habit	:	prostrate (branches more or less flat on ground)
2.10	If under cultivation	:	1. Monoculture ✓ 2. Mixed with other crops.
2.11.	Topography	:	plain level
2.12.	Health condition of material	:	healthy

3. PLANT DATA

3.1 General characters

3.1.1	Growth pattern (Plant type)	:	perennial, diffuse, prostrate
3.1.2	Sowing date	:	22nd June 1995
3.1.3	Emerging cotyledon colour	:	green
3.1.4	Hypocotyl colour	:	green
3.1.5	Plant pigmentation	:	stem and leaves green
3.1.6	Ramification index	:	short internodes on main stem with few lateral branches
3.1.7	Branch orientation	:	branches tending to be perpendicular to main stem, medium in length
3.1.8	Plant hairiness(hairs on stem, leaves, pods etc)	:	more or less clothed with soft whitish hairs
3.1.9	Growth habit	:	prostrate (branches more or less flat on ground)
3.1.10	No: of primary branches	:	17 - 19
3.1.11	*Plant height*	:	83 - 110 cm
3.1.12	Main stem girth	:	30 mm
3.1.13	Plant canopy height(canopy height at the end of flowering	:	1.1 m

3.2 Leaf characters

3.2.1	No: of leaves	:	218 - 225
3.2.2	No: of leaflets/leaf	:	3
3.2.3	Leaflet length	:	terminal leaflet - 4.5 - 9 cm lateral leaflet - 3.2 - 4.5 cm
3.2.4	Leaflet width	:	terminal leaflet - 3.8 - 5 cm lateral leaflet- 2.2 - 3.2 cm
3.2.5	Leaf area	:	82.25 cm^2

3.2.6	Vein colour of fully developed primary leaves	:	green
3.2.7	Leaf anthocyanin	:	absent
3.2.8	Leaf colour	:	dark green
3.2.9	Intensity of leaf green colour	:	dark green
3.2.10	Leaf hairiness	:	more or less hairy above, densely grey silky beneath
3.2.11	Leaf shape	:	terminal leaflet- homboid to ovate lateral leaflet-obliquely ovate to oblong or subrhomboid
3.2.12	Leaf persistence	:	all leaves persistent

3.3 Infloresence characters

3.3.1	No: of nodes on main stem from base to first inflorescence	:	4 - 6 nodes
3.3.2	Colour of flower standard	:	bright pink or purple
3.3.3	Colour of wings	:	bright pink or purple
3.3.4	Colour of keel	:	bright pink or purple
3.3.5	Flower bud size:		small
3.3.6	Flower buds per inflorescence	:	8 - 12
3.3.7	Length of inflorescence	:	20 - 30 cm
3.3.8	Length of pedicel	:	6 - 8 mm
3.3.9	Flower colour	:	bright pink or purple
3.3.10	Node no: at harvest on main stem	:	22 - 26

3.4 Pod characters

3.4.1	Pod colour	:	brownish black
3.4.2	Pod length	:	16 - 22 mm
3.4.3	Pod curvature	:	straight
3.4.4	No: of pods/plant	:	500 - 512

3.4.5	No: of locules/pod	:	3
3.4.6	Pod width	:	6 - 8 mm
3.4.7	Pod beak length	:	1 mm from end of last locule
3.4.8	Pod beak position	:	non marginal
3.4.9	Pod beak orientation	:	straight
3.4.10	Pod pubescence	:	slighly pubescent
3.4.11	Pod dehiscence	:	nonshattering
3.4.12	Orientation of pod bearing racemes	:	upright
3.4.13	Position of pod bearing racemes	:	concentrated on top

3.5 Seed characters

3.5.1	Colour of seed	:	brownish black
3.5.2	No: of seeds/pod	:	4 - 6
3.5.3	Seed shape	:	subreniform & compressed
3.5.4	Seed length	:	0.5 - 1mm
3.5.5	Seed width	:	1 mm
3.5.6	Seed weight	:	720 - 766 mg/100 seeds
3.5.7	Apparent seed veining	:	present
3.5.8	Seed volume	:	1.5 ml/100 seeds

3.6 Root characters

3.6.1	Root length	:	35 - 36 cm
3.6.2	Tap root girth	:	3 - 3.6 cm
3.6.3	No: of lateral roots (primary)	:	13 - 15
3.6.4	Root fresh weight	:	26.5 g
3.6.5	Root dry weight	:	15.17 g
3.7	Days to maturity	:	143 days
3.8	Days to flowering	:	107 days
3.9	Duration of flowering	:	52 days
3.10	Days to first mature pods	:	126 days

Appendix II . Meteorological data during the crop period from June 1995 to January 1996

Year & Month	Temperature (°C)		Relative humidity (%)	Precipitation (cm)	Sunshine hours *	
	Mean maximum	Mean miniumum			Coconut garden	Open condition
1995						
June	29.6	23.8	83.2	22.8	15,700 (23.36)	67,200 (100)
July	29.2	23.6	80.6	14.4	17,200 (24.04)	71,500 (100)
August	29.7	24.1	79.4	5.9	18,900 (24.35)	77,600 (100)
September	30.5	24.4	80.3	8.4	17,800 (24.58)	72,400 (100)
October	30.5	23.8	80.8	11.4	17,860 (25.14)	70,800 (100)
November	30.4	23.6	81.4	24.6	18,600 (25.62)	72,600 (100)
December	29.0	20.6	78.8	0.0	25,800 (26.27)	98,200 (100)
1996						
January	31.8	25.7	67.9	0.0	27,300 (26.50)	103,000 (100)

* Light intensity at the floor of the coconut garden in lux
Figures in parantheses represent percentage transmission of sunlight

COLLECTION, DESCRIPTION AND PERFORMANCE EVALUATION OF HERBACEOUS MEDICINAL LEGUMINOUS PLANTS OF KERALA

By

SUNITHA C.

ABSTRACT OF THE THESIS

Submitted in Partial fulfilment of
the requirement for the degree of
Master of Science in Horticulture
Faculty of Agriculture
Kerala Agricultural University

DEPARTMENT OF HORTICULTURE
COLLEGE OF AGRICULTURE
VELLAYANI
THIRUVANANTHAPURAM

1996

ABSTRACT

The present study titled 'Collection, description and performance evaluation of herbaceous medicinal leguminous plants of Kerala' was carried out at the Department of Horticulture, College of Agriculture, Vellayani from June 1995 to January 1996. Seeds of sixteen different species of herbaceous leguminous medicinal plants could be collected from authentic sources. Twelve different species with high rate of germination were raised and maintained till flowering and pod set in the medicinal plant garden of the Department of Horticulture. Detailed computerised descriptive blank supplemented with line drawings and authentic herbarium were prepared for each species. Cultural trial of eleven selected species of herbaceous leguminous medicinal plants, conducted as pure crop in open condition and as intercrop under shade in a twenty five year old coconut garden, indicated that under open condition the growth and yield are significantly superior in *Abrus precatorius*, *Clitoria ternatea* and *Atylosia scarabaeoides* than under shaded condition. Similarly, in *Crotalaria verrucosa* and *Desmodium triangulare* where leaves are the medicinally important plant part, the number of branches and number of leaves were significantly higher under open condition than under shade. The biomass yield of *Crotalaria verrucosa* was significantly superior under open condition than under shade. This revealed the limited chance of raising these five plant species as intercrops in coconut garden.

Growth and yield were significantly superior under shaded condition or were comparable under both conditions in *Mucuna prurita*, *Indigofera tinctoria*, *Cassia mimosoides* and *Pseudarthria viscida*. In *Desmodium gangeticum*, where root is the medicinally important plant part, no significant difference was noticed in the root characteristics, namely, root length, tap root girth and number of lateral roots under open and shaded conditions.

The content of active chemical ingredient in the medicinally important plant parts of the different plant species studied, showed no significant difference under open and shaded conditions. The presence of biochemical substances in these medicinal plants did not affect the association of rhizobia and mycorrhizae. Such positive association in native soil without artificial inoculation opens the scope for utilizing the microsymbiont technology for exploiting the full potential of growth and yield of medicinal plants.

The study, thus indicated the feasibility of growing herbaceous, leguminous medicinal plant species as intercrops in coconut garden, with the dual benefit of contributing a part of the requirement of raw materials in the indigenous pharmaceutical industry and at the same time enriching soil fertility by way of nitrogen fixation.