MEDICINAL PLANTS

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I. IMPORTANCE AND SCOPE

Herbs are staging a comeback and herbal 'renaissance' is happening all over the globe. The herbal products today symbolise safety in contrast to the synthetics that are regarded as unsafe to human and environment. Although herbs had been priced for their medicinal, flavouring and aromatic qualities for centuries, the synthetic products of the modern age surpassed their importance, for a while. However, the blind dependence on synthetics is over and people are returning to the naturals with hope of safety and security.

Over three-quarters of the world population relies mainly on plants and plant extracts for health care. More than 30% of the entire plant species, at one time or other, were used for medicinal purposes. It is estimated that world market for plant derived drugs may account for about Rs.2,00,000 crores. Presently, Indian contribution is less than Rs.2000 crores. Indian export of raw drugs has steadily grown at 26% to Rs.165 crores in 1994-'95 from Rs.130 crores in 1991-'92. The annual production of medicinal and aromatic plant's raw material is worth about Rs.200 crores. This is likely to touch US $1150 by the year 2000 and US $5 trillion by 2050.

It has been estimated that in developed countries such as United States, plant drugs constitute as much as 25% of the total drugs, while in fast developing countries such as China and India, the contribution is as much as 80%. Thus, the economic importance of medicinal plants is much more to countries such as India than to rest of the world. These countries provide two third of the plants used in modern system of medicine and the health care system of rural population depend on indigenous systems of medicine.

Of the 2,50,000 higher plant species on earth, more than 80,000 are medicinal. India is one of the world's 12 biodiversity centres with the presence of over 45000 different plant species. India's diversity is unmatched due to the presence of 16 different agro-climatic zones, 10 vegetation zones, 25 biotic provinces and 426 biomes (habitats of specific species). Of these, about 15000-20000 plants have good medicinal value. However, only 7000-7500 species are used for their medicinal values by traditional communities. In India, drugs of herbal origin have been used in traditional systems of medicines such as *Unani* and *Ayurveda* since ancient times. The *Ayurveda* system of medicine uses about 700 species, *Unani* 700, *Siddha* 600, Amchi 600 and modern medicine around 30 species. The drugs are derived either from the whole plant or from different organs, like leaves, stem, bark, root, flower, seed, etc. Some drugs are prepared from excretory plant product such as gum, resins and latex. Even the Allopathic system of medicine has adopted a number of plant-derived drugs (Table: medicinal plants used in modern medicine) which form an important segment of the modern pharmacopoeia. Some important chemical intermediates needed for manufacturing the modern drugs are also obtained from plants (Eg. diosgenin, solasodine, β-ionone). Not only, that plant-derived drug offers a stable market world wide, but also plants continue to be an important source for new drugs.

Traditional systems of medicine continue to be widely practised on many accounts. Population rise, inadequate supply of drugs, prohibitive cost of treatments, side effects of several allopathic drugs and development of resistance to currently used drugs for infectious diseases have led to increased emphasis on the use of plant materials as a source of medicines for a wide variety of human ailments. Global estimates indicate that 80% of about 4 billion population can not afford the products of the Western Pharmaceutical Industry and have to rely upon the use of traditional medicines which are mainly derived from plant material. This fact is well documented in the inventory of medicinal plants, listing over 20,000 species. In spite of the overwhelming influences and our dependence on modern medicine and tremendous advances in synthetic drugs, a large segment of the world population still like drugs from plants. In many of the developing countries the use of plant drugs is increasing because modern life saving drugs are beyond the reach of three quarters of the third world's population although many such countries spend 40-50% of their total wealth

on drugs and health care. As a part of the strategy to reduce the financial burden on developing countries, it is obvious that an increased use of plant drugs will be followed in the future.

Among ancient civilisations, India has been known to be rich repository of medicinal plants. The forest in India is the principal repository of large number of medicinal and aromatic plants, which are largely collected as raw materials for manufacture of drugs and perfumery products. About 8,000 herbal remedies have been codified in Ayurveda. The *Rigveda* (5000 BC) has recorded 67 medicinal plants, *Yajurveda* 81 species, *Atharvaveda* (4500-2500 BC) 290 species, *Charak Samhita* (700 BC) and *Sushrut Samhita* (200 BC) had described properties and uses of 1100 and 1270 species respectively, in compounding of drugs and these are still used in the classical formulations, in the Ayurvedic system of medicine. Unfortunately, much of the ancient knowledge and many valuable plants are being lost at an alarming rate. With the rapid depletion of forests, impairing the availability of raw drugs, Ayurveda, like other systems of herbal medicines has reached a very critical phase. About 50% of the tropical forests, the treasure house of plant and animal diversity have already been destroyed. In India, forest cover is disappearing at an annual rate 1.5mha/yr. What is left at present is only 8% as against a mandatory 33% of the geographical area. Many valuable medicinal plants are under the verge of extinction. *The Red Data Book of India* has 427 entries of endangered species of which 28 are considered extinct, 124 endangered, 81 vulnerable, 100 rare and 34 insufficiently known species (Thomas, 1997).

Ayurveda, Siddha, Unani and Folk (tribal) medicines are the major systems of indigenous medicines. Among these systems, Ayurveda is most developed and widely practised in India. Ayurveda dating back to 1500-800 BC has been an integral part of Indian culture. The term comes from the Sanskrit root *Au* (life) and *Veda* (knowledge). As the name implies it is not only the science of treatment of the ill but covers the whole gamut of happy human life involving the physical, metaphysical and the spiritual aspects. Ayurveda recognises that besides a balance of body elements one has to have an enlightened state of consciousness, sense organs and mind if one has to be perfectly healthy. Ayurveda by and large is an experience with nature and unlike in Western medicine, many of the concepts elude scientific explanation. Ayurveda is gaining prominence as the natural system of health care all over the world. Today this system of medicine is being practised in countries like Nepal, Bhutan, Sri Lanka, Bangladesh and Pakistan, while the traditional system of medicine in the other countries like Tibet, Mongolia and Thailand appear to be derived from Ayurveda. Phytomedicines are also being used increasingly in Western Europe. Recently the US Government has established the "Office of Alternative Medicine" at the National Institute of Health at Bethesda and its support to alternative medicine includes basic and applied research in traditional systems of medicines such as Chinese, Ayurvedic, etc. with a view to assess the possible integration of effective treatments with modern medicines.

The development of systematic pharmacopoeias dates back to 3000 BC, when the Chinese were already using over 350 herbal remedies. Ayurveda, a system of herbal medicine in India, Sri Lanka and South-East Asia has more than 8000 plant remedies and using around 35,000-70,000 plant species. China has demonstrated the best use of traditional medicine in providing the health care. China has pharmacologically validated and improved many traditional herbal medicines and eventually integrated them in formal health care system.

Green plants synthesise and preserve a variety of biochemical products, many of which are extractable and used as chemical feed stocks or as raw material for various scientific investigations. Many secondary metabolites of plant are commercially important and find use in a number of pharmaceutical compounds. However, a sustained supply of the source material often becomes difficult due to the factors like environmental changes, cultural practices, diverse geographical distribution, labour cost, selection of the superior plant stock and over exploitation by pharmaceutical industry.

Plants, especially used in Ayurveda can provide biologically active molecules and lead structures for the development of modified derivatives with enhanced activity and /or reduced toxicity. The small fraction of flowering plants that have so far been investigated have yielded about 120 therapeutic agents of known structure from about 90 species of plants. Some of the useful plant drugs include vinblastine, vincristine, taxol, podophyllotoxin, camptothecin, digitoxigenin, gitoxigenin, digoxigenin, tubocurarine, morphine, codeine, aspirin, atropine, pilocarpine, capscicine, allicin, curcumin, artemesinin and ephedrine among others. In some cases, the crude extract of medicinal plants may be used as medicaments. On the other hand, the isolation and identification of the active principles and elucidation of the mechanism of action of a drug is of paramount importance. Hence, works in both mixture of traditional medicine and single active compounds are very important. Where the active molecule cannot be synthesised economically, the product must be obtained from the cultivation of plant material. About 121 (45 tropical and 76 subtropical) major plant drugs have been identified for which no synthetic one is currently available (table 1). The scientific study of traditional medicines, derivation of drugs through bioprospecting and systematic conservation of the concerned medicinal plants are thus of great importance.

Table 1. Major plant drugs for which no synthetic one is currently available (Kumar *et al*, 1997).

Drug	**Plant**	**Use**
Vinblastine	*Catharanthus roseus*	Anticancer
Vinblastine	*Catharanthus roseus*	Anticancer
Ajmalacine	*Catharanthus roseus*	Anticancer, hypotensive
Rescinnamine	*Rauvolfia serpentina*	Tranquilizer
Reserpine	*Rauvolfia serpentina*	Tranquilizer
Quinine	*Cinchona sp.*	Antimalarial, amoebic dysentery
Pilocarpine	*Pilocarpus jaborandi*	Antiglucoma
Cocaine	*Erythroxylum coca*	Topical anaesthetic
Morphine	*Papaver somniferum*	Painkiller
Codeine	*Papaver somniferum*	Anticough
Atropine	*Atropa belladonna*	Spasmolytic, cold
Atropine	*Hyoscyamus niger*	Spasmolytic, cold
Cardiac glycosides	*Digitalis sp.*	For congestive heart failure
Artemisinin	*Artemesia annua*	Antimalarial,
Taxol	*Taxus baccata* *T. brevifolia*	Breast and ovary cancer, antitumour
Berberine	*Berberis*	For leishmaniasis
Pristimerin	*Celastrus paniculata*	Antimalarial
Quassinoids	*Ailanthus*	Antiprotozoal
Plumbagin	*Plumbago indica*	Antibacterial, antifungal
Diospyrin	*Diospyros montana*	
Gossypol	*Gossypium sp.*	Antispermatogenic
Allicin	*Allium sativum*	Antifungal, amoebiasis
Ricin	*Ricinus communis*	
Emetine	*Cephaelis ipecacuanha*	Amoebiasis
Glycyrrhizin	*Glycyrrhizia glabra*	Antiulcer
Nimbidin	*Azadirachta indica*	Antiulcer
Catechin	*Acacia catechu*	Antiulcer
Sophoradin	*Sophora subprostrata*	Antiulcer
Magnolol	*Magnolia bark*	Peptic ulcer
Forskolin	*Coleus forskohlii*	Hypotensive, cardiotonic

Digitoxin, Digoxin	*Digitalis, Thevetia*	Cardio tonic
Thevenerin,	*Thevetia*	Cardio tonic
Nerrifolin	*Thevetia*	Cardio tonic
Podophyllin	*Podophyllum emodi*	Anticancer
Indicine N-oxide	*Heliotropium indicum*	Anticancer
Elipticine	*Ochrosia*	Anticancer
Homoharringtonine	*Cephalotaxus*	Anticancer
Camptothecine	*Camptotheca acuminata*	Anticancer

A major lacuna in Ayurveda is the lack of drug standardisation, information and quality control. Most of the Ayurvedic medicines are in the form of crude extracts which are a mixture of several ingredients and the active principles when isolated individually fail to give desired activity. This implies that the activity of the extract is the synergistic effect of its various components. In the absence of pharmacopoeia data on the various plant extracts, it is not possible to isolate or standardise the active contents having the desired effects. Ayurvedic pharmacopoeia compiled on modern lines and updated periodically is an urgent requirement. A combination therapy integrating Ayurveda and allopathy whereby the side effects and undesirable reactions could be controlled can be thought of. Studies can show that the toxic effects of radiations and chemotherapy in cancer treatment could be reduced by Ayurvedic medications and similarly surgical wound healing could be accelerated by Ayurvedic medicines. Modern science and technology have an essential role to play in the process. An integrated approach for the cultivation, conservation and preservation of important plant species through plant molecular biology, plant tissue culture; research on the rationale and methodology of Ayurvedic medical practice; isolation of active constituents and their development into new therapeutics; standardisation and validation of known herbal medicines and other related aspects need to be focussed upon (Sharma, 1997).

Despite the diverse nature of crops grown in the country and the existence of a fast growing pharmaceutical sector, the share of India in world trade is quite insignificant considering the large geographical area. However, this is bound to rise rapidly with better research inputs and efficient management of the farm sector. So far, India has been involved in the export of only large volume raw material. To achieve competitive advantage we need to resort to low volume high cost (value) trade through value addition to the raw and unfinished products. It is therefore, necessary to develop genetically superior planting material for assured uniformity and desired quality and resort to organised cultivation to ensure the supply of raw material at grower's end. Post harvest storage and process technologies need to be developed to produce the value added finished products that may be directly utilised by the industry

Inventorisation of herbal drugs used in traditional and modern medicines for a country like India, appears to be a stupendous task, where a number of well established indigenous or traditional systems, including Ayurveda, Unani, Siddha, Homoeopathy, Tibetan, Amchi, Yoga and Naturopathy are practised along with modern medicine for the management of total health care system. In all these systems a large number of plant drugs are used, although there may be some common plants. Another problem in correct identification of plants is that the plant drugs in those systems of medicine are known by their classical, *Shastriya* or vernacular names. It is not easy to correlate these names with acceptable scientific names. One plant species can have many vernacular classical names and one name may refer to different plant species.

Chinese, Indian, Arabian and other traditional systems of medicines make extensive use of about 5000 plants. India is proud to be rich in biological diversity and tenth among the plant rich countries of Asia, sixth as far as centres of diversity especially agrodiversity are

concerned. Nearly three fourth of the drugs and perfumery products used in the world are available in natural state in the country. India possesses almost 8% of the estimated biodiversity of the world with around 1,26,000 species. It is one of the 12 mega biodiversity centres with 2 hot spots of biodiversity in western Ghats and north-eastern region. The sacred groves are a miniature ecosystem conserving biodiversity in its pristine form. There are about 400 families in the world of flowering plants, at least 315 are represented in India. According to WHO, around 21,000 plant species have the potential for being used as medicinal plants. About 5000 species have been studied (tables 2-6). There are at least 121 major plant drugs of known structure, but none of them is currently produced through synthetic means. For developing phytomedicines as a major area of concern, it would be essential to adopt a holistic interdisciplinary approach, have a scientific basis of the understanding of the plant systems, new innovations and their conservation for utilisation in future on a sustainable basis (Sharma, 1997).

Table 2. Plant species with therapeutic value under different plant groups (Jiaxiang, 1997).

Thalophytes	230
Bryophytes	39
Pteridophytes	382
Gymnospermae	55
Angiospermae:	
a) Monocotyledones	676
b) Dicotyledones	3495
Total	4877

Table 3. Plant families containing over 100 species with therapeutic value (Jiaxiang, 1997).

Family	*Genera*	*Species*
I. Monocots		
Liliaceae	45	165
Orchidaceae	45	135
II. Dicots		
Compositae	89	331
Leguminosae	91	313
Ranuculaceae	31	208
Laminaceae	46	189
Rosaceae	28	146
Umbelliferae	34	123
Rubiaceae	35	118
Euphorbiaceae	30	104
Asclepiadaceae	29	101

Table 4. Major medicinal plants that can be cultivated in India and have established demand for their raw materials (Kumar *et al*, 1997).

Acorus calamus	*Ammi majur*
Aconitum sp.	*Atropa acuminata*
Adhatoda vasica	*Berberis aristata*
Aloe vera	*Carica papaya*

Catharanthus roseus
Cassia senna
Cephaelis ipecacuanha
Cinchona spp.
Dioscorea spp.
Glycyrrhiza glabara
Hedychium spicatum
Heracleum candicans
Hyoscyamus sp.muticus
Inula racemosa
Juglans regia
Juniperus spp.
Matricaria chamomilla
Papaver somniferum
Plantago ovata
Podophyllum emodi
Rauvolfia serpentina
Rheum emodi
Saussurea lappa
Swertia chirata
Urginea indica
Valeriana wallichii
Zingiber officinale
Bacopa monnieri
Boerhaavia diffusa
Dudoisia myoporoides
Eclipta alba
Gymnema sylvestre
Phyllanthus amarus
Piper retrofractum
Panax quinquefolium
Silybum marialum

Table 5. Medicinal plants on which significant research leads have been obtained with respect to their pharmaceutical potential for which processing and agrotechnology need to be established (Kumar *et al*, 1997).

Andrographis paniculata
Artemisia annum
Boswellia serrata
Centella asiatica
Coleus forskohlii
Commiphora wightii
Curcuma longa
Phyllanthus amarus
Picrorhiza kurroa
Sida rhombifolia
Taxus baccata
Withania somnifera

Table 6. Plants which delay ageing process and form health food ingredients in several Ayurvedic formulations (Kumar *et al*, 1997).

Allium sativum
Aloe barbadensis
Asparagus racemosus
Cassia senna
Curculigo orchioides
Commiphora wightii
Centalla asiatica
Capsicum annum
Chlorophytum arundinaceum
Eclipta alba
Fagopyrum esculentum
Glycyrrhiza glabra
Oenothera biennis
Panax pseudoginseng
Plantago ovata
Withania somnifera

II. CLASSIFICATION OF MEDICINAL PLANTS

Of the 2,50,000 higher plant species on earth, more than 80,000 species are reported to have at least some medicinal value and around 5000 species have specific therapeutic value. They are classified according to the part used, habit, habitat, therapeutic value etc, besides the usual botanical classification.

1. Based on part used

i) Whole plant: Boerhaavia diffusa, Phyllanthus neruri
ii) Root: Dasamula
iii) Stem:Tinospora cordifolia, Acorus calamus
iv) Bark: Saraca asoca
v) Leaf: Indigofera tinctoria, Lawsonia inermis, Aloe vera
vi) Flower:Biophytum sensityvum, Mimusops elenji
vii) Fruit: Solanum species
viii) Seed: Datura stramonium

2. Based on habit

i) Grasses: Cynodon dactylon
ii) Sedges: Cyperus rotundus
iii) Herbs : Vernonia cineria
iv) Shrubs: Solanum species
v) Climbers: Asparagus racemosus
vi) Trees: Azadirachta indica

3. Based on habitat

i) Tropical: Andrographis paniculata
ii) Sub-tropical: Mentha arvensis
iii) Temperate: Atropa belladona

4. Based on therapeutic value

Antimalarial : Cinchona officinalis, Artemisia annua
Anticancer : Catharanthus roseus, Taxus baccata
Antiulcer : Azadirachta indica, Glycyrrhiza glabra
Antidiabetic : Catharanthus roseus, Momordica charantia
Anticholesterol : Allium sativum
Antiinflammatory : Curcuma domestica, Desmodium gangeticum
Antiviral : Acacia catechu
Antibacterial : Plumbago indica
Antifungal : Allium sativum
Antiprotozoal : Ailanthus sp., Cephaelis ipecacuanha
Antidiarrhoeal : Psidium gujava, Curcuma domestica
Hypotensive : Coleus forskohlii, Alium sativum
Tranquilizing : Rauvolfia serpentina
Anaesthetic : Erythroxylum coca
Spasmolytic : Atropa belladona, Hyoscyamus niger
Diuretic : Phyllanthus niruri, Centella asiatica
Astringent : Piper betle, Abrus precatorius
Anthelmentic : Quisqualis indica, Punica granatum
Cardiotonic : Digitalis sp., Thevetia sp.
Antiallergic : Nandina domestica, Scutellaria baicalensis
Hepatoprotective : Silybum marianum, Andrographis paniculata

5. Based on Ayurvedic formulations in which used

a) The ten roots of the Dasamoola (*Dasamoolam*)

i) Desmodium gangeticum (Orila)
ii) Uraria lagopoides (Cheria orila)
iii) Solanum jacquinii (Kantakari)
iv) Solanum indicum (Cheruchunda)
v) Tribulus terrestris (Njerinjil)
vi) Aegle marmelos (Koovalam)
vii) Oroxylum indicum (Palakapayyani)
viii) Gmelina arborea (Kumizhu)
ix) Steriospermum suaveolens (Pathiri)
x) Premna spinosus (Munja)

b) The ten flowers of the Dasapushpa (*Dasapushpam*)

i) Biophytum sensitivum (Mukkutti)
ii) Ipomea maxima (Thiruthali)
iii) Eclipta prostrata (Kayyuniam)
iv) Vernonia cineria (Poovamkurunnil)
v) Evolvulus alsinoides (Vishnukranthi)
vi) Cynodon dactylon (Karuka)
vii) Emelia sonchifolia (Muyalcheviyan)
viii) Curculigo orchioides (Nilappana)
ix) Cardiospermum halicacabum (Uzhinja)
x) Aerva lanata (Cherula)

c) The four trees of the Nalpamara (*Nalpamaram*)

i) Ficus racemosa (Athi)
ii) Ficus microcarpa (Ithi)
iii) Ficus relegiosa (Arayal)
iv) Ficus benghalensis (Peral)

d) The three fruits of the Triphala (*Thriphalam*)

i) Phyllanthus emblica (Nellikka)
ii) Terminalia bellerica (Thannikka)
iii) Terminalia chebula (Kadukka)

6. Botanical classification

This is the most comprehensive and scientific classification. The various medicinal plants are grouped below in table 7 according to their Class, Series, Order, Family, Genus and Species.

Table 7. Botanical classification of medicinal plants (Dey, 1984, modified)

Family	*Genus (species)*
SUBDIVISION	*: ANGIOSPERMAE*
CLASS	***: I. DICOTYLEDONAE***
SUBCLASS	*: 1. POLYGONAE*
Series	***: i. Thalamiflorae***
Order	***: a. Ranales***
Ranunculaceae	*Thalictrum (foliolosum)*
	Coptis (teeta)
	Delphinium (denudatum)
	Aconitum (ferox, heterophyllum, napellus)
	Actaea (spicata)
	Paeonia (emodi)
Dilleniaceae	*Dillenia (indica)*
Magnoliaceae	*Michelia (champaca)*
Anonaceae	*Cananga (odorata)*

	Anona (squamosa)
Menispermaceae	*Tinospora (cordifolia)*
	Anamirta (cocculus)
	Coscinium (fenestratum)
	Cocculus (villosus)
	Pericampylus (incanus)
	Cissampelos (pareira)
Berberidaceae	*Berberis (aristata, lycium, asiatica)*
	Podophyllum (emodi)
Nymphaeaceae	*Nymphaea (lotus, nouchali)*
	Euryale (ferox)
	Nelumbium (speciosum)
Order	***: b. Parietales***
Papaveraceae	*Papaver (rhoeas, somniferum)*
	Argemone (mexicana)
	Hypecoum (procumbens)
Fumariaceae	*Corydalis (govaniana)*
	Fumaria (officinalis)
Brassicaceae	*Brassica (nigra, campestris, juncea)*
(Cruciferae)	*Capsella (bursa-pastoris)*
	Lepidium (sativum)
	Raphanus (sativus)
Capparidaceae	*Cleome (viscosa)*
	Gynandropsis (pentaphylla)
	Maerua (arenaria)
	Crataeva (religiosa)
	Capparis (spinosa, aphylla)
Violaceae	*Viola (odorata)*
	Ionidium (suffruticosum)
Bixaceae	*Bixa (orellana)*
Flacourtiaceae	*Gynocardia (odorata)*
Order	: c. Caryophyllales
Tamaricaceae	*Tamarix (gallica)*
Order	: d. Guttiferales
Clusiaceae	*Garcinia (mangostana, indica, morella)*
(Guttiferae)	*Mesua (ferrea)*
Ternstroemiaceae	*Camellia (theifera)*
Dipterocarpaceae	*Dipterocarpus (turbinatus)*
	Shorea (robusta)
	Hopea (odorata)
	Vateria (indica)
Order	: f. Malvales
Malvaceae	*Althaea (officinalis)*
	Malva (sylvestris)
	Sida (cordifolia)
	Pavonia (odorata)
	Hibiscus (sabdariffa, abelmoschus, esculentus, rosa-sinensis)
	Gossypium (herbaceum)
	Adansonia (digitata)
	Bombax (malabaricum)
Sterculiaceae	*Helicteres (isora)*
	Abroma (augusta)
	Cola (acuminata)
Tiliaceae	*Grewia (asiatica)*
	Corchorus (capsularis, olitorius)
Linaceae	*Linum (usitatissimum)*
Erythroxylaceae	*Erythroxylum (coca, monogynum)*
Zygophyllaceae	*Tribulus (terrestris)*
Series	***: ii. Disciflorae***
Order	***: a. Geraniales***
Geraniaceae	*Geranium (robertianum)*

Oxalidaceae	*Oxalis (corniculata)*
Balsaminaceae	*Impatiens (sulcata)*
Rutaceae	*Ruta (graveolens)*
	Peganum (harmala)
	Toddalia (aculeata)
	Citrus (medica, aurantium)
	Feronia (elephantum)
	Aegle (marmelos)
Simarubaceae	*Ailanthus (excelsa)*
	Samadera (indica)
	Picrasma (quassioides)
Burseraceae	*Boswellia (serrata)*
	Garuga (pinnata)
	Balsamodendron (mukul, myrrha)
	Canarium (commune)
Meliaceae	*Naregamia (alata)*
	Melia (azadirachta, azedarach)
	Amoora (rohituka)
	Carapa (moluccensis)
	Soymida (febrifuga)
Order	***: b. Celastrales***
Celastraceae	*Celastrus (paniculatus)*
Rhamnaceae	*Zizyphus (jujuba)*
Vitaceae	*Vitis (vinifera)*
Order	***: c. Sapindales***
Sapindaceae	*Cardiospermum (halicacabum)*
	Schleichera (trijuga)
	Sapindus (trifoliatus)
Anacardiaceae	*Pistacia (integerrima, lentiscus, terebinthus, vera)*
	Mangifera (indica)
	Anacardium (occidentale)
	Melanorrhoea (usitata)
	Semecarpus (anacardium)
	Holigarna (longifolia)
Moringaceae	*Moringa (oleifera)*
Series	***: iii. Calyciflorae***
Order	***: a. Rosales***
Fabaceae	*Trigonella (foenum-groecum)*
(Papilionaceae)	*Melilotus (officinalis)*
	Indigofera (tinctoria)
	Psoralea (corylifolia)
	Sesbania (aegyptiaca)
	Sesbania (grandiflora)
	Astragalus (verus)
	Alhagi (maurorum)
	Eschynomene (aspera)
	Desmodium (gangeticum)
	Abrus (precatorius)
	Lens (esculenta)
	Lathyrus (sativus)
	Mucuna (pruriens)
	Erythrina (indica)
	Butea (frondosa)
	Clitoria (ternatea)
	Dolichos (biflorus)
	Pterocarpus (marsupium, santalinus, glabra)
Caesalpiniaceae	*Caesalpinia (bonducella, sappan)*
	Cassia (fistula, occidentalis, sophera, tora, obovata, alata, angustifolia)
	Hardwickia (pinnata)
	Saraca (indica)
	Tamarindus (indica)

	Bauhinia (variegata)
Mimosaceae	*Entada (scandens)*
	Mimosa (pudica)
	Adenanthera (pavonina)
	Acacia (farnesiana, arabica, catechu)
	Glycyrrhiza (glabra)
Rosaceae	*Prunus (amygdalus, communis)*
	Agrimonia (eupatoria)
	Rosa (damascena, centifolia)
	Cydonia (vulgaris)
Crassulaceae	*Bryophyllum (calycinum)*
	Kalanchoe (laciniata)
Droseraceae	*Drosera (burmanni, peltata)*
Hamamelidaceae	*Liquidambar (orientalis)*
	Altingia (excelsa)
Order	***: b. Myrtales***
Combretaceae	*Terminalia (catappa, bellerica, chebula, arjuna)*
Myrtaceae	*Melaleuca (leucandendron)*
	Psidium (gujava)
	Eugenia (jambolana)
	Barringtonia (acutangula)
	Careya (arborea)
	Caryophyllus (aromaticus)
	Eucalyptus (globulus)
	Myrtus (communis)
Lythraceae	*Ammania (baccifera)*
	Woodfordia (floribunda)
	Lawsonia (alba)
	Punica (Granatum)
Onagraceae	*Trapa (bispinosa)*
Order	***: c. Passiflorales***
Caricaceae	*Carica (papaya)*
Cucurbitaceae	*Trichosanthes (dioica)*
	Lagenaria (vulgaris)
	Luffa (acutangula)
	Benincasa (cerifera)
	Momordica (charantia)
	Cucumis (melo, sativus)
	Citrullus (colocynthis, vulgaris)
	Cephalandra (indica)
	Cucurbita (pepo)
	Bryonopsis (laciniosa)
	Corallocarpus (epigaeus)
Cactaceae	*Opuntia (dillenii)*
Order	***: d. Umbellales***
Umbelliferae	*Hydrocotyle (asiatica)*
(Apiaceae)	*Apium (graveolens)*
	Carum (carvi, copticum)
	Pimpinella (anisum)
	Foeniculum (vulgare)
	Ferula (narthex, alliacea, foetida, galbaniflua)
	Peucedanum (graveolens)
	Coriandrum (sativum)
	Cuminum (cyminum)
	Daucus (carota)
	Petroselinum (sativum)
Alangiaceae	*Alangium (lamarckii)*

SUBCLASS *: 2. GAMOPETALAE*

Series : i. Inferae

Order	***: a. Rubiales***
Rubiaceae	*Anthocephalus (cadamba)*
	Uncaria (gambier)
	Cinchona (calisaya, officinalis, succirubra)
	Hymenodictyon (excelsum)
	Oldenlandia (corymbosa)
	Ophiorrhiza (mungos)
	Randia (dumetorum)
	Gardenia (lucida, gummifera)
	Canthium (parviflorum)
	Pavetta (indica)
	Coffea (arabica, robusta)
	Morinda (citrifolia)
	Paederia (foetida)
	Rubia (cordifolia)
	Cephaelis (lpecacuanha)
Order	***: b. Asterales***
Valerianaceae	*Valeriana (wallichii)*
	Nardostachys (jatamansi)
Compositae	*Eupatorium (ayapana, triplinerve)*
(Asteraceae)	*Blumea (lacera)*
	Helianthus (annuus, tuberosus)
	Siegesbeckia (orientalis)
	Enhydra (fluctuans)
	Eclipata (alba)
	Guizotia (abyssinica)
	Achillea (millefolium)
	Anthemis (nobilis)
	Anacyclus (pyrethrum)
	Matricaria (chamomila)
	Artemisia (maritima, vulgaris)
	Calendula (officinalis)
	Saussurea (lappa)
	Carthamus (tinctorius)
	Cichorium (intybus)
	Taraxacum (officinale)
	Lactuca (scariola)
	Tagetes (erecta)
Series	***: ii. Heteromerae***
Order	***: a. Ericales***
Ericaceae	*Gaultheria (fragrantissima)*
Plumbaginaceae	*Plumbago (zeylanica, rosea)*
Order	***: b. Primulales***
Myrsinaceae	*Embelia (ribes, robusta)*
Order	***: c. Ebenales***
Sapotaceae	*Bassia (latifolia)*
	Bassia (butyracea)
	Mimusops (elengi)
Ebenaceae	*Diospryros (embryopteris)*
Symplocaceae	*Symplocos (racemosa)*
Styraceae	*Styrax (benzoin)*

Series : iii. Bicarpellatae

Order	***: a. Gentianales***
Oleaceae	*Jasminum (sambac, grandiflorum)*
	Nyctanthes (arbor-tristis)
	Fraxinus (floribunda, excelsior)
Salvadoraceae	*Salvadora (persica)*

Apocynaceae	*Rauvolfia (serpentina)*
	Alstonia (scholaris)
	Holarrhena (antidysenterica)
	Wrightia (zeylanica)
	Nerium (odorum)
	Thevetia (neriifolia)
	Strophanthus (sp.)
	Ichnocarpus (frutescens)
Asclepiadaceae	*Hemidesmus (indicus)*
	Oxystelma (esculentum)
	Calotropis (gigantea)
	Daemia (extensa)
	Gymnema (sylvestre)
	Tylophora (asthmatica)
Loganiaceae	*Strychnos (ignatii, nux-vomica, potatorum)*
	Fagraea (fragrans)
Gentianaceae	*Exacum (bicolor)*
	Enicostemma (littorale)
	Canscora (decussata)
	Gentiana (kurroo)
	Swertia (chirata)
Order	***: b. Polymoniales***
Boraginaceae	*Cordia (myxa)*
	Heliotropium (indicum)
	Onosma (echioides, bracteatum)
Convolvulaceae	*Argyreia (speciosa)*
	Ipomoea (hederacea, digitata, turpethum, purga)
	Cuscuta (reflexa)
	Convolvulus (scammonia)
Solanaceae	*Solanum (nigrum, dulcamara, indicum, melongena)*
	Capsicum (frutescens)
	Withania (somnifera, coagulans)
	Atropa (belladonna)
	Datura (stramonium, fastuosa)
	Hyoscyamus (niger)
	Nicotiana (tabacum)
Order	***: c. Personales***
Scrophulariaceae	*Herpestis (monniera)*
	Picrorhiza (kurrooa)
Bignoniaceae	*Oroxylum (indicum)*
Pedaliaceae	*Pedalium (murex)*
	Sesamum (indicum)
Acanthaceae	*Hygrophila (spinosa)*
	Andrographis (paniculata)
	Adhatoda (vasica)
	Rhinacanthus (communis)
Order	***: d. Lamiales***
Verbenaceae	*Gmelina (arborea)*
	Clerodendron (infortunatum)
Lamiaceae	*Ocimum (basilicum)*
(Labiatae)	*Ocimum (sanctum)*
	Mentha (arvensis)
	Origanum (vulgare)
	Hyssopus (officinalis)
	Lallemantia (royleana)
	Marrubium (vulgare)
Plantaginaceae	*Plantago (ovata)*
SUBCLASS	*: 3. MONOCHLAMIDEAE*
Series	: i. Curvembryeae
Nyctaginaceae	*Boerhaavia (repens)*

Amaranthaceae	*Amaranthus (spinosus)*
	Achyranthes (aspera)
Chenopodiaceae	*Chenopodium (botrys, ambrosioides)*
Series	***: ii. Multiovulatae aquaticae***
Polygonaceae	*Rheum (emodi)*
Series	***: iii. Multiovulatae terrestris***
Aristolochiaceae	*Aristolochia (indica)*
Series	***: iv. Microembryeae***
Piperaceae	*Piper (cubeba, longum, chaba, betle, nigrum)*
Series	***: v. Daphnales***
Myristicaceae	*Myristica (fragrans, malabarica)*
Lauraceae	*Cinnamomum (tamala, zeylanicum, glanduliferum)*
	Litssea (sebifera)
Series	***: vi. Achlamydesporae***
Thymelaeaceae	*Aquilaria (agallocha)*
Santalaceae	*Santalum (album)*
Series	***: vii. Unisexuales***
Euphorbiaceae	*Euphorbia (pilulifera, neriifolia, antiquorum)*
	Phyllanthus (emblica, urinaria, niruri)
	Jatropha (curcas)
	Aleurites (moluccana)
	Croton (tiglium)
	Acalypha (indica)
	Mallotus (phillippinensis)
	Ricinus (communis)
	Baliospermum (montanum)
	Manihot (utilissima)
Cannabinaceae	*Cannabis (sativa)*
Moraceae	*Morus (indica)*
	Ficus (benghalensis, elastica, religiosa, hispida, cunia, glomerata, carica)
	Antiaris (toxicaria)
	Artocarpus (integrifolia)
CLASS	*: II. MONOCOTYLEDONAE*
Series	***: i. Microspermae***
Juglandaceae	*Juglans (regia)*
Myricaceae	*Myrica (nagi)*
Fagaceae	*Quercus (infectoria)*
Salicaceae	*Salix (caprea)*
Orchidaceae	*Acampe (papillosa)*
	Eulophia (campestris)
	Orchis (mascula)
Series	***: ii. Epigynae***
Musaceae	*Musa (sapientum)*
Zingiberaceae	*Curcuma (angustifolia, aromatica, zedoaria, amada, longa)*
	Kaempferia (rotunda, galanga)
	Hedychium (spicatum)
	Amomum (subulatam)
	Zingiber (officinale, zerumbet)
	Costus (speciosus)
	Elettaria (cardamomum)
	Alpinia (galanga, calcarata, allughas)
Marantaceae	*Maranta (arundinacea)*
Bromeliaceae	*Ananas (sativa)*
Iridaceae	*Iris (foetidissima)*
	Crocus (sativus)
Amaryllidaceae	*Curculigo (orchioides)*
	Crinum (asiaticum)
	Agave (americana)

Series	***: iii. Coronarieae***
Liliaceae	*Smilax (ferox)*
	Asparagus (adscendens, sarmentosus)
	Allium (cepa, sativum)
	Urginea (indica)
	Scilla (indica)
	Colchicum (luteum)
	Gloriosa (superba)
Series	***: iv. Calycinae***
Aracaceae	*Areca (catechu)*
(Palmae)	*Phoenix (sylvestris, dactylifera)*
	Calamus (draco)
	Borassus (flabelliformis)
	Cocos (nucifera)
	Lodoicea (seychellarum)
Pandaneae	*Pandanus (fascicularis, odoratissimus)*
Series	***: v. Nudiflorae***
Aroideae	*Pistia (stratiotes)*
(Araceae)	*Colocasia (antiquorum)*
	Alocasia (indica)
	Scindapsus (officinalis)
	Acorus (calamus)
Series	***: vi. Glumaceae***
Cyperaceae	*Cyperus (scariosus, rotundus)*
Gramineae	*Cymbopogon (citratus, flexuosus, martinii, muricatus, nardus, schoenanthus)*
(Poaceae)	*Bambusa (arundinacea)*
	Cynodon (dactylon)
	Hordeum (vulgare)
	Oryza (sativa)
	Triticum (sativum)
	Saccharum (officinarum)
SUBDIVISION	*: GYMNOSPERMAE*
Pinaceae	*Juniperus (communis)*
(Coniferae)	*Pinus (longifolia)*
	Cedrus (deodara)
	Abies (webbiana)

III. CULTIVATION OF MEDICINAL PLANTS

Most of medicinal plants, even today, are collected from wild. The continued commercial exploitation of these plants has resulted in receding the population of many species in their natural habitat. Vacuum is likely to occur in the supply of raw plant materials that are used extensively by the pharmaceutical industry as well as the traditional practitioners. Consequently, cultivation of these plants is urgently needed to ensure their availability to the industry as well as to people associated with traditional system of medicine. If timely steps are not taken for their conservation, cultivation and mass propagation, they may be lost from the natural vegetation for ever. In situ conservation of these resources alone cannot meet the ever increasing demand of pharmaceutical industry. It is, therefore, inevitable to develop cultural practices and propagate these plants in suitable agroclimatic regions. Commercial cultivation will put a check on the continued exploitation from wild sources and serve as an effective means to conserve the rare floristic wealth and genetic diversity.

It is necessary to initiate systematic cultivation of medicinal plants in order to conserve biodiversity and protect endangered species. In the pharmaceutical industry, where the active medicinal principle cannot be synthesised economically, the product must be obtained from the cultivation of plants. Systematic conservation and large scale cultivation of the concerned medicinal plants are thus of great importance. Efforts are also required to suggest appropriate cropping patterns for the incorporation of these plants into the conventional agricultural and forestry cropping systems. Cultivation of this type of plants could only be promoted if there is a continuous demand for the raw materials. There are at least 35 major medicinal plants that can be cultivated in India and have established demand for their raw material or active principles in the international trade (table). It is also necessary to develop genetically superior planting material for assured uniformity and desired quality and resort to organised cultivation to ensure the supply of raw material at growers end. Hence, small scale processing units too have to be established in order that the farmer is assured of the sale of raw material. Thus, cultivation and processing should go hand in hand in rural areas.

In order to initiate systematic cultivation of medicinal and aromatic plants high yielding varieties have to be selected (table 8). In the case of wild plants, their demonstration would require careful development work. Sometimes high yielding varieties have also to be developed by selective breeding or clonal micropropagation. The selected propagation materials have to be distributed to the farmer either through nurseries or seed banks. Systematic cultivation needs specific cultural practices and agronomical requirements. These are species specific and are dependent on soil, water and climatic conditions. Hence research and development work has to be done to formulate Good Agricultural Practices (GAP) which should include proper cultivation techniques, harvesting methods, safe use of fertilizers and pestisides and waste disposal.

Table 8. New varieties of medicinal plants developed in India (Gupta, 1993)

Crop	**Variety**	**Characters** (Institution where developed)
Psyllium *Plantago ovata*	Gujarat Isabgol-1	High seed yield (1t/ha) with synchronous maturing of seed (GAU, Anand)
	Gujarat Isabgol-2 (GI-2)	Seed yield of 1t/ha, moderately resistant to downy mildew disease(GAU, Anand)

Opium poppy *Papaver somniferum*	Jawahar Aphim-16 (JA-16)	White flowered with serrated petals, produces oval capsules maturing early at 105-110 days for lancing. Yield 66kg of latex averaging 10% of morphine (JNKVV, Mandsur)
	Trishna (IC-42)	Medium dwarf, pink flowered, serrated petals. Produces large bumble-shaped capsules, high latex and morphine content.(over JA-16) (NBPGR, Delhi)
	Udaipur Opium (UO-285)	High latex yield in Rajasthan tract (58kg/ha) with high morphine content (12.3%) and high seed yield (1.2t/ha) (RU, Udaipur)
	NRBI-3	High latex yield in central and eastern UP. Latex yield 47-57.54kg/ha. (NBRI, Lucknow)
	Kirtiman (NOP-4)	Latex yield 45.84kg/ha, morphine content 11.94% in eastern U.P. Moderately resistant to downy mildew (NDUA & T, Faizabad)
	Sweta (GS-24)	With pale white peduncle, produces 66.5kg latex/ha with 18% morphine (CIMAP)
	Shyama (IS-34)	Foliage erect and incised, bears black flowering stalk. Produces 78.1% latex with 15.5% morphine (CIMAP).
Sarpagandha *Rauvolfia serpentina*	RS-1	High seed germination (50%). Root yields 2.5t/ha in 18 months. Roots carry 1.45-1.80% of total alkaloids; half of it yields reserpine + serpentine combined (JNKVV, Indore)
Dioscorea floribunda	FB(C)-1	A composite culture, produces fast growing vines relatively free from diseases and pest attack; produces 50t/ha of fresh tubers in 2 years containing 3.5% diosgenin (IIHR, Bangalore)
	Arka-Upkar	Selection through hybridisation, producing 60t of fresh tubers containing 3.5-4.0% diosgenin (IIHR, Bangalore)
Khasi-kateri *Solanum viarum*	Glaxo	Plants devoid of spines, produces high berry yield at high density planting containing 2.5-3.0% solasodine (Glaxo, India).
	IIHR 2n-11	Completely devoid of spines, produces high berry yield at high density planting containing 2.5-3% solasodine (IIHR, Bangalore)
Kangaro kateri *Solanum laciniatum*	EC-113465	Long duration crop (300 days) suitable for temperate regions. High solasodine content in leaves (1.8%) and mature berries (4%) (YSPHU, Solan)
Henbane *Hyocyamus niger*	IC-66	Short duration (100 days), early *rabi* crop in plains. Yields 2.5t/ha of dry herb with minimum 0.05% total alkaloids (NBPGR, Delhi)
	Aela	A mutant characterised by yellow flower petals, produces 7.5t/ha dry herb or 23kg total alkaloids/ha (CIMAP)
Egyptian Henbane *Hyocyamus muticus*	Auto-tetraploid	Vigorously growing and high seed fertile mutant, produces 4.5t/ha of dry herb or 23kg total alkaloids/ha (CIMAP)
Senna *Cassia*	ALFT-2	Late flowering type, tailored to produce purely leaf crop in one harvest at 100 days. Foliage sennoside

angustifolia		content (6.0%) (GAU, Anand)
Japanese mint *Mentha arvensis* var. *piperascens*	MAS-1	Yields fresh herb of 37.2t/ha in 2 cuttings; containing 0.8-1.0% oil with high leaf/stem ratio. Matures 10-15 days early. Oil yield 290kg/ha containing 83% menthol (CIMAP)
	MAS-2	Fresh herb yield 69t/ha, oil 348kg/ha (CIMAP)
	Hyb-77	A tall vigorous, compact growing type, cross of MAS-2 x MA-2. Produces 78.2t/ha fresh herb, oil yield 486kg/ha with 81.5% menthol. Highly resistant to leaf spot and rust diseases (CIMAP)
	Siwalik	Introduced from China, produces compact bushy growth with thick leathery leaves, high herb and oil yield.
	EC-41911	A progeny selection of interspecific cross between *M. arvensis* and *M. piperita* in USSR. High herbage yield with high oil content (0.8-1%); oil contains 70-80% menthol (YSPHU, Solan).
Ocimum gratissimum	Clocimum	High herbage yield with high oil content, 75% eugenol (RRL, Jammu).
Thymol basil *O. viride*	Thymol type	Herb yield 3t/ha, 59kg/ha oil/annum. (CIMAP, Lucknow)
Sacred basil *O. sanctum*	EC-1828893	Superior selection with high oil yield 55l/ha in 110 days containing 53% eugenol and 19% caryophylline (NBPGR, Delhi)

Taking into consideration the requirements of the plants selected, an agrotechnological package has to be developed to suit the infrastructural facilities available. Research and development work has also to be carried out in the following areas (Silva, 1997).

1. Optimisation of agronomical conditions for cultivation
2. Training in safe fertiliser and pesticide use
3. Development of fast growing varieties with disease resistance
4. Determination of maturity and time of harvesting
5. No. of economically viable harvests
6. Methods of harvesting.

Decision on a limited scale of exploitation of medicinal plants from wild sources has to be based on accurate inventories about the kinds of plant resources, abundance and the feasibility of harvesting without damage to the ecosystem. In case potential candidates identified are not abundantly available, cultivation of them through agroforestry and community forestry programmes will have to be initiated. In this regard, development of industries based on medicinal plants can be included as a priority area as niche markets for these are already available.

Organic Farming

In the recent times, agricultural scenario is witnessing a trend towards organic farming. It is seen that agricultural products produced through organic farming, without using any inorganic fertilisers and pesticides, fetch high demand and price in the international market.. Organic farming has its root in Nature and it makes use of only organic materials. It observes and learns from nature. It believes that soil has life and cares about its fertility. It protects the flora and fauna of the soil. Organic farming is not for a single crop but it envisages the entire farm. The main objective of organic farming includes mulching, crop rotation, cover cropping green manuring, animal waste, composting, bio-gas slurry, biofertilisers and organic recycling. The energy sources are windmills, solar panels, small-scale hydroelectric projects and biogas. The changeover from inorganic to organic farming is to be carried out only systematically and carefully. Organic farming can be adopted in crops too by decreasing the

dose of inorganic fertilisers rather than an immediate removal and adopting organic farming practices timely and correctly.

Farmers have to be trained in all aspects of organic farming including obtaining certification from associations that do the monitoring, starting from cultivation to final harvesting. As chemicals cannot be used as fertilizers and pest control agents, the cultivation is labour intensive requiring labour for weeding and other farming activities. Hence, developing countries, which have cheap labour and unpolluted land, can opt for organic cultivation. Organic manure has to be prepared which leads to environment friendly methods of organic waste disposal. Organic farming will reduce environment pollution, toxic effects due to use of pesticides and minerals and problems of biodiversity conservation.

The trend for green products is also increasing and it is expected that the industrialised countries will insist on ecolabelling of products in tune with ISO 14000 as a condition of import. This will mean that any product produced has to be certified to ensure that no ecological damage what so ever has been caused during the production process.

IV. PROCESSING AND UTILIZATION

Medicinal principles are present in different parts of the plant like root, stem, bark, heartwood, leaf, flower, fruit or plant exudates. These medicinal principles are separated by different processes; the most common being extraction. Extraction is the separation of the required constituents from plant materials using a solvent. In the case of medicinal plants, the extraction procedure falls into two categories (Paroda, 1993).

a) Where it is sufficient to achieve within set limits equilibrium of concentration between drug components and the solution. Eg. Tinctures, decoction, teas, etc.

b) Where it is necessary to extract the drug to exhaustion, ie., until all solvent extractables are removed by the solvent.

Both the methods are employed depending on the requirement although in industry the latter method is mostly used. In all industrial procedures, the raw material is pre-treated with solvent outside the extractor before changing the latter. This prevents sudden bulk volume changes (which are the main cause of channelling during extraction) and facilitates the breaking up of the cell walls to release the extractables. To facilitate the extraction, the solvent should diffuse inside the cell and the substance must be sufficiently soluble in the solvent. The ideal solvent for complete extraction is one that is most selective, has the best capacity for extraction and is compatible with the properties of the material to be extracted. These parameters are predetermined experimentally. The cost and availability of the solvent are also taken into account. Alcohol, though widely used, because of its great extractive power it is often the least selective, in that it extracts all soluble constituents. Alcohol in various ratios is used to minimise selectivity. The ideal alcohol ratio for woody or bark material is 75%. For leafy material, it is often less than 50% thus avoiding extraction of the chlorophyll which makes purification difficult.

Some materials such as alkaloids being soluble in acids, their extraction is facilitated by adjusting the pH in the acidic range. A number of alkaloids can be extracted easily with hydrocarbons after they have been released from combination with organic acids by grinding with alkali. It is first ground with moist calcium oxide and extracted with chloroform. A large number of alkaloids can be extracted directly with aqueous acids, organic or inorganic acids, and the alkalised extracts counter extracted with hydrocarbons or other apolar solvents.

Experiment used for extraction with solvents usually comprise an extraction vessel with a heating jacket for steam heating or fitted with electrical devices, a condenser in reflux position, a solvent reservoir, a facility to convert to reboiler position or a separate reboiler and a short column for solvent recovery. Some times, sophisticated and costly equipment like the Carousel or the Inoxa extractor is employed.

Technology for the manufacture of standardised extracts and phytochemicals is available and there are many extracts already in the international market as drugs. A drug such as an extract of *Centella asiatica* can be manufactured as an extract containing a standard quantity of asiaticoside. Similarly for senna a standardised extract of which, containing a standard quantity of sennosides a and b could easily be produced with equipment that can be designed and constructed in most developing countries (Wijesekera, 1991).

The promotion and development of processing of medicinal and aromatic plants have gained momentum recently in many developing countries. Green consumerism and resurgence of interest for plant based products, liberalised and free market economy, increasing awareness about biodiversity conservation and sustainable use of natural resources coupled with poor socio-economic conditions of native populations are ground realities for planning and harnessing the low-cost and purpose oriented process technologies.

UNIDO has developed a Polyvalent Pilot Plant with a view to enabling developing countries to upgrade their technology for the processing of medicinal and aromatic plants. This plant incorporates all salient features of a low cost, efficient, small capacity factory which can carry out solvent extraction, solvent percolation, concentration of miscella, solvent recovery, steam distillation and oil separation (UNIDO, 1991; Silva, 1997). The design and

fabrication of the process equipment need not be over emphasised, as even if a good design is available for adaptation, it must be done to fit the given situation.

The polyvalent plant is characterised by simplicity of design, installation, operation, maintenance and repair. Some of its features are

1. Modular construction so as to permit increase in capacity and function by duplicating or adding modules.
2. Simultaneous processing for more than one product, such as extraction at one end, production of solid extract or oleoresins at the other.
3. Standardised or optimised process control and measuring units, pumps and other ancillaries can be easily replaced.
4. All plumbing and electrical wiring are simple and easily accessible.
5. Multipurpose uses. Eg. Solvent/aqueous extraction, continuous extraction, preparation of solid extract and oleoresins, essential oil distillation, fractionation of essential oils and production of absolutes and concretes or even processing of other phytoproducts.

Formulation and Industrial Utilisation

Medicinal plants are used as raw materials for extraction of active constituents in pure form (eg. alkaloids like quinine and quinidine from cinchona bark, emetine from ipecacuanha root, glycosides from digitalis leaves, sennosides from senna leaves), as precursors for synthetic vitamins or steroids, and as preparations for herbal and indigenous medicines. Products such as ginseng, valerian and liquorice roots are part of the herbal and health food market, as well as the food flavours, fragrance and cosmetic industries. Certain plant products are industrially exploited like liquorice in confectionery and tobacco, papaine as meat tenderiser, quinine as soft drink tonic and cinchona as wine flavour. A large quantity of medicinal plant material is used in the preparation of herbal and medicinal teas, eg. chamomile. These herbal and food uses are of great importance, also to the exporters from developing countries. Hundreds of medicinal plants are items of commerce, however relatively small countries are used in formulated herbal remedies.

Several formulations like herbal teas, extracts, decoctions, infusions, tinctures, etc are prepared from medicinal plants (Kraisintu, 1997).

1. **Herbal teas, Herbal remedies**: herbal tea or infusion mixtures are mixture of unground or suitably ground medicinal plants to which drug plant extracts, ethereal oils or medicinal substances can be added. Infusion mixtures should be as homogenous as possible.
2. **Drug extracts**: They are preparations obtained by extracting drugs of a certain particle size with suitable extraction agents (menstrua). The extract obtained after separation of the liquid from the drug residue is called miscella. It may already represent the final liquid dose form eg. as a so called fluid extract, or be used as an intermediary product which is to be further processed as quickly as possible.
3. **Aqueous drug extracts**: The following degrees of comminution are used for the extract depending on the type of plant parts. Leaves, flowers and herbs shredded (4000mm); woods, barks and roots shredded (2800mm); fruits and seeds (2000mm). Alkaloid containing drugs powdered (700mm).

3.1. **Decoctions**: The drug in the prescribed comminution is put in to water at a temperature above 90°C. The container is suspended in a water bath and maintained at this temperature for 30 minutes, with repeated stirring. The mixture is then strained while still hot.

3.2. **Infusions**: One part of the comminuted drug is kneaded several times in a mortar with 3-5 parts of water and left to stand for 15 minutes. The rest of the boiling water is then poured on to the mixture, which is suspended in a container in a water bath and kept for 5 minutes, with repeated stirring at a temperature above 90°C. The mixture is covered and left to stand until cool.

3.3. **Macerates**: The comminuted drug is left to stand, with occasional stirring, for 30 minutes after the required quantity of water has been poured on to it at room temperature. The extract is then strained and made up to the prescribed weight with rinsings.

3.4. **Tinctures**: Tinctures are extracts from drug plants prepared with ethanol of varying concentration, ether or mixtures of these, perhaps with certain additives, in such a way that one part of drug is extracted with more than two parts, but at most ten parts, of extraction liquid.

3.5. **Fluid extracts:** Like tinctures, they are liquid preparations, the difference being that they are more concentrated.

3.6. **Dry extracts:** They are usually very hygroscopic and should therefore be ground and mixed under conditions which exclude moisture as much as possible. Intermediate and end product must also be stored under dry conditions.

There are also liquid, semisolid, solid and controlled release formulations or preparations. The other dose forms are injections, implants, ocular preparations, inhalations and transdermal systems. Liquid formulations may be solutions, emulsions, colloids or suspensions in the increasing order of particle size. They may be intended for administration parenterally, orally or topically including administration into body cavities. Homogeneity for the formulations is very important, particularly where the active ingredient is present in lower concentration.

A generalised production scheme include the following (Kraisintu, 1997):

1. Pre-processing: Washing, particle size optimisation, moisture reduction, refinement or concentration.
2. Solublisation: Insolubles removal, product stabilisation.
3. Primary extraction: Primary contaminations removal.
4. Purification: Secondary contaminations removal, decolourisation, concentration, recemization
5. Derivatization (optional): Chemical modification.
6. Drying(optional): Lyophilization or spray drying

Compounding of drugs

According to the guidelines of formulations, a prescription is composed of four different component parts of ingredients as given below (Jiaxiang, 1997).

1. The principal ingredient which provides the principal curative action
2. The adjuvent which strengthen the principal action
3. The auxillary ingredient which relieves secondary symptoms or tempers the action of principle ingredient
4. The conductant which directs action to the affected conduit or site. It may also be a less significant auxillary ingredient.

The introduction of a polyvalent pilot plant has been the most significant contribution of UNIDO to the development of the industrial utilisation of medicinal and aromatic plants in developing countries. The gap that prevented the transfer of processes and products developed on a laboratory to industry can be bridged by introducing pilot plant processing facility and multidisciplinary teamwork. Many research and development institutions in developing countries lacked the support of their engineering counter parts and most research therefore was confined to academic pursuits. If one is to undertake commercial production of herbal medicines, the vital role played by chemical engineers in translating laboratory findings to industrial scale outputs through pilot scale process parameter development has to be recognised.

Developing countries need to build up technological and scientific capabilities to develop and improve the production of medicinal principles for use in their countries and to conduct R&D to develop products for export thereby, enabling countries to supply new markets which are being created as a result of consumer orientation of societies, increasing affluence and demand for green products. Sustainable use of this renewable natural resource

will not only contribute to rural industrial development and poverty alleviation but also to biodiversity and forest conservation.

Requirement for plant based industries

Major requirements for establishing medicinal and aromatic plant based industries in developing countries are the following (Silva, 1997):

- Availability of natural forest resources capable of being sustainably harvested.
- Initiation of systematic cultivation programmes
- Selection of plants for processing based on facilities available and marketability
- Fabrication or procurement of equipment, provision of required services (water, energy, chemical)
- Transfer of expertise on agronomical practices, harvesting and post-harvest treatment.
- Training in methods of processing and quality control
- Actual processing with assistance from experts and NGO's and international agencies
- Packaging and storage of finished products
- Marketing outlets

In some cases the primary processed product could be used as a raw material for downstream processing such as production of medicinal principles, aroma chemicals, isolates, flavours, perfumes, extraction of pure chemicals and other consumer products. The following aspects have to be taken into consideration in designing country specific programmes for implementation.

- Suitability of climate and soil conditions
- Availability of raw materials
- Economic benefit, if any from export as well as import substitution
- Factors that hinder systematic cultivation and industrial production.
- Appropriate technologies that could be absorbed
- Prospects for regional, inter regional and global co-operation
- Inter agency co-operation and collaboration
- Other issues such as conservation, energy, employment generation and involvement of women.

V. STORAGE OF MEDICINAL PLANTS OR CRUDE DRUGS

Dry extracts are usually very hygroscopic and should therefore be ground, mixed under conditions, which exclude moisture as much as possible. Intermediate and end products must also be stored under dry conditions. Annealing or sealing of the products in suitable moisture tight synthetic foils has proved a good method for this.

Requirement of packaging materials

The general requirements of packaging materials are the following (Kraisintu, 1997)

1. Economical or low cost
2. Impermeable as glass or metal or of acceptable permeability to moisture, gases, volatile solvents etc.
3. Non reactive-relatively inert with no extraction, exchange or interaction
4. Easy to manufacture in a wide range of shapes, preferably by a number of manufacturing processes.
5. Easy to decorate and /or print by a range of processes
6. Good production line efficiency-performance, with the minimum of rejects or wastage.
7. Effective as a pack(container and closure), i.e., easy to open and reclose and use if multidose; or open if single dose, whilst meeting any special requirements such as child resistance, tamper evidence or resistance, etc.
8. Easy to produce and maintain clean
9. Preferably readily available both in terms of source of supply for raw materials and as a converted item component from several suppliers.
10. Environmentally friendly
11. Able to optimise use of space when stacked or during transportation.

Types of Packing Materials

The common types of packaging materials currently available are given below (Kraisintu, 1997)

1. Glass: It can be found as several variants such as treated soda glass, soda glass and non parenteral.
2. Metals: A variety of metals including tin plate(tin coated mild steel) tin free steel, aluminium, aluminium alloys are widely used in packaging, being found as rigid containers, collapsible containers, aluminium foils, metalised coatings etc.
3. Plastics: There are five economical materials for rigid type of containers i.e., those based on polyethylene (PE), polypropylene(PP), Polystyrene(PS), PVC and polyester.
4. Elastomeric materials: Elastomers can be found as a wide range of basic materials (i.e., natural rubber, synthetic polyisoprene, neoprene, nitryl, butyl, including bromo-and chloro butyl, ethylene propylene diene modified (EPDM), acid silicone elastomers.)

VI. QUALITY AND EVALUATION

A major lacuna in Ayurveda is the lack of drug standardisation, information and quality control. Most of the Ayurvedic medicines are in the form of crude extracts which are a mixture of several ingredients and the active principles when isolated individually fail to give desired activity. This implies that the activity of the extract is the synergistic effect of its varies components. In the absence of pharmacopeic data on the various plant extracts, it is not possible to isolate or standardise on the active contents having the desired effects. Ayurvedic pharmacopoeia compiled on modern lines and updated periodically is an urgent requirement. Research on the rationale and methodology of Ayurvedic medical practice; isolation of active constituents and their development into new therapeutics; standardisation and validation of known herbal medicines and other related aspects are needed (Sharma, 1997).

These are some problems concerning the proper identity of a number of drug species. In many cases, a single plant species has several different commercial or medicinal names in different regions. Several distinct species are often used under the same drug name. Another problem relates to adulteration in the market samples. In other words, authentication of the botanical identity and ascertaining the genuineness of drug is great concern in practical situation. To some extent, it can be overcome by drug characterisation which is done by estimating their active principles, recording the anatomical features under microscope and their curative effects by clinical trials. When the botanical identity of the plant is controversial, it is better to go for estimation of the therapeutic agent responsible for the curative effect ascribed to the species. The species rich in the ascribed compound should be taken as the genuine drug, those with relatively small amounts may be accepted as substitute of the original drug, and those lacking the required constituents may be rejected.

Quality control of the phytoproducts for human consumption and world market can be ensured by maintaining the quality of raw material adequacy of processing technology and quality of the finished products. Thus, the quality concept commences right from the choice of authentic and improved seeds (varieties) to the post harvest treatment of the raw material and to the process control for avoiding contamination. As such for developing phytoproducts, WHO's, Good Manufacturing Practice (GMP) must be followed to satisfy the ISO 9000 certification. Recently, ISO 14000 certification has also become necessary to safeguard the environment. This means certifying that the product has been developed without inflicting ecological damage whatsoever.

In general, during the drug production process, the raw materials are subjected to macroscopic and microscopic examination and physicochemical parameters such as ash values, analysis of ash for major elements such as Sodium, Potassium and Calcium, alcohol soluble and water soluble extractive values and fluorescence analysis, quantitative estimation of phytoconstituents such as total tannins, total glycosides, total alkaloids, total resins and total sugars of the raw materials as well as the formulations was carried out. The formulations were also evaluated for the general parameters such as organoleptic properties, pH, viscosity, specific gravity, optical rotation and refractive index. High Performance Thin Layer Chromatography (HPTLC) technique was employed to obtain characteristic HPTLC *fingerprints* of the individual raw materials and formulations. Using the spectral patterns of the separated components, the presence of certain raw materials in the formulations could also be established. Batch to batch variation was also studied using HPTLC *fingerprinting* technique.

General scheme for quality assurance of crude drugs and raw materials

The general scheme for quality assurance of crude drugs and raw materials as suggested by Pei-Gen and Hui-zhen (1997) is given below.

1. Importance of quality assurance of crude drugs and raw material:
   a) Guarantee the best final pharmaceutical products.
   b) Environmental protection
   c) Sustainable utilisation and development of natural resource
2. Criteria of good quality:
   a) Good efficacy- high active ingredient, high yield
   b) Good safety-less toxicity and side effects, minimum pesticide residues, minimum heavy metals
   c) Purity
   d) Stability
3. Genebank conservation (see also table 9):
   a) Biodiversity conservation
   b) To store plant germplasm for future uses
   c) To make germplasm available to create new cultivars
   d) *Insitu* conservation- genebanks of medicinal and aromatic plants in Asia
   e) *Invitro* conservation
   f) Breeding
4. Biotechnology
   a) Plant cell culture eg. *Digitalis, Catharanthus*
   b) Hairy root culture eg. *Salvia, Glycyrrhiza uralensis, Datura stramoniun, Artemesia annua*
   c) Tissue culture eg. *Aloe, Crocus sativa, Mentha*
   d) Genetic engineering: Isolation and purification of an antifungal protein from *Phytolacca americana* against American ginseng pathogens and synthesis of its gene and expression in *E. coli.*
5. Suitable growth region: In order to get higher quality of crude drugs and raw materials selection of the most suitable growth region for relevant medicinal plant is quite important. According to the ecological conditions, flora and other criteria, several regions of crude drug development have been identified.
6. GAP: Good Agrotechnological Practices. Large cultivation of medicinal plants relies upon strong and continuing research. Plant varieties with an abundance of desired constituents can be reproduced and improved upon under cultivation even in an entirely different area. Eg. Cultivation of American ginseng (*Panax quinquefolia*) in China. Attempt should be made to select appropriate region based on similar ecological conditions to introduce good cultivated variety, improve yield of the desired secondary metabolite and reduce the undesirable constituents.
7. Non polluted cultivation: In order to protect the environment, to sustainably utilise the resources and to get a good quality of crude drug, non-polluted agrotechnology is rapidly developed in recent years. These products are commonly called as "Green crude drugs" This involve biological control of insects and pathogens and use of botanical pesticides for the control of pest and diseases.
8. Post harvest technology: Right time harvesting, good processing, good storage, extraction or distillation, quality control.

Table 9. Genebanks of medicinal and aromatic plants in Asia (Haq, 1993)

Country	Collections	Institutions

China	2500	IMPLAD Beijing and its 3 stations
India	1400	NBPGR, New Delhi; CIMAP Lucknow; AMPRS Odakkali
Korea	850	Medicinal plants gardens
Malaysia	450	National Research council and Kuala Lumpur city council gardens
Nepal	340	Royal Botanic gardens
Philippines	220	University Herbal garden, Los Banos
Sri Lanka	200	Royal Botanic garden, Kaudy
Thailand	100	Botanic gardens

Quality control requirement of new preparation of traditional medicines

1. Prescription and its basis
2. Literature and research data of physico-chemical characteristic concerned with quality
3. Preparation technology and its research references
4. The draft of the quality standard and explanation of medicinal material, and medicament.
5. Literature and test data of initial stability for clinical research
6. The reports of quality detection and hygiene standard detection of the preparation for clinical research
7. Property and specification of the packing material of the medicament, design draft of the label and applied instructions

General requirement of quality control standard of medicament

1. Quantitative determination of the effective compound or indicative component of 1-2 species of main medicinal materials in the prescription
2. Qualitative identification of several to half of the medicinal materials in the prescription
3. Determination of content of Pb, Cd, Hg, As and limit test of heavy metals in medicines
4. Hygienic standard: bacteria < 1000/1gm, mould < 100/1gm, colibacillosis-nil
5. Determination of pesticide residues (organic Cl and P) in the medicament

The general scheme for quality assessment of botanicals

The general scheme for quality assessment of botanicals as suggested by Kraisintu (1997) is as follows.

I. Assessment of crude plant materials

1. General description of the plant
2. Parts used
3. Production of crude drugs-cultivation, harvesting, post-harvest handling, packing, storage.
4. Quality specification: Chemical or chromatographic identification, foreign organic mater limit, ash content, acid insoluble ash content, water soluble extractive, alcohol soluble extract, moisture content, active constituent content, microbial limit, pesticide residue limit, heavy metal limit, likely contaminants, adulterants.

II. Assessment of finished products

1. Tablets: Weight variation, disintegration time, identification of preservatives and active ingredients, determination of extractives in various solvents, microbial limit, heavy metals.
2. Solutions: pH, identification of preservatives and active ingredients, alcohol content, microbial limit, Sodium Saccharic content.
3. Infusions: Weight variations, identification of preservatives and active ingredients, determination of extractives in various solvents, microbial limit, heavy metals, Borax.

III. Chemical Standardisation methods: TLC/HPTLC, HPLC,GLC,FTIR

IV. *Chemical Markers:* Specification for raw materials, quality assurance in process control, standardisation of product, obtaining stability profiles, single marker vs. *fingerprint*.

V. Parameters of assay validation: Linearity, limits of quantification and detection, precision, robustness, recovery.

Complex and variable mixtures, choice of compounds to quantify, difficult sample preparation, lack of pure reference standards, lack of methods with adequate tolerances by analytical chemistry standards are some of the challenges in Chemical Standardisation of plant drugs.

International scheme for quality assurance of pharmaceutics

International scheme for quality assurance of pharmaceutics involves the following standard practices.

GAP: Good Agricultural Practice
GLP: Good Laboratory Practice
GMP: Good Manufacturing Practice
GCP: Good Clinical Practice
GALP: Good Analytical/Automated Laboratory Practice

Quality has to be built into the whole process beginning from the selection of propagation material to the final product reaching the consumer. It is therefore a management system where all steps involved in the industrial utilisation process have to be properly and strictly controlled to produce the desired quality products. The requirements for ISO 9000 certification have to be introduced and personnel trained so that enterprises could introduce the proper systems needed for certification. The control of the quality of the raw materials, finished products and of processes is an absolute necessity, if one is to produce goods for world markets and human use. Monographs have to be prepared for each product to include all specifications developed. Modern analytical techniques have to be extensively used to develop identity and quality parameters. The machinery and processes used in industries have to be validated to comply with international standards. It is imperative that the processed products comply with national and/or international specification. There are International Standard Organisation Specification (ISO) for many of the products. In addition, countries and buyers can have their own requirements. Hence the products could be tailor made to conform to the buyers' requirements. Sometimes the requirements of the buyers are more stringent and specific, demanding the application of good manufacturing procedures. Associated with quality management is the compliance with current good manufacturing practices. WHO requirements of good manufacturing practices have to be introduced in every project as most developing countries fall very short of GMP. Without GMP products can not be expected to be of required standards and quality. The concept of safety is almost non-existent in many developing countries. Safety requirements with respect to buildings, machinery and staff have to be introduced and if possible, safety manuals have to be prepared in order to focus the attention of the management and staff on these issues. Stringent requirements are being introduced presently to safeguard the environment, to reduce pollution caused by use of synthetic materials and to conserve the biodiversity. Hence eco-audit procedures will be required for safeguarding environmental damage. Organic production will reduce the risks of contamination of products and the environment with synthetic chemicals. In fact ISO 14000 requirements may have to be met in the future if the buyers insist on eco-labelling.

Modern approach to standardisation comprises mainly examination of organoleptic characters and qualitative estimation of some salts, minerals, ash contents, pH value, etc.

There is one basic difference of outlook between the Ayurvedic and modern Allopathic system regarding the therapeutic use of drugs. While in Ayurveda, whole drug is used, in Allopathy the isolated active ingredient present in the drug is used. Ayurvedic drugs act moderately and gradually, but Allopathic drugs react severely and quickly.

Charak has prescribed the following four standards for effective drugs.

1. Which grow in proper season

2. Have attained maturity in taste, potency and smell
3. Whose smell, appearance, taste and touch remains unvitiated by the effect of weather, fire, air and insects.
4. Fresh

Sushruta has propounded a general principle regarding acceptability of plants for use as medicine.

A drug may be accepted for use whether it is new or old provided its odour has not vitiated and its taste etc., not deteriorated.

TROPICAL MEDICINAL PLANTS

Tropical countries are a treasure house of a wide variety of medicinal plants. Some species are found wild, while a number of species have been domesticated by the farmers. Many species have been grown in homesteads and become part of traditional home remedies. A limited number of species are commercially cultivated though a few more have potential for large-scale production. The important tropical and subtropical medicinal plants are discussed here highlighting the importance, medicinal and other uses, distribution, botany, agrotechnology, chemical constituents and activity. For practical convenience of the discussion in this book, they are classified under the following four broad groups.

a) Medicinal herbs
b) Medicinal shrubs
c) Medicinal climbers
d) Medicinal trees

AMBRETTE *Abelmoschus moschatus* *Malvaceae*

San: Latakasturika Hin, Guj, Ben: Mushkdana Mal: Kasthurivenda Mar: Kasthuri- bhendi Tel: Kasturi benda Tam: Varttilaikasturi Kan: Kasturi bende Ass: Gorukhiakorai

Importance

Ambrette, also popularly known as musk or Muskmallow, is an erect annual herb which yields musk-like scented seeds and woos everybody through its sensuous **musky** fragrance. Every part of this medicinal plant is used in one or the other way . Seeds are effective aphrodisiac and antispasmodic, and used in tonics. They check vomiting and cure diseases due to *kapha* and *vata* and are useful in treating intestinal disorders, urinary discharge, nervous disorders, hysteria, skin diseases, snake bites, pruritus, leucoderma and general debility. Flower infusion is contraceptive. The leaves and roots are used for gonorrhoea and to treat boils and swellings.

Ambrette oil of commerce is extracted from the seeds and is used in perfumery, flavouring, cosmetic and agarbathi industries. The essential oil is employed in non-alcoholic beverages, ice-creams, candies and baked foods. The aromatic concrete and absolute, extracted from seeds are used as base material for preparing high grade perfumes, scents and cosmetics. It is also known for exalting, amplifying and diffusing effects it imparts to perfumes. It blends well with rose, neroli, and sandal wood oil and aliphatic aldehydes.

The flowers are in great demand for making *'zarda'* a flavoured tobacco in India. The seeds are mixed with tea and coffee for flavour. The seed is rich in essential amino acids and is used as cattle or poultry feed. The stem bark yields a good quality fibre. Seeds are used to protect woollen garments against moth and it imparts a musky odour to sachets, hair powder, panmasala and incense. Its tender shoots are used in soups, green pods as vegetable and seed husk in flower arrangements. From perfumes to panmasalas and tonics, it is the musky musk all the way. In addition to internal consumption, its seeds are exported to Canada, France and UK because of its diversified uses (Srinivasan *et al*, 1997).

Distribution

The musk plant is a native of India and it grows in the tropical subtropical and hilly regions of the country; particularly in the states of Maharashta, Gujarat, Madhyapresh, Tamil Nadu and Kerala. More than 50 collections of the plant are maintained by the National

Bureau of Plant Genetic Resources (NBPGR), New Delhi and its regional station in Akola, Maharashtra.

Botany

Abelmoschus moschatus Medicus syn. *Hibiscus abelmoshus* Linn. belongs to Family Malvaceae. Muskmallow is an erect annual or biennial hirsute or hispid herb of 60-180 cm height. The leaves are simple polymorphous, usually palmately 3-7 lobed; lobes narrow, acute or oblong-ovate, crenate, serrate or irregularly toothed, hairy on both surfaces. Flowers are large and bright yellow with purple centre. Fruits are fulvous, hairy and capsular. Seeds are many, subreniform, black or greyish - brown and musk scented (Husain *et al*, 1992).

Agrotechnology

Ambrette is a hardy plant which can be grown in varied climate under tropical and subtropical conditions. It can be grown both as a rainfed crop and as an irrigated crop. It grows on well drained loamy and sandy loam soils. Loamy soils with neutral pH and plenty of organic matter are ideal for its cultivation.

Musk of propagated through seeds. The optimum time of sowing is June-July with pre-monsoon showers. The land is prepared well by ploughing, harrowing and levelling. Well decomposed FYM or compost is incorporated into the soil at 10 - 15 t/ha. Ridges and furrows are formed giving a spacing of 60 - 100 cm. Seed rate is 2-3 kg/ha. Seeds are soaked in water before sowing for 24 hours. Two to three seeds are sown per hole at 60 cm spacing on one side of the ridge at a depth of 1 cm and covered with a pinch of sand or loose soil. It takes 5-7 days for proper germination. After germination, extra seedlings are thinned out leaving one healthy growing plant per hole within 20 days. Fertilisers are applied at 120:40:40 kg N, P_2O_5, K_2O/ha generally. However, a dose 160:80:80 kg/ha is recommended for best yields of seed and oil. Phosphorus is applied fully as basal. N and K are applied in 3 equal doses at planting, 2 and 4 months after planting. Fertilizers are applied 10 cm away from the plants. For irrigated crop, field is irrigated soon after sowing. Irrigation is given twice a week during the initial period and once a week thereafter. The field is kept weed free by regular weeding during the growing period (Farooqi and Khan, 1991).

Musk plants suffer from pests like spider mites, fruit bores and leaf eating caterpillars. Diseases like powdery mildew and wilt are also observed on the plant. Spider mites and powdery mildew are controlled by spraying 30g wettable sulphur in 10 litres of water. Pod borers can be controlled by spraying 20ml oxydemeton methyl in 10 litres of water.

The crop starts flowering about 75 days after sowing. The flowers set into fruits in 3-4 days and the pods take nearly a month to mature. Flowering and fruit setting extends from October to April. Harvesting is arduous. Fruits have to be plucked as soon as they attain black colour; otherwise, they split and seeds scatter. Therefore, weekly collection of pods is necessary and in all 20-25 pluckings may be required as it is a 170-180 days duration crop. The fruits are further dried and threshed to separate seeds. The seed yield is 1-1.5 /ha

Postharvest technology

. The oil is extracted from seed by steam distillation followed by solvent extraction. The concrete of solvent extraction is further extracted with alcohol to get the absolute, that is, the alcohol soluble volatile concentrate.

Properties and activity

The fatty oil of seeds contain phospholipids as 2 - cephalin, phosphatidylserine and its plasmalogen and phosphatidyl choline plasmalogen. Absolute contains farnesol and ambrettolic acid lactone. β- sitosterol and its β- d - glucosides are isolated from leaves. Petals contain β-sitosterol, flavonoid myricetin and its glucoside. Anthocyanins like cyanidin - 3 - sambubioside and cyanidin - 3 - glucoside are present in the flowers. (Chopra and Nayar, 1980)

Seeds are aphrodisiac, antispasmodic, diuretic, demulcent, antiseptic, stomachic, tonic, carminative, antihysteric, antidiarrhoeal, ophthalmic, cardiac and antivenum.

DATURA *Datura metel*

Solanaceae

San: Dhustura Hin.: Kaladhatura Ben: Dhatura Mal: Ummam Kan; Dattura Tam: Vellummattai Tel: Tellavummetta

Importance

Downy datura or thorn apple is an erect branched under shrub whose intoxicating and narcotic properties have been made use of by man from ancient time. The plant and fruit are spasmolytic, anticancerous and anthelmintic. Leaves and seeds are inhaled in whooping cough, asthma and other respiratory diseases. Root, leaf and seed are febrifuge, antidiarrhoeal, anticatarrhal and are used in insanity, cerebral complications and skin diseases. Leaf is antitumour, antirheumatic and vermicide. Flower is antiasthamatic, anaesthetic and is employed in swellings and eruptions on face. Fruit juice is used in earache and seed decoction in ophthalmia. For the rheumatic swellings of joints, lumbago, sciatica and neuralgia, warm leaf smeared with an oil is used as a bandage or sometimes the leaf is made into a poultice and applied. The root boiled with milk is used in insanity. It is also an ingredient in the ayurvedic preparation *Kanakasva* used in bronchial troubles, and the *Unani* formulations "*Roghan dhatura*" used as a massage oil for the paralysed part. The alkaloids of pharmaceutical interest present in the plant are **hyoscyamine, hyoscine** and **meteloidine**. Datura is the chief commercial source of hyoscine available from natural source. Hyoscine, in the form of hyoscine hydrobromide, is used as a pre-anaesthetic in surgery, child birth, ophthalmology and prevention of motion sickness. It is also employed in the relief of withdrawal symptoms in morphine and alcoholic addiction, paralysis agitans, post-encephaletic parkinsonianism and to allay sexual excitement. Hyoscyamine and its salt hyoscyamine sulphate and hyoscyamine hydrobromide are used in delerium, tremour, menia and parkinsonianism (Kaul and Singh, (1995).

Distribution

Datura is distributed throughout the world, particularly the warmer regions. *Datura stramonium* is indigenous to India. Out of 15 species reported from different parts of the world, only 10 are known to occur in India. They are found commonly in wastelands, gardens and roadsides. They are distributed in rich localities under semi-arid and arid regions of Punjab, Haryana, Rajastan, and Gujarat; the Central Plateau of Andhra Pradesh and Maharastra and the southern peninsular region of Tamil Nadu. *Datura innoxia* is indigenous to Mexico and is distributed in Latin American countries. A wealth of genetic stock on genotypes and varieties are maintained in several research institutes in Germany, Bulgaria, USSR and Poland.

Botany

The genus *Datura*, belonging to the family solanaceae, consists of annual and perennial herbs, shrubs and trees. Three species,viz, *Datura metel* Linn., *D. stramonium* Linn. *and D. innoxia* Mill. are medicinally important. *D. innoxia* mill. and *D. metel* Linn. (var. *alba*, and var, *fastuosa*) are the choice drug plants, rich in hyoscine. *D. metel* Linn. is the most common in India. The names, *D. metel* Linn., *D. fastuosa* Linn., *D. alba* Nees., *D. fastuosa* Linn. var. *alba* (Nees) C.B. Clarke and *D. metel* Linn. var. *fastuosa* (Linn.) Safford are synonymously used by many workers. Two varieties are often noted in *D. metel* Linn., namely the white flowered var. *alba* and purple flowered var. *fastuosa*. *D. metel* Linn. is an erect succulent branched undershrub divaricate often purplish branches and ovate pubescent leaves which are oblique at the base of lamina. Flowers are large, solitary, short pedicelled, purplish outside and white inside. Fruits are sub-globose capsules covered all over with numerous, fleshy prickles, irregularly breaking when mature. Seeds are numerous, smooth, yellowish brown. (warrier *et al*, 1994).

Agrotechnology

Datura grows well in a wide range of climate from tropical to temperate conditions. The plant thrives best in areas of low rainfall where winter and monsoon rains are followed

by long dry periods. Areas with annual rainfall below 1000mm with mean temperature of 10-15°C in winter and 27 - 28°C in May-June are ideal. The crop cannot stand frost, high rainfall or high temperature in the plains in May-June. It grows on majority of soils, however, alkaline or neutral clay loam soil or those tending to saline-alkaline reaction rich in organic matter are ideal for vigorous growth. The clayey, acidic, water-logged or moisture deficient soils do not suit this crop.

The plant is propagated by seeds but it is characterised by poor and often erratic seed germination which can be improved either by leaching out the inhibitor from the seeds or by alternate freezing and thawing of seeds. The optimum season for raising the crop is Rabi in tropical and subtropical areas while *Kharif* in temperate areas. The seeds can be broadcast - sown or seedlings can be raised in nursery and then transplanted. Seed rate is 7-8 kg/ha for broadcasting and 2-3 kg/ha. for transplanting. The field is ploughed and disced adequately to produce fine seed bed. In the case of direct seeding, seeds are drilled in rows taken 45-60 cm apart. The plants are thinned to keep a spacing of 30-45 cm at the time of first weeding. In the case of transplanting 4-6 weeks old seedlings are planted at 45-60 x 30-45 cm spacing. The field should be irrigated immediately after sowing or planting if soil moisture is inadequate. Thereafter 3-4 irrigations may be given if sufficient rainfall is not received. Application of organic manure at 10-15 t/ha and fertilisers at 60:40:40 kg N, P_2O_5 and K_2O/ha is recommended for the crop for better growth and yield N may be applied in 3-4 equal split doses at planting and after each weeding which is required 2-3 times during the growing season. Application of micronutrients is reported to improve the alkaloid contents. No major insect pest is known to attack this crop. However, leaf spot, wilt and mosaic diseases cause damage to this crop. Leaf spot is caused by *Alternaria tennuissima* (Nees) Wiltshire and characterised by brown round to oval spots, becoming necrotic at later stage which leads to withering and dropping of leaves. Wilt is caused by *Sclerotium rolfsii* Sace; it starts with dropping of leaves and finally wilting of the entire plant. Root and foot wilt, caused by *Corticium solani*, appears as damping off of seedlings and mature plants. Datura distortion mosaic is characterised by yellowing of the veins followed by inward rolling and distortion of leaves with a reduction in plant size. For reducing the impact of these diseases, field sanitation, use of resistant varieties, crop rotation for 3-4 years and fungicide application should be resorted to. For the purpose of leaf and top, harvesting is done as soon as flowering starts. Entire top containing leaves and twigs is cut, dried in shade and stored in gunny bags. For seed and fruit, fully grown fruits, still green are picked 2-3 times before final harvest when the entire plant is cut from the base and dried in the open. The dried fruits are then thrashed with a stick to separate the seeds. The seed yield is 1-1.5 t/ha. (Husain, 1993; Kaul and Singh, 1995)

Properties and activity

The alkaloids hyoscyamine and hyoscine (scopolamine) and meteloidine are found in all parts of the plant. The total alkaloid content is 0.26 - 0.42 % Fruits contain daturaolone and daturadiol while roots contain additionally ditigloyloxy tropane derivatives, tigloidine, apohyoscine, norhyoscine, norhyocyamine, cusiohygrine and tropine. Other alkaloids isolated from the plant are apohyoscyamine, DL-scopolamine, normeteloidine, tigloylputrescine, scopine, nortigloidine, tropine, psuedo valeroidine, fastudine, fastunine, fastusinine, 7-hydroxy-3, 6-ditigloyloxytropane (2) datura nolone and fastusic acid. The physiological effects of hyoscyamine are qualitatively the same as those of its recemic derivative atropine. This is relatively more active in its paralysing affect on nerve endings and less active in its stimulant action on the central nervous system. The sedative and hypnotic action of hyoscyamine is weaker than that of hyoscine. Atropine has a stimulant action on the central nervous system and depresses the nerve endings to the secretary glands and plain muscles. The plant or the different alkaloids have narcotic, anthelmintic, spasmolytic anaesthetic, sedative, ophthalmic, anticancerous, antitumour, antirheumatic, antiasthmatic, antidiarrhoeal and anticatarrhal activities. (Thakur *et al*, 1989).

ASPARAGUS *Asparagus racemosus* *Liliaceae*

San, Mar, Hin, Mal: Satavari; Ben: Shatamuli, Guj: Ekalkanto, Tel: Pilligadalu, Philithaga Tam: Ammaikodi, Kilwari, Kan: Aheruballi, Ori: Manajolo

Importance

Asparagus is a climbing undershrub with widespread applications as diuretic, cooling agent and an excellent safe herbal medicine for ante-natal care. It is useful in nervous disorders, dyspepsia, diarrhoea, tumours, inflammations, vitiated conditions of *vata* and *pitta*, burning sensation, hyperdipsia, ophthalmopathy, nephropathy, hepatopathy, strangury, scalding of urine, throat infections, tuberculosis, cough, bronchitis, gleet, gonorrhoea, leucorrhoea, leprosy, epilepsy, fatigue, hyperacidity, colic haemorrhoids, hypertension, abortion, agalactia, cardiac and general debility (Warrier *et al*, 1993).

Shatavari is described in *Rigveda* and *Atharvaveda*. In Ayurvedic classics it is prescribed as a cooling agent and uterine tonic. It is the main ingredient in ayurvedic medicines like *shatavari gulam* and *shatavari ghrtam*. Besides quenching thirst, its root juice helps in cooling down the body from summer heat, curing hyper-acidity and peptic ulcer. It contains good amount of mucilage which soothes the inner cavity of stomach. It relieves burning sensation while passing urine and is used in urinary tract infections. It contains an anticancer agent **asparagin** which is useful against leukaemia. It also contains active antioxytocic saponins which have got antispasmodic effect and specific action on uterine musculature. It is very good relaxant to uterine muscles, especially during pregnancy and is used to prevent abortion and pre-term labour on the place of progesterone preparations. Its powder boiled with milk is generally used to prevent abortion. It increases milk production in cows and buffaloes. Its preparations in milk helps in increasing breast milk in lactating women. Its proper use helps in avoiding excessive blood loss during periods. It clears out infections and abnormalities of uterine cavity and hence it is used to rectify infertility in women. The leaves are used to prepare toilet soaps. The plant has also ornamental value both for indoor and out door decorations (Syamala, 1997).

Distribution

The plant is found wild in tropical and subtropical India including Andaman and Nicobar Islands. It is distributed from mean sea level upto 1500m in the Himalayas from Kashmir eastwards. The crop is cultivated in Kerala, Tamil Nadu, Andhra Predesh and northern states in India. However, most of the requirement of the industry is met through wild collections from forests. It is also grown in gardens.

Botany

Satavari, *Asparagus racemosus* Willd. belongs to the lily family, Liliaceae. *Asparagus adscendens* Roxb., *A. filicinus* Lam., *A. gonoclados* Baker, *A. officinalis* Linn. and *A. sarmentosus* Willd. are the other important medicinal plant species of the genus. *A. racemosus* Willd. is an armed climbing undershrub with woody terete stems and recurved or rarely straight spines. The tuberous succulent roots are 30cm to 100cm or more in length, fascicled at the stem base, smooth tapering at both ends. Young stems are very delicate, brittle and smooth. Leaves are reduced to minute chaffy scales and spines; cladodes triquetrous, curved in tufts of 2-6. Flowers are white fragrant in simple or branched recemes

on the naked nodes of the main shoots or in the axils of the thorns. Fruits are globular or obscurely 3-lobed, pulpy berries, purplish black when ripe; seeds with hard and brittle testa.

Agrotechnology

The plant comes up well under a wide range of tropical and subtropical climate. Fertile moist sandy loam soils are ideal for its cultivation though it grows in a wide range of soils. Better root development is observed in soils in increased proportion of sand. However, a decline in the yield of the crop is noticed in soils containing previous year's residue of the roots. Asparagus plant is best grown from its tuberous roots even though it can be successfully propagated through seeds. Since root tubers are of commercial value seed propagation provides economic advantage to the farmers. Seeds usually start germinating after 40 days and average germination is 70% (Tewari and Misra, 1996).

For the cultivation of the crop, the land is ploughed well with pre-monsoon showers and seed nurseries are raised on seed beds of approximately 1m width, 15cm height and suitable length. Seed nursery should be irrigated regularly and kept weed free. With the onset of monsoon in June-July the main field is ploughed thoroughly and pits of size 30cm cube are dug at a spacing of 60-100cm. Tiwari and Misra (1996) have reported that irrespective of more number of roots and higher fresh weight per plant under wider spacings, the per hectare yields were highest in the closer spacing of 30cm x 30cm. The pit is filled with a mixture of top soil and well decomposed FYM or compost applied at 10 - 15 t/ha and the seedlings are transplanted. Application of N, P_2O_5 and K_2O at 60:30:30 kg/ha increases the root yield. Regular irrigation and weeding are required to realize higher yields. Standards are to be provided for training the plant (Sharma *et al*, 1992). Few pests and diseases are observed on this crop. Harvesting the crop after two years provided higher root yield than annual harvests in pots as well as in field experiments. Irrigating the field prior to harvest enables easy harvesting of the root tubers. The average yield is 10 - 15 t/ha of fresh root tubers though yields over 60t/ha have been reported.

Properties and Activity

Asparagus roots contain protein 22%, fat 6.2%, Carbohydrate 3.2%, Vitamin B 0.36%, Vitamin C 0.04% and traces of Vitamin A. It contains several alkaloids. Alcoholic extract yields *asparagin*- an anticancer agent. It also contains a number of antioxytocic saponins, viz. Shatavarisn - I to IV (Syamala, 1997). Leaves contain rutin, diosgenin and a flavonoid glycoside identified as quercetin - 3 - glucuronide. Flowers contain quercetin hyperoside and rutin. Fruits contain glycosides of quercetin, rutin and hyperoside while fully ripe fruits contain cyanidin - 3 - galactoside and cyanidin - 3 - glucorhamnoside.

Root is demulcent, diuretic, aphrodisiac, tonic, alterative, antiseptic, antidiarrhoeal, glalctogogue and antispasmodic. Aerial part is spasmolytic, antiarrhythmic and anticancer. Bark is antibacterial and antifungal.

GREATER AMMI *Ammi majus* *Apiaceae*

Importance

Greater Ammi, also known as **Bishop's weed** or **Honey plant** is an annual or biennial herb which is extensively used in the treatment of leucoderma (vitiligo) and psoriasis. The compounds responsible for this are reported to be **furocoumarin**s like **ammoidin (xanthotoxin), ammidin (imperatorin)** and **majudin (bergapten)** present in the seed. Xanthotoxin is marketed under the trade name "*Ox soralen*" which is administered orally in doses of 50 mg t.d. or applied externally as 1% liniment followed by exposure of affected areas to sunlight or UV light for 2 hours. It is also used in "*Suntan lotion*". Meladinine is a by-product of *Ammi majus* processing, containing both xanthotoxin and imperatorin sold in various formulations increases pigmentation of normal skin and induces repigmentation in vitiligo. Imperatorin has antitumour activity. Fruit or seed causes photosensitization in fouls and sheep.

Distribution

The plant is indigenous to Egypt and it grows in the Nile Valley, especially in Behira and Fayoom. It is also found in the basin of the Mediterranean Sea, in Syria, Palestine, Abyssinia, West Africa, in some regions of Iran and the mountains of Kohaz (Ramadan, 1982). It grows wild in the wild state in Abbottabad, Mainwali, Mahran and is cultivated in Pakistan. The crop was introduced to India in the Forest Research Institute, Dehra Dun, in 1955 through the courtesy of UNESCO. Since then, the crop has been grown for its medicinal fruit in several places in Uttar Pradesh, Gujarat, Kashmir and Tamil Nadu.

Botany

Ammi majus Linn. belongs to the family Apiaceae (Umbelliferae). *A. visnaga* is another related species of medicinal importance. *A. majus* is an annual or beinnial herb growing to a height of 80 to 120 cm. It has a long tap root, solid erect stem, decompound leaves, light green alternate, variously pinnately divided, having lanceolate to oval segments. Inflorescence is axillary and terminal compound umbels with white flowers. The fruits are ribbed, ellipsoid, green to greenish brown when immature, turning reddish brown at maturity and having a characteristic terebinthinate odour becoming strong on crushing with extremely pungent and slightly bitter taste.

Agrotechnology

Ammi is relatively cold loving and it comes up well under subtropical and temperate conditions. It does not prefer heavy rainfall. Though the plant is biennial it behaves as an annual under cultivation in India. A mild cool climate in the early stages of crop growth and a warm dry weather at maturity is ideal. It is cultivated as a winter annual crop in *rabi* season. A wide variety of soils from sandy loam to clay loam are suitable. However, a well drained loamy soil is the best. Waterlogged soils are not good. Being a hardy crop, it thrives on poor and degraded soils.

The plant is seed propagated. Seeds germinate within 10-12 days of sowing. The best time of sowing is October and the crop duration is 160-170 days in north India. Crop sown later gives lower yield. The crop can be raised either by direct sowing of seed or by raising a nursery and then transplanting the crop. Seed rate is 2 kg/ha. The land is brought to

a fine tilth by repeated ploughing and harrowing. Ridges and furrows are then formed at 45-60 cm spacing. Well decomposed FYM at 10-15 t/ha and basal fertilisers are incorporated in the furrows. Seeds being very small are mixed with fine sand or soil, sown in furrows and covered lightly with a thin layer of soil. A fertilizer dose of 80:30:30 kg N, P_2O_5 and K_2O/ha is generally recommended for the crop while 150:40:40 kg/ha is suggested in poor soils for better yields. The furocoumarin content of *Ammi majus* is increased by N fertiliser and the N use efficiency increases with split application of N at sowing, branching and at flowering. For obtaining high yields it is essential to give one or two hoeings during November to February which keeps down the weeds. If winter rains fail, one irrigation is essential during November to January. As the harvesting season is spread over a long period of time, two irrigations during March and April meets the requirements of the crop (Chadha and Gupta, 1995).

White ants and cut worms are reported to attack the crop which can be controlled by spraying the crop with 40g carbaryl in 10 l of water. Damping off and powdery mildew are the common diseases of the crop. Seed treatment with organomercuric compounds is recommended for damping off. To control powdery mildew the crop is to be sprayed with 30g wettable sulphur in 10 l of water whenever noticed.

The crop flowers in February. Flowering and maturity of seed is spread over a long period of two months. The primary umbels and the early maturing secondary umbels are the major contributors to yield. A little delay in harvesting results in the shattering of the seed which is the main constraint in the commercial cultivation of the crop and the main reason for low yields in India. Sobti *et al* (1978) have reported increased yield by 50 - 60% by the application of planofix at 5 ppm at flower initiation and fruit formation stages. The optimum time of harvest is the mature green stage of the fruit in view of the reduced losses due to shattering and maximum contents of furocoumarins. The primary umbels mature first within 35-45 days. These are harvested at an interval of 2-4 days. Later, the early appearing secondary umbels are harvested. Afterwards, the entire crop is harvested, stored for a couple of days and then threshed to separate the seeds. The seed yield is 900-1200 kg/ha.

Postharvest technology

The processing of seed involves solvent extraction of powdered seeds, followed by chilling and liquid extraction and chromatographic separation after treatment with alcoholic HCl. Bergapten, xanthotoxin and xanthotoxol can be separated. Xanthotoxol can be methylated and the total xanthotoxin can be purified by charcoal treatment in acetone or alcohol.

Properties and activity

Ammi majus fruit contains amorphous glucoside 1%, tannin 0.45%, oleoresin 4.76%, acrid oil 3.2%, fixed oil 12.92%, proteins 13.83% and cellulose 22.4%. This is one of the richest sources of linear furocoumarins. Ivie (1978) evaluated the furocoumarin chemistry of taxa *Ammi majus* and reported the presence of xanthotoxin, bergapten, imperatorin, oxypencedanin, heraclenin, sexalin, pabulenol and many other compounds. Furocoumarins have bactericidal, fungicidal, insecticidal, larvicidal, moluscicidal, nematicidal, ovicidal, viricidal and herbicidal activities (Duke, 1988).

PERIWINKLE Catharanthus roseus Apocynaceae

San: Nityakalyani; Hin: Sadabahar, Baramassi; Mal: Ushamalari, Nityakalyani Tel: Billaganeru; Tam: Sudukattu mallikai; Pun: Rattanjot; Kan: Kasikanigale, Nitya Mallige

Importance

Periwinkle or Vinca is an erect handsome herbaceous perennial plant which is a chief source of patented cancer and hypotensive drugs. It is one of the very few medicinal plants which has a long history of uses as diuretic, antidysenteric, haemorrhagic and antiseptic. It is known for use in the treatment of diabetes in Jamaica and India. The alkaloids **vinblastine** and **vincristine** present in the leaves are recognized as anticancerous drugs. Vinblastine in the form of vinblastin sulphate is available in market under the trade name "*VELBE*" and Vincristine sulphate as "*ONCOVIN*" (Eli Lilly). Vinblastine is used in combination with other anticancer agents for the treatment of lymphocytic lymphoma, *Hodgkin's* disease, testicular carcinoma and choriocarcinoma. Vincristine is used in acute leukemia, lymphosarcoma and *Wilm's* tumour. Its roots are a major source of the alkaloids, **raubasine (ajmalicine), reserpine** and **serpentine** used in the preparation of antifibrillic and hypertension-relieving drugs. It is useful in the treatment of choriocarcinoma and *Hodgkin's* disease-a cancer affecting lymph glands, spleen and liver. Its leaves are used for curing diabetes, menorrhagia and wasp stings. Root is tonic, stomachic, hypotensive, sedative and tranquilliser (Narayana and Dimri,1990).

Distribution

The plant is a native of Madagascar and hence the name **Madagascar Periwinkle**. It is distributed in West Indies, Mozambique, South Vietnam, Sri Lanka , Philippines and Australia . It is well adapted to diverse agroclimatic situations prevalent in India and is commercially cultivated in the states of Tamil Nadu, Karnataka, Gujarat, Madhya Pradesh and Assam. USA, Hungary, West Germany, Italy, Netherlands and UK are the major consumers.

Botany

Catharanthus roseus (Linn.) G.Don. syn. *Vinca rosea* Linn. belongs to the family Apocynaceae. It is an erect highly branched lactiferous perennial herb growing up to a height of one metre. Leaves are oblong or ovate, opposite, short-petioled, smooth with entire margin. Flowers are borne on axils in pairs . There are three flower colour types , **pink, pink-eyed** and **white**. Calyx with 5 sepal, green, linear, subulate. Corolla tube is cylindrical with 5 petals, rose-purple or white with rose-purple spot in the centre; throat of corolla tube hairy, forming a corona-like structure. The anthers are epipetalous borne on short filaments inside the bulging distal end of corolla tube converging conically above the stigma. Two characteristic secretary systems, namely a column like nectarium on both sides of pistil and a secretory cringulam circling the papillate stigma with a presumed role in pollination - fecundation process are present . Ovary bicarpellary, basally distinct with fused common style and stigma. The dehiscent fruit consists of a pair of follicles each measuring about 25 mm in length and 2.3 mm in diameter, containing up to thirty linearly arranged seeds with a thin black tegumen. On maturity, the follicles split along the length dehiscing the seeds.

Agrotechnology

Periwinkle grows well under tropical and subtropical climate. A well distributed rainfall of 1000 mm or more is ideal. In north India the low winter temperatures adversely affect the crop growth. It can grow on any type of soil ,except those which are highly saline, alkaline or waterlogged. Light soils, rich in humus are preferable for large scale cultivation since harvesting of the roots become easy .

Catharanthus is propagated by seeds . Fresh seeds should be used since they are short-viable. Seeds can be either sown directly in the field or in a nursery and then transplanted. Seed rate is 2.5 kg/ha for direct sowing and the seeds are drilled in rows 45 cm apart or broadcasted. For transplanted crop the seed rate is 500gm/ha. Seeds are sown in nursery and transplanted at 45x 30cm spacing after 60 days when the seedlings attain a height of 15-20cm Nursery is prepared two months in advance so that transplanting coincides with the on set of monsoons. Application of FYM at the rate of 15 t/ha is recommended. An alternate approach is to grow leguminous green manure crops and incorporate the same into the soil at flowering stage. Fertilisers are recommended at 80:40:40 kg $N:P_2O_5:K_2O$/ha for irrigated crop and 60:30:30 kg/ha for rainfed crop. N is applied in three equal splits at planting and at 45 and 90 days after planting. 4 or 5 irrigations will be needed to optimise yield when rainfall is restricted. Fortnightly irrigations support good crop growth when the crop is grown exclusively as an irrigated crop. Weeding is carried out before each topdressing. Alternatively, use of fluchloraline at 0.75 kg a.i. /ha pre-plant or alachlor at 1.0 kg a.i. per ha as pre-emergence to weeds provides effective control of a wide range of weeds in periwinkle crop. Detopping of plants by 2cm at 50% flowering stage improves root yield and alkaloid contents. No major pests, other than Oleander hawk moth, have been reported in this crop . Fungal diseases like twig blight (top rot or dieback) caused by *Phytophthora nicotianae*., *Pythium debaryanum*, *P. butleri* and *P. aphanidermatum*; leaf spot due to *Alternaria tenuissima, A. alternata, Rhizoctonia solani* and *Ophiobolus catharanthicola* and foot-rot and wilt by *Sclerotium rolfsii* and *Fusarium solani* have been reported. However, the damage to the crop is not very serious. Three virus diseases causing different types of mosaic symptoms and a phyllody or little leaf disease due to mycoplasma-like organisms have also been reported; the spread of which could be checked by uprooting and destroying the affected plants.

The crop allows 3-4 clippings of foliage beginning from 6 months. The flowering stage is ideal for collection of roots with high alkaloid content. The crop is cut about 7 cm above the ground and dried for stem, leaf and seed. The field is irrigated, ploughed and roots are collected. The average yields of leaf, stem and root are 3.6, 1.5and 1.5 t/ha, respectively under irrigated conditions and 2.0, 1.0 and 0.75t/ha, respectively under rainfed conditions on air dry basis. The harvested stem and roots loose 80% and 70% of their weight, respectively. The crop comes up well as an undercrop in eucalyptus plantation in north India. In north western India a two year crop sequence of *periwinkle-senna-mustard* or *periwinkle-senna- coriander* are recommended for higher net returns and productivity (Krishnan,1995).

Properties and activity

More than 100 alkaloids and related compounds have so far been isolated and characterised from the plant. The alkaloid contents in different parts show large variations as roots 0.14-1.34%, stem 0.074-0.48%, leaves 0.32-1.16%, flowers 0.005-0.84%, fruits 0.40%, seeds 0.18% and pericarp 1.14% *(*Krishnan *et al,* 1983). These alkaloids includes monomeric indole alkaloids, 2-acyl indoles, oxindole, α-methylene indolines, dihydroindoles, bisindole and others. Dry leaves contain vinblastine (vincaleucoblastine or VLB) 0.00013-0.00063%, and vincristine (leurocristine or LC) 0.0000003-0.0000153% which have anticancerous activity (Virmani *et al*, 1978). Other alkaloids reported are vincoside, isovincoside (strictosidine), catharanthine, vindolinine, lochrovicine, vincolidine, ajmalicine (raubasine), reserpine, serpentine, leurosine, lochnerine, tetrahydroalstonine, vindoline, pericalline, perivine, periformyline, perividine, carosine, leurosivine, leurosidine and rovidine. The different alkaloids possessed anticancerous, antidiabetic, diuretic, antihypertensive, antimicrobial, antidysenteric, haemorrhagic, antifibrillic, tonic, stomachic, sedative and tranquillising activities.

LONG PEPPER *Piper longum*

Piperaceae

San: Pippali; Hin, Ben, Pun: Piplamul; Kan, Mal:Thippali ; Tam: Thippili; Mar: Pimpli; Tel: Pipppaloo; Ass: Piplu.

Introduction

Long pepper is a slender aromatic climber whose spike is widely used in ayurvedic and unani systems of medicine particularly for diseases of respiratory tract. *Pipalarishta, Pippalyasava, Panchakola, Pippalayadilauha,* and *Lavana bhaskar churan* are common ayurvedic preparations made out of the dry spikes of female types. *Ittrifal fauladi, Angaruya-i-kabir* and *Majun khadar* are well known *unani* preparations of long pepper. Its roots also have several medicinal uses. The root is useful in bronchitis, stomach ache, diseases of spleen and tumours . Fruit is useful in *vata* and *kapha,* asthma, bronchitis, abdominal complaints, fever, leucoderma, urinary discharges, tumours, piles, insomnia and tuberculosis. Root and fruit are used in gout and lumbago. The infusion of root is prescribed after parturition to induce the expulsion of placenta. The root and fruit decoction are used in acute and chronic bronchitis and cough. It contains the alkaloid **piperine** which has diverse pharmacological activities, including nerve depressant and antagonistic effect on electro-shock and chemo-shock seizures as well as muscular incoordination.

Distribution

The plant is a native of Indo-Malaya region. It was very early introduced to Europe and was highly regarded as a flavour ingredient by the Romans. The Greek name *"Peperi*", the Latin *"Piper"* and the English *"Pepper*" were derived from the Sanskrit name *"Pippali*". It grows wild in the tropical rain forests of India, Nepal, Indonesia, Malaysia, Sri lanka, Rhio, Timor and the Philippines. In India, it is seen in Assam, West Bengal, Uttar Pradesh, Madhya Pradesh, Maharashtra, Kerala, Karnataka.and Tamil Nadu. It is also cultivated in Bengal, Chirapunchi area of Assam, Akola-Amravati region of Maharashtra, Anamalai hills of Tamil Nadu, Orissa, Uduppi and Mangalore regions of Karnataka. Bulk of Indian long pepper comes from its wild growth in Assam, Shillong and West Bengal, supplemented by imports from Sri Lanka and Indonesia (Viswanathan,1995)

Botany

Piper longum Linn. is a member of Piperaceae family. The plant is a glabrous perennial under-shrub with erect or sub-scandent nodose stem and slender branches, the latter are often creeping or trailing and rooting below or rarely scandent reaching a few metres height. Leaves are simple, alternate, stipulate, and petiolate or nearly sessile; lower ones broadly ovate, cordate; upper ones oblong, oval, all entire, smooth, thin with reticulate venation; veins raised beneath. It flowers nearly throughout the year. Inflorescence is spike with unisexual small achlamydeous densely packed flowers and form very close clusters of small greyish green or darker grey berries. Female spikes with short thick stalk varying from 1.5 to2.5 cm in length and 0.5 to 0.7 cm in thickness.

A number of geographical races are available in different agroclimatic regions of India; the most popular being Assam, West Bengal and Nepal races. *Piper officinarum* DC; syn. *Chavica officinarum* Miquel, *Piper pepuloides* and *Piper chaba* Hunter are the other related species of importance.

Agrotechnology

Long pepper is a tropical plant adapted to high rainfall areas with high humidity. An elevation of 100-1000 m is ideal. It needs partial shade to the tune of 20-30% for best growth. The natural habitat of the plant is on the borders of streams. It is successfully cultivated in well drained forest soils rich in organic matter. Laterite soils with high organic matter content and moisture holding capacity are also suitable for cultivation.

Long pepper is propagated by suckers or rooted vine cuttings.15-20 cm long 3-5 nodded rooted vine cuttings establishes very well in polybags. The best time for raising nursery is March-April. Normal irrigation is given on alternate days. The rooted cuttings will

be ready for transplanting in 2 months time. With the onset of monsoon in June the field is ploughed well and brought to good tilth. 15-20 cm raised beds of convenient length and breadth are taken. On these beds, pits are dug at 60 x 60 cm spacing and well decomposed organic manure at 100 g/pit is applied and mixed with the soil. Rooted vine cuttings from polybags are transplanted to these pits. Gap filling can be done after one month of planting.The crop needs heavy manuring at the rate of 20 t FYM/ha every year. Application of heavy dose organic matter and mulching increase water retention in the soil and control weeds. Small doses of chemical fertilisers can also be used. The crop needs irrigation once a week. Sprinkler irrigation is ideal. With irrigation the crop continues to produce spikes and off-season produce will be available. However, it is reported that unirrigated crop after the onset of monsoon grows vigorously and shows much hardiness than the irrigated crop.

Crop losses can be heavy due to pests and diseases. Mealy bugs and root grubs, attack the plant particularly during summer. Infested plants show yellowing and stunted growth. Application of systemic insecticides like nuvacron or dimecron will control the pests. Adults and nymphs of *Helopeltis theivora* severely feeds on the foliage which can be controlled by 0.25% neem kernel suspension. Rotting of leaves and vines during monsoon season is caused by *Colletotrichum glorosporiodes* and necrotic lesions and blights on the leaves during summer is caused by *Colletotrichum* and *Cercospora spp*. These diseases can be controlled by spraying of 1% Bordeaux mixture repeatedly. A virus like disease characterised by yellowing and crinkling of leaves, stunted growth and production of spikes of smaller size and inferior quality was also recently reported.

The vines start flowering six months after planting and flowers are produced almost throughout the year. The spikes mature in 2 months time. The optimum stage of harvest is when the spikes are blackish green. The pungency is highest at this stage. Spikes are hand picked when they become mature and then dried. The yield of dry spike is 400 kg /ha during first year, increases to 1000kg during third year and thereafter it decreases. Therefore, after 3 years the whole plant is harvested. The stem is cut close to the ground and roots are dug up. Average yield is 500 kg dry roots/ha (Viswanathan,1995).

Piper longum can also be cultivated as an intercrop in plantations of coconut, subabul and eucalyptus.

Post harvest technology

The harvested spikes are dried in sun for 4-5 days until they are perfectly dry. The green to dry spike ratio is 10:1.5 by weight. The dried spikes have to be stored in moisture proof containers. Stem and roots are cleaned, cut into pieces of 2.5-5 cm length, dried in shade and marketed as piplamool. There are three grades of piplamool, based on the thickness. The commercial drug consists 0.5-2.5 cm long ,0.5-2.5 mm thick, cylindrical pieces dirty light brown in colour and peculiar odour with a pungent bitter taste, producing numbness to the tongue.

Properties and activity

The spike of long pepper contains 4-5% piperine, piplartin, piperolactam, N-isobutyl deca trans-2-trans-4-dienamide and piporadione alkaloides, besides 0.7 % essential oil. Roots gave the alkaloids piperine, piperlongumine (piplartine) and piperlonguminine; sesamine, methyl 3, 4, 5-trimethoxy cinnamate. Stem gave triacoutane 22, 23 - dihydrostigmasterol. Fruit essential oil contains piperidine, caryophyllene and sesquiterpene alcohol (Atal *et al*, 1975).

The root is plungent, hot, stomachic, laxative, anthelmintic and carminative. The fruit is sweetish, pungent, hot, stomachic, aphrodisiac, alterative, laxative, antidysenteric, emmenagogue, abortifacient, diuretic and tonic. The essential oil is antimicrobial and anthelmintic. N-isobutyl-deca-trans-2-trans-4-dienamide is antitubercular. Piperine is hypotensive, antipyretic, analeptic, and nerve stimulant (Warrier *et al*, 1995).

SERPENTWOOD Rauvolfia serpentina Apocynaceae

San: Sarpagandha | Hin: Chandrabhaga | Mal: Sarpagandhi, Amalpori
Tam: Chivan amelpodi | Kan: Sutranbhi | Tel: Patalagandhi

Introduction

Serpentwood is an erect, evergreen , perennial undershrub whose medicinal use has been known since 3000 years. Its dried root is the economical part which contains a number of alkaloids of which reserpine, rescinnamine, deserpidine, ajamalacine, ajmaline, neoajmalin, serpentine, α-yohimbine are pharmacologically important. The root is a sedative and is used to control high blood pressure and certain forms of insanity. In Ayurveda it is also used for the treatment of insomnia, epilepsy, asthma, acute stomach ache and painful delivery. It is used in snake-bite, insect stings, and mental disorders. It is popular as "*Madman's medicine*" among tribals. *'Serpumsil'* tablet for high blood pressure is prepared from *Rauvolfia* roots. Reserpine is a potent hypotensive and tranquillizer but its prolonged usage stimulates prolactine release and causes breast cancer. The juice of the leaves is used as a remedy for the removal of opacities of the cornea.

Distribution

Rauvolfia serpentina is native to India. Several species of *Rauvolfia* are observed growing under varying edaphoclimatic conditions in the humid tropics of India, Nepal, Burma, Thailand, Bangladesh, Indonesia , Cambodia, Philippines and Sri Lanka. In India, it is cultivated in the states of Uttar Pradesh, Bihar, Tamil Nadu, Orissa, Kerala, Assam, West Bengal and Madhya Pradesh (Dutta and Virmani, 1964). Thailand is the chief exporter of *Rauvolfia* alkaloids followed by Zaire, Bangladesh, Sri Lanka, Indonesia and Nepal. In India, it has become an endangered species and hence the Government has prohibited the exploitation of wild growing plants in forest and its export since 1969.

Botany

Plumier in 1703 assigned the name *Rauvolfia* to the genus in honour of a German physcian -Leonhart Rauvolf of Augsburg. The genus *Rauvolfia* of Apocynaceae family comprises over 170 species distributed in the tropical and subtropical parts of the world including 5 species native to India. The common species of the genus *Rauvolfia* and their habitat as reported by Trivedi (1995) are given below.

R. serpentina Benth. ex Kurz.(Indian serpentwood) - India ,Bangladesh, Burma, Sri Lanka, Malaya, Indonesia
R. vomitoria Afz. (African serpentwood) - West Africa, Zaire, Rwanda, Tanzania
R. canescens Linn. syn. *R. tetraphylla* (American serpentwood) - America, India
R. mombasina - East Africa , Kenya, Mozambique
R. beddomei - Western ghats and hilly tracts of Kerala
R. densiflora - Maymyo, India
R. microcarpa - Thandaung
R. verticillata syn. *R. chinensis* - Hemsl
R. peguana - Rangoon-Burma hills
R. caffra - Nigeria, Zaire, South Africa
R. riularis - Nmai valley
R. obscura - Nigeria, Zaire

R. serpentina is an erect perennial shrub generally 15-45 cm high, but growing upto 90cm under cultivation. Roots nearly verticle, tapering up to 15 cm thick at the crown and long giving a **serpent-like** appearance, occasionally branched or tortuous developing small fibrous roots. Roots greenish-yellow externally and pale yellow inside, extremely bitter in taste. Leaves born in whorls of 3-4 elliptic-lanceolate or obovate, pointed. Flowers numerous borne on terminal or axillary cymose inflorscence. Corolla tubular, 5-lobed, 1-3 cm long, whitish-pink in colour. Stamens 5, epipetalous. Carpels 2, connate, style filiform with large bifid stigma. Fruit is a drupe, obliquely ovoid and purplish black in colour at maturity with stone containing 1-2 ovoid wrinkled seeds. The plant is cross-pollinated, mainly due to the protogynous flowers (Sulochana ,1959).

Agrotechnology

Among the different species of Rauvolfia, R. serpentina is preferred for cultivation because of higher reserpine content in the root . Though it grows in tropical and subtropical areas which are free from frost, tropical humid climate is most ideal. Its common habitats receive an annual rain fall of 1500-3500 mm and the annual mean temperature is 10-38 °C. It grows up to an elevation of 1300-1400m from msl. It can be grown in open as well as under partial shade conditions. It grows on a wide range of soils. Medium to deep well drained fertile soils and clay-loam to silt-loam soils rich in organic matter are suitable for its cultivation. It requires slightly acidic to neutral soils for good growth.

The plant can be propagated vegetatively by root cuttings, stem cuttings or root stumps and by seeds. Seed propagation is the best method for raising commercial plantation. Seed germination is very poor and variable from 10-74%. Seeds collected during September to November give good results. It is desirable to use fresh seeds and to sock in 10% sodium chloride solution. Those seeds which sink to the bottom should only be used. Seeds are treated with ceresan or captan before planting in nursery to avoid damping off. Seed rate is 5-6 kg/ha. Nursery beds are prepared in shade, well rotten FYM is applied at 1kg/m^2 and seeds are dibbled 6-7cm apart in May-June and irrigated. Two months old seedlings with 4-6 leaves are transplanted at 45-60 x 30 cm spacing in July -August in the main field. Alternatively, rooted cuttings of 2.5-5cm long roots or 12-20cm long woody stems can also be used for transplanting. Hormone (Seradix) treatment increases rooting . In the main field 10-15 t/ha of FYM is applied basally. Fertilisers are applied at 40:30:30kg N: P_2O_5 :K_2O/ha every year. N is applied in 2-3 splits. Monthly irrigation increases the yield. The nursery and the main field should be kept weed free by frequent weeding and hoeing. In certain regions intercroping of soybean, brinjal, cabbage, okra or chilly is followed in Rauvolfia crop.

Pests like root grubs (Anomala polita), moth (Deilephila nerii), caterpillar (Glyophodes vertumnalis), black bugs and weevils are observed on the crop, but the crop damage is not serious. The common diseases reported are leaf spot (Cercospora rauvolfiae, Corynespora cassiicola), leaf blotch (Cercospora serpentina), leaf blight (Alternaria tenuis), anthracnose (Colletotrichum gloeosporioides), die back (Colletotrichum dematrium), powdery mildew (Leviellula taurica), wilt (Fusarium oxysporum), root-knot (Meloidogyne sp.), mosaic and bunchy top virus diseases. Field sanitation, pruning and burning of diseased parts and repeated spraying of 0.2% Dithane Z-78 or Dithane M-45 are recommended for controlling various fungal diseases. Rauvolfia is harvested after 2-3 years of growth. The optimum time of harvest is in November -December when the plants shed leaves, become dormant and the roots contain maximum alkaloid content. Harvesting is done by digging up the roots by deeply penetrating implements (Guniyal et al, 1988).

Postharvest technology

The roots are cleaned washed cut into 12-15cm pieces and dried to 8-10% moisture. The dried roots are stored in polythene lined gunny bags in cool dry place to protect it from mould. The yield is 1.5-2.5 t/ha of dry roots. The root bark constitutes 40-45% of the total weight of root and contributes 90% of the total alkaloids yield.

Properties and activity

Rauvolfia root is bitter, acrid, laxative, anthelmintic, thermogenic, diuretic and sedative. Over 200 alkaloids have been isolated from the plant. *Rauvolfia serpentina* root contains 1.4-3% alkaloids. The alkaloids are classsified into 3 groups, *viz*, reserpine, ajmaline and serpentine groups. Reserpine group comprising reserpine, rescinnamine, deserpine *etc* act as hypotensive, sedative and tranquillising agent. Overdose may cause diarrhoea, bradycardia and drowsiness. Ajmaline, ajmalicine, ajmalinine, iso-ajmaline *etc* of the ajmaline group stimulate central nervous system, respiration and intestinal movement with slight hypotensive activity. Serpentine group comprising serpentine, sepentinine, alstonine *etc* is mostly antihypertensive. (Husain,1993; Trivedi, 1995; Iyengar, 1985).

BAEL *Aegle marmelos*

Rutaceae

San: Bilva, Sriphal Hin, Ben, Ass: Bael Mal: Koovalam Tam: Vilvam
Mar, Ben: Baela Tel: Marendu, Bilvapondu Guj: Bilviphal Kan: Bilvapatra

Importance

Bael or Bengal quince is a deciduous sacred tree, associated with Gods having useful medicinal properties, especially as a cooling agent. This tree is popular in '*Shiva*' and '*Vishnu*' temples and it can be grown in every house. Its leaves are trifoliate symbolizing the '*Thrimurthies*'-*Brahma, Vishnu, Shiva,* with spear shaped leaflets resembling "*Thrisoolam*" the weapon of Lord *Shiva*. Many legends, stories and myths are associated with this tree. The leaflets are given to devotees as *'prasadam*' in *Shiva* temples and as *'Tulasi*' in *Vishnu* temples.

Every part of the tree is medicinal and useful. The roots are used in many Ayurvedic medicines for curing diabetes and leprosy. It is an ingredient of the '*dasamoola*'. The Bark is used to cure intestinal disorders. Leaves contain an alkaloid rutacin which is hypoglycaemic. '*Two leaves before breakfast'* is said to keep diabetes under control. Leaves and fruits are useful in controlling diarrhoea and dysentery. Fruit pulp is used as *'shampoo*' and cooling agent. It is also a rich source of carbohydrate, protein, fat, fibre, minerals and vitamin B and C. Fruit pulp is used to cure mouth ulcers as it is the richest natural source of riboflavin (1191 units/ 100 g). '*Bael sharbat*' is prepared by mixing the fruit pulp with sugar, water and tamarind juice, which is very useful for stomach and intestinal disorders. The rind of the fruit is used for dyeing and tanning. The aromatic wood is used to make pestles in oil and sugar mills and also to make agricultural implements (Rajarajan, 1997).

Distribution

Bael tree is native to India and is found growing wild in Sub-Himalayan tracts from Jhelum eastwards to West Bengal, in central and south India. It is grown all over the country, especially in the premises of temples and houses.

Botany

Aegle marmelos (Linn.) Corr.ex Roxb. belongs to the citrus family Rutaceae. The golden coloured bael fruit resembles a golden apple and hence the generic name *Aegle*. The specific name *marmelos* is derived from marmelosin contained in the fruit (Nair, 1997). *Aegle marmelos* is a medium sized armed deciduous tree growing upto 8m in height with straight sharp axillary thorns and yellowish brown shallowly furrowed corky bark. Leaves are alternate, trifoliate and aromatic; leaflets ovate or ovate-lanceolate, crenate, pellucid-punctate, the laterals subsessile and the terminal long petioled. Flowers are greenish-white, sweet scented, borne on axillary panicles. Fruit is globose, woody berry with golden yellow rind when ripe. Seeds are numerous oblong, compressed and embedded in the orange brown sweet gummy pulp.

Agrotechnology

Bael comes up well in humid tropical and subtropical climate. It grows on a wide range of soils from sandy loam to clay loam. North Indian varieties are preferred to South Indian types for large scale cultivation. Twelve varieties are cultivated in North India for

their fruits. *Kacha, Ettawa, Seven Large, Mirsapuri* and *Deo Reo Large* are varieties meant specially for '*Sharbat*'. The plant is propagated mainly by seeds and rarely by root cuttings. Seeds are freshly extracted from ripe fruits after removing the pulp and then dried in sun. Seeds are soaked in water for 6 hours and sown on seed beds which are covered with rotten straw and irrigated regularly. Seeds germinate within 15-20 days. One month old seedlings can be transplanted into polybags which can be planted in the field after 2 months. Budded or grafted plants as well as new saplings arising from injured roots can also be used for planting. Grafted plants start yielding from the 4^{th} year while the trees raised from seeds bear fruits after 7-10 years. Planting is done in the main field with onset of monsoon in June-July at a spacing of 6-8m. Pits of size $50cm^3$ are dug. Pits are filled with a mixture of top soil and 10kg of well decomposed FYM and formed into a heap. Seedlings are transplanted in the middle of the heap and mulched. Chemical fertilisers are not usually applied. The dose of organic manure is increased every year till 50kg/tree of 5 years or more. Regular irrigation and weeding are required during early stages of growth. No serious pests and diseases are noted in the crop. Bael tree flowers during April. The flowers are aromatic with pleasant and heavenly odour. The fruits are set and slowly develop into mature fruits. Fruits are seen from October-March. A single tree bears 200-400 fruits each weighing 1-2 kg. Roots can be collected from mature trees of age 10 years or more. Tree is cut down about 1m from the ground. The underground roots are carefully dug out. Roots with the attached wood is then marketed (Rajarajan,1997).

Properties and activity

Bael is reported to contain a number of coumarins, alkaloids, sterols and essential oils. Roots and fruits contain coumarins such as scoparone, scopoletin, umbelliferone, marmesin and skimmin. Fruits, in addition, contain xanthotoxol, imperatorin and alloimperatorin and alkaloids like aegeline and marmeline identified as N-2-hydroxy-2-[4 -(3',3'-dimethyl allyloxy) phenyl] ethyl cinnamide. β- sitosterol and its glycoside are also present in the fruits. Roots and stem barks contain a coumarin - aegelinol. Roots also contain psoralen, xanthotoxin, 6,7-dimethoxy coumarin, tembamide, mermin and skimmianine. Leaves contain the alkaloids - O-(3,3-dimethyl allyl)-halfordinol, N-2-ethoxy-2 (4-methoxy phenyl) ethyl cinnamide, N-2-methoxy-2-(4-3',3'-dimethyl allyloxy) phenyl] ethyl cinnamide, N- 2-[4-(3',3'-dimethyl allyloxy) phenyl] ethyl cinnamide, N-2-hydroxy-2-[4-(3',3'-dimethyl allyloxy) phenyl] ethyl cinnamide, N-4-methoxy steryl cinnamide and N-2-hydroxy-2-(4-hydroxy phenyl) ethyl cinnamide. Mermesinin, rutin and β-sitosterol - β-D-glucoside are also present in the leaves (Husain *et al*, 1992).

Root, bark, leaves and fruits are hypoglycaemic, astringent and febrifuge. Root, stem and bark are antidiarrhoeal and antivenin. Leaf is antiinflammatory, expectorant, anticatarrhal, antiasthamatic, antiulcerous and ophthalmic. Flower is emetic. Unripe fruit is stomachic and demulcent. Ripe fruit is antigonorrhoeal, cardiotonic, restorative, laxative, antitubercular, antidysenteric and antiscorbutic. Seed is anthelmintic and antimicrobial (Warrier *et al*, 1993).

INDIAN GOOSEBERRY Phyllanthus emblica Euphorbiaceae

San: Amalaka, Adiphala Hin, Mar: Amla Ben: Amlaki Mal, Tam: Nelli
Tel: Amalakam Kan: Amalaka Guj: Ambala Kas: Aonla

Importance

Indian gooseberry or emblic myrobalan is a medium sized tree the fruit of which is used in many Ayurvedic preparations from time immemorial. It is useful in haemorrhage, leucorrhaea, menorrhagia, diarrhoea and dysentery. In combination with iron, it is useful for anaemia, jaundice and dyspepsia. It goes in combination in the preparation *of triphala, arishta, rasayan, churna* and *chyavanaprash. Sanjivani* pills made with other ingredients is used in typhoid, snake-bite and cholera. The green fruits are made into pickles and preserves to stimulate appetite. Seed is used in asthma, bronchitis and biliousness. Tender shoots taken with butter milk cures indigestion and diarrhoea. Leaves are also useful in conjunctivitis, inflammation, dyspepsia and dysentery. The bark is useful in gonorrhoea, jaundice, diarrhoea and myalgia. The root bark is astringent and is useful in ulcerative stomatitis and gastrohelcosis. Liquor fermented from fruit is good for indigestion, anaemia, jaundice, heart complaints, cold to the nose and for promoting urination. The dried fruits have good effect on hair hygiene and used as ingredient in shampoo and hair oil. The fruit is a very rich source of Vitamin C (600mg/100g) and is used in preserves as a nutritive tonic in general weakness (Dey, 1980).

Distribution

Indian gooseberry is found through out tropical and subtropical India, Sri Lanka and Malaca. It is abundant in deciduous forests of Madhya Pradesh and Darjeeling, Sikkim and Kashmir. It is also widely cultivated.

Botany

Phyllanthus emblica Linn. syn. *Emblica officinalis* Gaertn. belongs to Euphorbiaceae family. It is a small to medium sized deciduous tree growing up to 18m in height with thin light grey, bark exfoliating in small thin irregular flakes. Leaves are simple, many subsessile, closely set along the branchlets, distichous light green having the appearance of pinnate leaves. Flowers are greenish yellow in axillary fascicles, unisexual; males numerous on short slender pedicels; females few, subsessile; ovary 3-celled. Fruits are globose, 1-5cm in diameter, fleshy, pale yellow with 6 obscure vertical furrows enclosing 6 trigonous seeds in 2-seeded 3 crustaceous cocci. Two forms Amla are generally distinguished, the wild ones with smaller fruits and the cultivated ones with larger fruits and the latter are called '*Banarasi'*(Warrier *et al*, 1995).

Agrotechnology

Gooseberry is quite hardy and it prefers a warm dry climate. It needs good sunlight and rainfall. It can be grown in almost all types of soils, except very sandy type. A large fruited variety "*Chambakad Large*" was located from the rain shadow region of the Western Ghats for cultivation in Kerala. *Amla* is usually propagated by seeds and rarely by root suckers and grafts. The seeds are enclosed in a hard seed coat which renders the germination difficult. The seeds can be extracted by keeping fully ripe fruits in the sun for 2-3 days till they split open releasing the seeds. Seeds are soaked in water for 3-4 hours and sown on

previously prepared seed beds and irrigated. Excess irrigation and waterlogging are harmful. One month old seedlings can be transplanted to polythene bags and one year old seedlings can be planted in the main field with the onset of monsoon. Pits of size 50 cm^3 are dug at 6-8m spacing and filled with a mixture of top soil and well rotten FYM and planting is done. *Amla* can also be planted as a windbreak around an orchard. Irrigation and weeding are required during the first year. Application of organic manure and mulching every year are highly beneficial. Chemical fertilisers are not usually applied. No serious pests or diseases are generally noted in this crop. Planted seedlings will commence bearing from the 10^{th} year, while grafts after 3-4 years. The vegetative growth of the tree continues from April to July. Along with the new growth in the spring, flowering also commences. Fruits will mature by December-February. Fruit yield ranges from 30-50kg/tree/year when full grown (KAU,1993).

Properties and Activity

Amla fruit is a rich natural source of vitamin C. It also contains cytokinin like substances identified as zeatin, zeatin riboside and zeatin nucleotide. The seeds yield 16% fixed oil, brownish yellow in colour. The plant contains tannins like glucogallia, corilagin, chebulagic acid and 3,6-digalloyl glucose. Root yields ellagic acid, lupeol, quercetin and β-sitosterol (Thakur *et al*, 1989).

The fruit is diuretic, laxative, carminative, stomachic, astringent, antidiarrhoeal, antihaemorrhagic and antianaemic.

INDIAN BDELLIUM *Commiphora mukul*

Burseraceae

San: Gugulu, Mahisaksah, Koushikaha, Devadhupa

Hin:Gugal Mal:Gulgulu Tam, Tel: Gukkulu Kan: Guggul Ben: Guggul

Importance

Indian bdellium is a small, armed, deciduous tree from the bark of which gets an aromatic gum resin, the *'**Guggul**'* of commerce. It is a versatile indigenous drug claimed by ayurvedists to be highly effective in the treatment of rheumatism, obesity, neurological and urinary disorders, tonsillitis, arthritis and a few other diseases. The fumes from burning guggul are recommended in hay- fever, chronic bronchitis and phytises.

The price of guggulu gum has increased ten fold in ten years or so, indicating the increase in its use as well as decrease in natural plant stand. It has been listed as a threatened plant by Botanical Survey of India (Dalal, 1995) and is included in the Red Data Book (IUCN) and over exploited species in the country (Billare,1989).

Distribution

The center of origin of *Commiphora* spp. is believed to be Africa and Asia. It is a widely adapted plant well distributed in arid regions of Africa (Somalia, Kenya and Ethiopia in north east and Madagascar, Zimbabwe, Botswana, Zaire in south west Africa), Arabian peninsula (Yemen, Saudi Arabia and Oman). Different species of *Commiphora* are distributed in Rajasthan, Gujarat, Maharashtra and Karnataka states of India and Sind and Baluchistan provinces of Pakistan (Tajuddin *et al*, 1994). In India, the main commercial source of gum guggul is Rajasthan and Gujarat.

Botany

The genus *Commiphora* of family Burseraceae comprises about 185 species. Most of them occur in Africa, Saudi Arabia and adjoining countries. In India only four species have been reported. They are *C. mukul*(Hook. ex Stocks) Engl. syn. *Balsamodendron mukul* (Hook. ex Stocks), *C. wightii* (Arnott) Bhandari, *C.stocksiana* Engl., *C. berryi and C.agallocha* Engl.

In early studies about the flora of India, the '*guggul*' plant was known as *Commiphora mukul*(Hook. ex Stocks) Engl. or *Balsamodendron mukul* (Hook. ex Stocks). It was renamed as *C. roxburghii* by Santapau in 1962. According to Bhandari the correct Latin name of the species is *C. wightii*(Arnott) Bhandari, since the specific name '*wightii*' was published in 1839, prior to '*roxburghi*' in 1848 (Dalal and Patel, 1995).

C. mukul is a small tree upto 3-4m height with spinescent branching. Stem is brownish or pale yellow with ash colored bark peeling off in flakes. Young parts are glandular and pubescent. Leaves are alternate, 1-3 foliate, obovate, leathery and serrate (sometimes only towards the apex). Lateral leaflets when present only less than half the size of the terminal ones. Flowers small, brownish red, with short pedicel seen in fascicles of 2-3. Calyx campanulate, glandular, hairy and 4-5 lobed. Corolla with brownish red, broadly linear petals reflexed at apex. Stamens 8-10, alternatively long and short. Ovary oblong, ovoid and stigma bifid. Fruit is a drupe and red when ripe, ovate in shape with 2-3 celled stones. The chromosome number 2n= 26 (Warrier *et al*, 1994; Tajuddin *et al*, 1994).

Agrotechnology

Guggal being a plant of arid zone thrives well in arid- subtropical to tropical climate. The rainfall may average between 100mm and 500mm while air temperature may vary between 40°C in summer and −3°C during winter. Maximum relative humidity prevails during rainy season (83% in the morning and 48% in the evening).Wind velocity remains between 20-25 km/hour during the year is good. Though they prefer hard gypseous soil, they are found over sandy to silt loam soils, poor in organic matter but rich in several other minerals in arid tracks of western India (Tajuddin *et al*, 1994).

Plants are propagated both by vegetatively and seeds. Plants are best raised from stem cuttings from the semi woody (old) branch. For this purpose one metre long woody stem

of 10mm thickness is selected and the cut end is treated with IBA or NAA and planted in a well manured nursery bed during June-July months; the beds should be given light irrigation periodically. The cuttings initiate sprouting in 10-15 days and grow into good green sprout in 10-12 months. These rooted plants are suitable for planting in the fields during the next rainy season. The cuttings give 80-94% sprouting usually. Air layering has also been successfully attempted and protocol for meristem culture is available in literature. Seed germination is very poor (5%) but seedling produce healthier plants which withstand high velocity winds.

The rooted cuttings are planted in a well laid-out fields during rainy season. Pits of size 0.5m cube are dug out at 3-4 m spacing in rows and given FYM and filler soil of the pit is treated with BHC (10%) or aldrin (5%) to protect the new plants from white ants damage. Fertilizer trials have shown little response except due to low level of N fertilization. Removal of side branches and low level of irrigation supports a good growth of these plants. The plantation does not require much weeding and hoeing. But the soil around the bushes be pulverised twice in a year to increase their growth and given urea or ammonium sulphate at 25- 50g per bush at a time and irrigated. Dalal *et al* (1989) reported that *cercospora* leaf spot was noticed on all the cultures. Bacterial leaf blight was also noticed to attack the cultures. A leaf eating caterpillar (*Euproctis lanata* Walker) attack guggal, though not seriously. White fly (*Bemisia tabaci*) is observed to suck sap of leaves and such leaves become yellowish and eventually drop. These can be effectively controlled by using suitable insecticide.

Stem or branch having maximum diameter of about 5cm at place of incision, irrespective of age is tapped. The necrotic patch on the bark is peeled off with a sharp knife and Bordeaux paste is applied to the exposed (peeled off) surface of the stem or branch. A prick chisel of about 3cm width is used to make bark- deep incisions and while incising the bark, the chisel is held at an acute angle so that scooped suspension present on the body of the chisel flows towards the blade of the chisel and a small quantity of suspension flows inside the incised bark. If tapping is successful, gum exudation ensures after about 15-20 days from the date of incision and continues for nearly 30-45 days. The exuded gum slides down the stem or branch, and eventually drops on the ground and gets soiled. A piece of polythene sheet can be pouched around the place of incision to collect gum. Alternatively, a polythene sheet can be spread on the ground to collect exuded gum. A maximum of about 500g of gum has been obtained from a plant (Dalal, 1995).

Post harvest technology

The best grade of guggul is collected from thick branches of tree. These lumps of guggul are translucent. Second grade guggul is usually mixed with bark, sand and is dull coloured guggul. Third grade guggul is usually collected from the ground which is mixed with sand, stones and other foreign matter. The final grading is done after getting cleansed material. Inferior grades are improved by sprinkling castor oil over the heaps of the guggul which impart it a shining appearance (Tajuddin *et al*, 1994).

Properties and Activity

The gum resin contains guggul sterons Z and E, guggul sterols I-V, two diterpenoids- a terpene hydrocarbon named cembreneA and a diterpene alcohol- mukulol, α-camphrone and cembrene, long chain aliphatic tetrols- octadecan-1,2,3,4-tetrol, eicosan-1,2,3,4-tetrol and nonadecan-1,2,3,4-tetrol. Major components from essential oil of gum resin are myrcene and dimyrcene. Plant without leaves, flowers and fruits contains myricyl alcohol, β-sitosterol and fifteen aminoacids. Flowers contain quercetin and its glycosides as major flavonoid components, other constituents being ellagic acid and pelargonidin glucoside (Patil *et al*, 1972; Purushothaman and Chandrasekharan, 1976).

The gum resin is bitter, acrid, astringent, thermogenic, aromatic, expectorant, digestive, anthelmintic, antiinflammatory, anodyne, antiseptic, demulcent, carminative, emmenagogue, haematinic, diuretic, lithontriptic, rejuvenating and general tonic. Guggulipid is hypocholesteremic (Husain *et al*, 1992; Warrier *et al*, 1994).

INDIAN GINSENG *Withania somnifera*

Solanceae

San: Aswagandha, Varahakarni Hin: Asgandh, Punir Mal: Amukkuram Tam: Amukkira
Tel: Vajigandha Mar: Askandha Guj: Ghoda Kan: Viremaddinagaddi

Importance

Indian ginseng or **Winter cherry** is an erect branching perennial undershrub which is considered to be one of the best rejuvenating agents in Ayurveda. Its roots, leaves and seeds are used in Ayurvedic and Unani medicines, to combat diseases ranging from tuberculosis to arthritis. The pharmacological activity of the plant is attributed to the presence of several alkaloids and withaniols. Roots are prescribed in medicines for hiccup, several female disorders, bronchitis, rheumatism, dropsy, stomach and lung inflammations and skin diseases. Its roots and paste of green leaves are used to relieve joint pains and inflammation. It is also an ingredient of medicaments prescribed for curing disability and sexual weakness in male. Leaves are used in eye diseases. Seeds are diuretic. It is a constituent of the herbal drug '*Lactare*' which is a galactagogue.

Aswagandha was observed to increase cell-mediated immunity, prevent stress induced changes in adrenal function and enhance protein synthesis. Milk fortified with it increases total proteins and body weight. It is a well known rejuvenating agent capable of imparting long life, youthful vigour and intellectual power. It improves physical strength and is prescribed in all cases of general debility. Aswagandha powder (6-12g) twice a day along with honey and ghee is advised for tuberculosis in Sushruta Samhita. It also provides sound sleep (Prakash, 1997).

Distribution

Aswagandha is believed to have oriental origin. It is found wild in the forests of Mandsaur and Bastar in Mandhya Pradesh, the foot hills of Punjab, Himachal Pradesh, Uttar Pradesh and western Himalayas in India. It is also found wild in the Mediterranean region in North America. In India it is cultivated in Madhya Pradesh, Rajastan and other drier parts of the country.

Botany

Aswagandha belongs to the genus *Withania* and family Solanaceae. Two species, viz, *W. coagulans* Dunal and *W. somnifera* Dunal are found in India. *W. coagulans* is a rigid grey under shrub of 60-120cm high. *W. somnifera* is erect, evergreen, tomentose shrub, 30-75cm in height. Roots are stout, fleshy, cylindrical, 1-2cm in diameter and whitish brown in colour. Leaves are simple, ovate, glabrous and opposite. Flowers are bisexual, inconspicuous, greenish or dull yellow in colour born on axillary umbellate cymes, comprising 5 sepals, petals and stamens each; the two celled ovary has a single style and a bilobed stigma. The petals are united and tubular. The stamens are attached to the corolla tube and bear erect anthers which form a close column or cone around the style. Pollen production is poor. The fruit is a small berry, globose, orange red when mature and is enclosed in persistent calyx. The seeds are small, flat, yellow and reniform in shape and very light in weight. The chromosome number 2n = 48.

The cultivated plants have sizable differences from the wild forms not only in their morphological characters but also in the therapeutical action, though the alkaloids present are the same in both (Kaul, 1957). Some botanists, therefore, described the cultivated plant distinct from wild taxa and have coined a new name *W. aswagandha* (Kaul, 1957) which is contested by Atal and Schwarting (1961).

Agrotechnology

Asgandh is a tropical crop growing well under dry climate. The areas receiving 600 to 750mm rainfall is best suited to this crop. Rainy season crop requires relatively dry season and the roots are fully developed when 1-2 late winter rains are received. Sandy loam or light red soils having a pH of 7.5- 8.0 with good drainage are suitable for its cultivation. It is usually cultivated on poor and marginal soils. *Withania* is propagated through seeds. It is a

late *kharif* crop and planting is done in August. Seeds are either broadcast-sown or seedlings are raised in nursery and then transplanted. Seed rate is 10-12 kg/ha for broadcasting and 5kg/ha for transplanting. In direct sown crop plants are thinned and gap filling is done 25-30 days after sowing. Seeds should be treated with Dithane M-45 at 3g/kg of seeds before sowing. Seeds are sown in the nursery just before the onset of rainy season and covered with light soil. Seeds germinate in 6-7 days. When seedlings are six weeks old they are transplanted at 60cm in furrows taken 60cm apart. The crop is mainly grown as a rainfed crop on residual fertility and no manure or fertilizers are applied to this crop generally. However, application of organic manure is beneficial for realizing better yields. It is not a fertilizer responsive crop. One hand weeding 25-30 days after sowing helps to control weeds effectively. No serious pest is reported in this crop. Diseases like seedling rot and blight are observed. Seedling mortality becomes serious under high temperature and humid conditions. The disease can be minimized by use of disease free seeds and treatment with thiram or deltan at 3-4g/kg seed before sowing. Further, use of crop rotation, timely sowing and keeping field well drained also protect the crop. Spraying with 0.3% fytolan, dithane Z-78 or dithane M-45 will help controlling the disease incidence. Spraying is repeated at 15 days interval if the disease persists. Aswagandha is a crop of 150-170 days duration. The maturity of the crop is judged by the drying of the leaves and reddening of berries. Harvesting usually starts from January and continues till March. Roots, leaves and seeds are the economical parts. The entire plant is uprooted for roots, which are separated from the aerial parts. The berries are plucked from dried plants and are threshed to obtain the seeds. The yield is 400-500kg of dry roots and 50-75kg seeds per hectare.

Post harvest technology

The roots are separated from the plant by cutting the stem 1-2cm above the crown. Roots are then cut into small pieces of 7-10cm to facilitate drying. Occasionally, the roots are dried as a whole. The dried roots are cleaned, trimmed, graded, packed and marketed. Roots are carefully hand sorted into the following four grades.

Grade A : Root pieces 7cm long, 1-1.5cm diameter, brittle, solid, and pure white from outside.

Grade B : Root pieces 5cm long, 1cm diameter, brittle, solid and white from outside.

Grade C : Root pieces 3-4cm long, less than 1cm diameter and solid.

Lower grade : Root pieces smaller, hollow and yellowish from outside.

Properties and activity

Aswagandha roots contain alkaloids, starch, reducing sugar, hentriacontane, glycosides, dulcital, withaniol acid and a neutral compound. Wide variation (0.13-0.31%) is observed in alkaloid content. Majumdar (1955) isolated 8 amorphous bases such as withanine, somniferine, somniferinine, somnine, withananine, withananinine, pseudowithanine and withasomnine. Other alkaloids reported are nicotine, tropine, pseudotropine, 3,α-tigloyloxytropane, choline, cuscudohygrine, anaferine, anahygrine and others. Free aminoacids in the roots include aspartic acid, glycine, tyrosine, alanine, proline, tryptophan, glutamic acid and cystine. Leaves contain 12 withanolides, alkaloids, glycosides, glucose and free amino acids. Berries contain a milk coagulating enzyme, two esterases, free amino acids, fatty oil, essential oil and alkaloids. Methods for alkaloid's analysis in Asgandh roots have also been reported (Majumdar, 1955; Mishra, 1989; Maheshwari, 1989). Withania roots are astringent, bitter, acrid, somniferous, thermogenic, stimulant, aphrodisiac, diuretic and tonic. Leaf is antibiotic, antitumourous, antihepatotoxic and antiinflammatory. Seed is milk coagulating, hypnotic and diuretic.

NEEM *Azadirachta indica* *Meliaceae*

San: Nimbah, Prabhadrah Hin, Ben: Nim, Nim Mal: Aryaveppu Tel: Vepa Ori: Nimba Tam: Vembu, Veppu Pun: Bakam,Bukhain Guj: Limba Kan: Bevu Mar: Limbu

Importance

Neem or **margose tree**, also known as **Indian lilac** is a highly exploited medicinal plant of Indian origin, widely grown and cultivated throughout India. Every part of the tree, namely root, bark, wood, twig, leaf, flower, fruit, seed, kernel and oil has been in use from time immemorial in the Ayurvedic and Unani systems of medicine. *Nimbarishta, nimbadi churna* and *nimbharidra khand* are well known preparations. It is valuable as an antiseptic, used in the treatment of small pox. Small twigs are used as tooth brushes and as a prophylactic for mouth and teeth complaints. Extract from the leaves are useful for sores, eczema and skin diseases. Boiled and smashed leaves serve as excellent antiseptic. Decoction of leaves is used for purifying blood. Neem oil is used in soaps, toothpaste and as a hair tonic to kill lice. Seed is used in snake bite. The fruits and leaves being renewable, provide sustainable returns. Different parts of the fruit are separated into components and each one produces derivatives of varying chemical nature and utility. Neem derivatives are now used in agriculture, public health, human and veterinary medicines, toiletries, cosmetics and livestock production. Applications as pesticides, allied agrochemicals, plant nutrients and adjuvants for improving nitrogen use efficiency are of much importance. Neem kernel suspension (1%) is a house hold insecticide. Pesticide formulations containing ***azadirachtin*** are now commercially available in India, USA, Canada, Australia and Germany. Neem cake is rich in N, P, K, Ca and S. Neem Meliacins like epinimbin and nimbidin are commercially exploited for the preparation of slow and extended release of nutrients including nitrification inhibitors (Eg. Nimin). Extracts of neem seed oil and bark check the activity of male reproductive cells and prevents sperm production. Neem seed oil is more effective than the bark for birth control. Neem based commercial products are also available for diabetes treatment (Nimbola, JK-22), contraceptive effect (Sensal, Nim-76) and mosquito/ insect repelling (Srivastava, 1989; Tewari, 1992; Parmer and Katkar, 1993; Pushpangadan *et al*, 1993; Mariappan, 1995).

Distribution

Neem is a native of the Siwalik deccan parts of South India. It grows wild in the dry forests of Andra Pradesh, Tamil Nadu and Karnataka. It has spread to Pakistan, Bangladesh , Sri Lanka, Malaysia, Indonesia, Thailand, Middle East Sudan and Niger. It is now grown in Australia, Africa, Fiji, Mauritious, Central and South America, the Carribeans, Puerto Rico and Haiti. The largest known plantation of nearly 50,000 trees is at Arafat plains en route to Mecca in Saudi Arabia for providing shade to Haj pilgrims (Ahmed, 1988).

Botany

The genus *Azadirachta* of family Meliaceae comprises two species: *A. indica* A. Juss syn. *Melia azadirachta* Linn. and *A. excelsa* (Jack) Jacobs syn. *A. integrifolia* Mers., the latter being found in Philippines, Sumatra, Malaya, Borneo and New Guinea. Neem is a hardy medium to large, mostly evergreen tree attaining 20m height and 2.5m girth. It has a short bole with wide spreading branches and glabrous twigs forming a round to oval crown. The bark is thick, dark-gray with numerous longitudinal furrows and transverse cracks. Leaves are imparipinnately compound, alternate, exstipulate and 20-38cm long. Inflorescence is long, slender, axillary or terminal panicle. Flowers are white or pale yellow, small, bisexual, pentamerous and bracteate. Stamens 10; filaments unite to form a moniliform tube. Gynoecium is tricarpellary and syncarpous, ovary superior, trilocular. Each carpel bears two collateral ovules on parietal placentation. Fruit is one seeded drupe with woody endocarp, greenish yellow when ripe. Seed ellipsoid, cotyledons thick fleshy and oily. Neem has chromosome number 2n = 28. Neem trees tend to become deciduous for a brief period in dry ecology. Ecotypes, exhibiting morphological variation in root growth, leaf size, contents, bole length , canopy, inflorescence, fruit bearing, seed size, shape and quality exist in natural populations.

Agrotechnology

Neem grows in tropical arid regions with high temperatures, altitudes between 50m and 1000m, as little rainfall as 130mm/yr and long stretches of drought. Well drained sunny hill places are ideal. It grows on most kinds of soils including dry, stony, shallow, nutrient deficient soils with scanty vegetation, moderately saline and alkali soils, black cotton, compact clays and laterite crusts. However, silty flats, clayey depressions and land prone to inundation are not conducive for its growth (Chaturvedi, 1993). Soil pH of 5.0 to 10.0 is ideal. It brings surface soil to neutral pH by its leaf litter. It has extensive and deeply penetrating root system capable of extracting moisture and nutrients even from highly leached poor sandy soils.

Neem propagates easily by seed without any pretreatment, though it can be regenerated by vegetative means like root and shoot cuttings. Seeds are collected from June to August. These remain viable for 3-5 weeks only which necessitates sowing within this short time. Seeds may be depulped and soaked in water for 6 hours before sowing. Seeds are sown on nursery beds at 15x5cm spacing, covered with rotten straw and irrigated. Germination takes 15-30 days. Seedlings can be transplanted after two months of growth onwards either to polybags or to mainfield. Neem can be grown along with agricultural crops like groundnut, bean, millets, sorghum and wheat. It is also suitable for planting in roadsides, for afforestation of wastelands and under agroforestry system. For field planting, pits of size 50-75 cm cube are dug 5-6m apart, filled with top soil and well rotten manure, formed into a heap, and seedling is planted at the centre of the heap. FYM is applied at 10-20 kg/plant every year. Chemical fertilizers are not generally applied. Irrigation and weeding are required during the first year for quick establishment.

More than 38 insect pests are reported on Neem which may become serious at times. The important ones are seed and flower insect (*Scirtothrips dorsalis* Hood), defoliators (*Boarmia variegata* Moore and *Eurema* sp.), sap suckers (*Helopeltes antonii* Signoret and *Pulvinaria maxima* Green) , root feeders (*Hototrichia consanguinea* Blanchard), mealy bug (*Pseudococus gilbertensis*), scale insect (*Parlatoria orientalis*) and a leaf webber (*Loboschiza Koenigiana*)(Beeson, 1941, Bhasin *et al*, 1958, Parmar, 1995). They can be controlled by the application of 0.01-0.02% monocrotophos or dimethoate. No serious diseases are reported in Neem. Flowering starts after 5 years. In India flowering is during January-May and fruits mature from May-August. The leaves are shed during February-March and a full grown tree produces about 350 kg dry leaves and 40-50 kg berries per annum. Fresh fruits give 60% dry fruits which yield 10% kernel which contains 45% fixed oil, on an average. After 10 years of growth the wood can be cut and used as timber.

Properties and Activity

Dry Neem leaves contain carbohydrates 47-51%, crude protein 14-19%, crude fiber 11-24%, fat 2-7%, ash 7-9%, Ca 0.8-2.5% and P 0.1-0.2%. Leaves also contain the flavanoid quercetin, nimbosterol (β-sitosterol), kaempferol and myricetin. Seed and oil contains desacetylnimbin, azadirachtin ($C_{35}H_{44}O_{16}$), nimbidol, meliantriol ,tannic acid, S and amino acids. Neem cake contain the highest sulphur content of 1.07% among all the oil cakes. Trunk bark contains nimbin 0.04%, nimbinin 0.001%, nimbidin 0.4%, nimbosterol 0.03%, essential oil 0.02%, tannins 6.0 %, margosine and desacetylnimbin (Atal and Kapur, 1982; Thakur *et al* 1989).

Neem bark is bitter, astringent, acrid, refrigerant, depurative, antiperiodic, vulnerary, demulcent, insecticidal, liver tonic, expectorant and anthelmintic. Leaves are bitter, astringent, acrid, depurative, antiseptic, ophthalmic, anthelmintic, alexeteric, appetizer, insecticidal, demulcent and refrigerant. Seed and oil are bitter, acrid, thermogenic, purgative, emollient, anodyne, anthelmintic depurative, vulnerary, uterine stimulant, urinary astringent, pesticidal and antimicrobial (Warrier *et al*, 1993).

CINCHONA *Cinchona spp.* *Rubiaceae*

San: Cinchona, Kunayanah Hin: Kunain Mal: Cinchona, Quoina Tam: Cinchona

Importance

Cinchona, known as **Quinine, Peruvian** or **Crown bark tree** is famous for the antimalarial drug '***quinine***' obtained from the bark of the plant. The term cinchona is believed to be derived from the countess of cinchon who was cured of malaria by treating with the bark of the plant in 1638. Cinchona bark has been valued as a febrifuge by the Indians of south and central America for a long time. Over 35 alkaloids have been isolated from the plant; the most important among them being quinine, quinidine, cinchonine and cinchonidine. These alkaloids exist mainly as salts of quinic, quinovic and cinchotannic acids. The cultivated bark contains 7-10% total alkaloids of which about 70% is quinine. Similarly 60% of the total alkaloids of root bark is quinine. Quinine is isolated from the total alkaloids of the bark as quinine sulphate. Commercial preparations contain cinchonidine and dihydroquinine. They are useful for the treatment of malarial fever, pneumonia, influenza, cold, whooping couphs, septicaemia, typhoid, amoebic dysentery, pin worms, lumbago, sciatica, intercostal neuralgia, bronchial neuritis and internal hemorrhoids. They are also used as anesthetic and contraceptive. Besides, they are used in insecticide compositions for the preservation of fur, feathers, wool, felts and textiles. Over doses of these alkaloids may lead to deafness, blindness, weakness, paralysis and finally collapse, either comatose or deleterious. Quinidine sulphate is cardiac depressant and is used for curing arterial fibrillation.

Distribution

Cinchona is native to tropical South America. It is grown in Bolivia, Peru, Costa Rica, Ecuador, Columbia, Indonesia, Tanzania, Kenya, Zaire and Sri Lanka. It was introduced in 1808 in Guatemala,1860 in India, 1918 in Uganda, 1927 in Philippines and in 1942 in Costa Rica. Roy Markham introduced the plant to India. The first plantation was raised in Nilgiris and later on in Darjeeling of West Bengal. The value of the tree was learnt by Jessuit priests who introduced the bark to Europe. It first appeared in London pharmacopoeia in 1677 (Husain, 1993).

Botany

The quinine plant belongs to the family Rubiaceae and genus *Cinchona* which comprises over 40 species. Among these a dozen are medicinally important. The commonly cultivated species are *C. calisaya* Wedd., *C. ledgeriana* Moens, *C. officinalis* Linn., *C. succirubra* Pav. ex Kl., *C. lancifolia* and *C. pubescens. Cinchona* species have the chromosome number 2n=68. *C. officinalis* Linn. is most common in India. It is an evergreen tree reaching a height of 10-15m. Leaves are opposite, elliptical, ovate- lanceolate, entire and glabrous. Flowers are reddish-brown in short cymbiform, compound cymes, terminal and axillary; calyx tubular, 5-toothed, obconical, subtomentose, sub-campanulate, acute, triangular, dentate, hairy; corolla tube 5 lobed, densely silky with white depressed hairs, slightly pentagonal; stamens 5; style round, stigma submersed. Fruit is capsule ovoid-oblong; seeds elliptic, winged margin octraceous, crinulate-dentate (Biswas and Chopra, 1982).

Agrotechnology

The plant widely grows in tropical regions having an average minimum temperature of 14°C. Mountain slopes in the humid tropical areas with well distributed annual rainfall of 1500-1950mm are ideal for its cultivation. Well drained virgin and fertile forest soils with pH 4.5-6.5 are best suited for its growth. It does not tolerate waterlogging. Cinchona is propagated through seeds and vegetative means. Most of the commercial plantations are raised by seeds. Vegetative techniques such as grafting, budding and softwood cuttings are employed in countries like India, Sri Lanka, Java and Guatemala. *Cinchona succirubra* is commonly used as root stock in the case of grafting and budding. Hormonal treatment induces better rooting. Seedlings are first raised in nursery under shade. Raised seedbeds of convenient size are prepared, well decomposed compost or manure is applied , seeds are broadcasted uniformly at $2g/m^2$, covered with a thin layer of sand and irrigated. Seeds germinate in 10-20 days. Seedlings are transplanted into polythene bags after 3 months. These can be transplanted into the field after 1 year at 1-2m spacing. Trees are thinned after third year for extracting bark , leaving 50% of the trees at the end of the fifth year. The crop is damaged by a number of fungal diseases like damping of caused by *Rhizoctoria solani,* tip blight by *Phytophthora parasatica*, collar rot by *Sclerotiun rolfsii,* root rot by *Phytophthora cinnamomi*, *Armillaria mellea* and *Pythium vexans*. Field sanitation, seed treatment with organo mercurial fungicide, burning of infected plant parts and spraying 1% Bordeaux mixture are recommended for the control of the diseases (Crandall, 1954). Harvesting can be done in one or two phases. In one case, the complete tree is uprooted, after 8-10 years when the alkaloid yield is maximum. In another case, the tree is cut about 30cm from the ground for bark after 6-7 years so that fresh sprouts come up from the stem to yield a second crop which is harvested with the under ground roots after 6-7 years. Both the stem and root are cut into convenient pieces, bark is separated, dried in shade, graded, packed and traded. Bark yield is 9000-16000kg/ha (Husain, 1993).

Properties and activity

Over 35 alkaloids have been isolated from Cinchona bark, the most important among them are quinine, quinidine, cinchonine, cinchonidine, cinchophyllamine and idocinchophyllamine. There is considerable variation in alkaloid content ranging from 4% to 20%. However, 6-8% yield is obtained from commercial plantations. The non alkaloidal constituents present in the bark are bitter glycosides, α-quinovin, cinchofulvic, cinchotannic and quinic acids, a bitter essential oil possessing the odour of the bark and a red coloring matter. The seed contains 6.13% fixed oil. Quinine and its derivatives are bitter, astringent, acrid, thermogenic, febrifuge, oxytocic, anodyne, anti-bacterial, anthelmintic, digestive, depurative, constipating, anti pyretic, cardiotonic, antiinflammatory, expectorant and calcifacient (Warrier *et al,* 1994; Bhakuni and Jain, 1995).

GLORY LILY *Gloriosa superba*

Liliaceae

San : Langali, Visalya, Agnishika,Shakrapushpi, Garbhaghatini Hin : Kalihari
Mal: Menthonni Tam: Akkinichilam Pan: Kariari
Guj: Dudhiya vachnag Kan: Nangulika Mar: Nagakaria
Ben: Bishalanguli Ori: Dangogahana Tel : Adavinabhi

Importance

Glory lily is a glabrous herbaceous climber which yields different types of troplone alkaloids of medicinal importance. The major alkaloids are **colchicine**, 3-demethyl colchicine and colchicoside. There is another alkaloid **gloriosine** which promises to be even more effective than colchicine in plant breeding for inducing polyploidy. The genus has importance in the ornamental horticulture due to its bright flowers and wiry climbing stem.

The roots and rhizomes are used in traditional system of medicine. Its abortifacient and antipyretic properties have been mentioned in ancient classics *"Charaka*". The name *Garbhaghatini* is due to this abortifacient activity. They are useful in the treatment of inflammations, ulcers, scrofula, hemorrhoids, pruritus, dyspepsia, helminthiasis, flatulence, intermittent fevers and debility. The root is given internally as an effective antidote against cobra poison. A paste of the root is also used as an anodyne; applications in bites of poisonous insects, snake bites, scorpion sting, parasitic skin diseases and leprosy (Nadkarni,1954; Chaudhuri and Thakur; 1994).

Distribution

The plant is distributed throughout tropical India upto an altitude of 2500m and in Andaman islands. It is also cultivated in tropical and South Africa, Madagaskar, Indonesia and Malasia. It is reported to be cultivated in some parts of Europe. In India it was cultivated in RRL, Jammu in 1960s. Recently it was taken up by Indian Council of Agricultural Research(ICAR). Cultivation of the plant is mostly confined to the Southern states of India besides its collection from wild sources.

Botany

Gloriosa superba Linn. belongs to Liliaceae family. It is a glabrous climbing herb with tuberous root stock grows over hedges and small trees. Stem is 6m long which grows to a height of 1.2-1.5m before the stem branches. Leaves are simple, alternate or whorled, sessile, ovate-lanceolate, 17x4.5cm, tip elongating into a spirally coiled tendril, base cordate and margin entire. Flowers are large in terminal racemes; perianth segments 6, linear, flexuosus and deflexed, basal half bright yellow, upper half red; stamens 6; ovary glabrous, 3-celled. Fruits are capsules, linear-oblong, upto 6.8cm long, 3 equal lobes, one or two lobes shorter in malformed fruits; green dried to pale and then black colour, dehisced into three sections. Seeds are oval in shape, testa spongy, embryo cylindric, 30-150 seeds per capsule, pale orange attached to the sutures. Tubers are cylindric, large, simple, 'V' shaped with the two limps equal or unequal in lenth pointed towards end
brownish externally and yellowish internally. (Narain, 1977)

Agrotechnology

This is a rainy season plant and sprouts well in warm, humid and tropical conditions. It should be grown in sun as the plants in shade become weedy and thin and move towards light. *G. superba* is a shallow rooted plant and grows well in a variety of soils either clay or sand through out India. It grows well in a light porous soil with good drainage. For vigorous growth, greater blooms and strong tuber, a mixture of soil, sand and compost manure is recommended. The propagation is mainly by tubers, by division of rhizomes. Seeds remain dormant for 6-9 months and due to hard seed coat, about 20-30 days are required for germination and seeds may take 3-4 years before it matures to flower. Treatment of seeds by gibberellin(1-3 ppm) resulted in higher yield of colchicine in the plant and higher production of tubers. In tissue culture, young sprouts are cultured on Murashige and Skoog's medium (Msb) supplemented with kinetin (1-4 mg/l). Direct regeneration of the explants are obtained.

The seeds and rhizomes are sown usually in the last week of June to mid July. The rhizomes are planted by splitting carefully into two from their 'V' shaped joints (two buds being at the extreme end of each rhizome) in lines 20cm apart at a distance of 20cm (while seeds are sown in lines at a distance of 4-6cm apart). They are watered regularly when the plants are growing. After green shoots appear 2-3 showers are weekly. The irradiation of the plant at 42% natural sunlight intensity increased the production of tuber and colchicine. They usually takes 6-10 weeks to flower after sprouting and then set on fruits. The fruits ripen at the end of October and after that aerial shoot eventually dies, leaving the fleshy tubers underground. The tubers are dug out with great care. An individual plant produces 50g tubers on an average. The average yield is approximately 4000-5000kg of rhizomes and 1000 kg of seed per hectare. The content of colchicine is usually 0.358% and 1.013% in tubers and seeds, respectively.

Post harvest technology

Lixivation of the material is done with 70% ethyl alcohol. Concentrated under vacuum to one third of its volume and extracted with chloroform for colchicine and related substances-concentration of the aqueous phase to syrup which is extracted 6-8 times with a mixture of $CHCl_3$ - alcohol (4:1) to yield colchicoside.

Properties and activity

The flowers, leaves and tubers contain colchicine, superbin, N-formyl deacetyl colchicine, demethyl colochicine and lumicolchicine. Tubers also contain gloriosine. Leaves in addition, contain chelidonic acid, 2-hydroxy 6-methoxy benzoic acid and β-sitosterol glucoside. Colchicine, demethyl colchicine and colchicoside have been reported from seeds. Rhizome is oxytocic, anticancerous, antimalarial, stomachic, purgative, cholagogue, anthelmintic, alterative, febrifuge and antileprotic. Leaf is antiasthmatic and antiinflammatory. Root shows antigonorrhoeic and antibiotic activity. This plant has poisonous effect to enviroment and livestock. The toxic properties are due to presence of alkaloids chiefly colchicine (Clewer *et al*, 1915).

LIQUORICE *Glycyrrhiza glabra* *Papilionaceae*

San: Yashtimadhu Hin: Jathimadh Mal: Irattimadhuram Tam:Athimadhuram
Tel: Yashtimadhukam Ben: Yashtomadhu Pun:Muleti

Importance

Liquorice or **Muleti** is a perennial herb or undershrub about 1m high. Its dried peeled or unpeeled underground stems and roots constitute the drug which is an important constituent of all cough and catarrh syrups, throat lozenges and pastilles. This has been used in medicine for more than 4000 years. Hippocrates (400 BC) mentioned its use as a remedy for ulcers and quenching of thirst. Dioscorides, the father of Greek medicine described this drug in detail and considered it useful for maintaining shape of arteries and in burning stomach, trouble of liver and kidney, scabies, healing of wounds and as a remedy for eye diseases. It has been used in Arab system of medicine for more than 600 years from where it has been adopted to modern medicine (Gibson, 1978).

The commercial name of the dried rhizome and root of the plant is liquorice which is used as flavouring agent and the taste coorigent in pharmaceutical and confectionery industries and its products are widely reported to be useful in ulcer therapy. Glycyrrhizin, a triterpene glucoside, is the principal constituent of *G. glabra* which is 50 times sweeter than sugar.

Distribution

Liquorice is native to Mediterranean region, South Europe and Middle East. It is widely distributed in Spain, Italy, Greece, Syria, Iraq, Afghanistan, Turkey, parts of USSR and China. However its cultivation is limited to small areas in USSR, UK, and USA. In India, it grows in Punjab and Jammu and Kashmir. Semi arid areas of Haryana, Rajasthan and Gujarath states are suitable for the cultivation of Liquorice. However, its commercial cultivation has not yet been possible and the domestic requirement is largely met through imports.

Botany

Glycyrrhiza glabra Linn. belongs to the family Papilionaceae. The word *Glycyrrhiza* is of Greek origin meaning '*sweet*' and glabra means '*smooth*' which refers to smooth fruit of the species. This is a tall perennial, self pollinated herb or undershrub about 1m high with long cylindrical burrowing rootstock and horizontal creeping stolons which reach 1.5-1.8m in length. Leaves are alternate, pinnate with 9-17 leaflets. Leaflets are yellowish-green, 2.5-5cm long, ovate and obtuse. Flowers are pale blue arranged in a raceme and 1.25cm long. Calyx is glandular and pubescent. The pods are glabrous, red to brown having 3-4 seeds. Rhizome is soft, flexible and fibrous with light yellow colour and a characteristic sweet taste.

Agrotechnology

This plant thrives well in subtropical areas with very warm summers and cool winters with a rainfall not exceeding 500mm. Semi-arid and arid areas in subtropical zones

are not suitable for the cultivation of this crop. It does not tolerate high humidity and waterlogged conditions. Well drained light loam soils which are rich in calcium and magnesium with slightly alkaline pH and free from stones are ideal for this crop. There are a number of varieties of this crop among which *Spanish, Russian* and *Persian* liquorice are quite common. Commercial varieties are *Typica, Regel* and *Herd*. This is propagated by seed, but usually multiplied vegetatively either through crown cuttings or stolon pieces. In the case of crown cuttings, 10-15cm long crown pieces with 2-3 buds are planted vertically at a distance of 0.6-0.7m in rows 1-1.5m apart. However, most of the liquorice is propagated through stolon pieces of the above size planted horizontally, preferably on ridges during spring at the same distance as above. Rapid clonal propagation is also possible by tissue culture technique. *Murashige and Skoog's* medium supplemented with 6-benzylaminopurine and indole-3-acetic acid favoured multiple shoot production without any intervening callus phase. These regenerated plantlets can be transferred to earthen pots in the glass house and after a brief hardening phase, these are transplanted in the field with a high rate (90-95%) of survival. This plant normally does not require much fertilizers but in deficient soils, it is better to apply 10-15 tonnes FYM per hectare before planting. The field should be immediately irrigated after planting in spring and after the crop has sprouted, it requires very little irrigation. Space between the rows should be kept free from weeds. Short term vegetables like carrot or cabbage can be planted between the rows for additional income. In order to produce good rhizome, flowering shoots are clipped. No serious disease except leaf spot caused by *Cercospora cavarae* has been reported in this crop. Roots are ready for harvesting after 3-4 years. The root is dug when the top has dried during autumn (November-December). A trench 60cm deep is dug along the ridges and the entire root is lifted. Broken parts of the root left in the soil, sprout again and give another crop after 2-3 years. Thus liquorice once planted properly can be harvested for 10-15 years.

Postharvest technology

Harvested roots are cut into pieces of 15-20cm long and 1-2cm in diameter. They are washed and dried upto 6-8% moisture in the sun and shade alternately which reduces the weight by 50%. The average yield of dried roots varies from 1-3 tonnes per hectare depending on the variety, soil and climatic conditions.

Properties and activity

Roots gave a number of compounds the most important bieng a glucoside, glycyrrhizin which gave glycyrrhetinic acid on enzyme hydrolysis. Root also contains flavans, flavones, iso-flavanoes and coumarins including a 4-methyl coumarin, liqcoumarin, glabridin, glabrene, 4'-0-methyl and 3'-methoxyglabridin, formononetin, salicylic acid, 0-acetyl salicylic acid which has been isolated first time from nature, hispaglabridins A and B and 4'0-methylglabridin.On hydrolysis it also gave two molecules of d-glucuronic acid, each linked with β1-2 linkage to 3-hydroxyl of the sapogenin (Elgamal *et al*, 1969)

Glycyrrhizin is antidiuretic, antiinflammatory, expectorant, antiulcerous, antihistamine. Glycyrrhizic acid is antiviral. The roots are emetic, tonic, diuretic, demulcent, mild laxative, aphrodisiac, trichogenous, expectorant, emmenagogue, alexipharmic, alterant and intellect promoting.

GREATER GALANGAL *Alpinia galanga* *Zingiberaceae*

San:Sugandhamula, Rasna; Hin:Kulainjan; Mal:Aratta, Chittaratha; Tam:Arattai; Guj: Kolinjan; Kan: Dumba-rasmi; Mar: Kosht-Kulinjan; Tel: Pedda-dumparash-tram

Importance

The *greater galangal, Java galangal* or ***Siamese ginger*** is a perennial aromatic rhizomatous herb. This plant is cultivated for its rhizome in tropical areas of south and East India. Because of the presence of essential oil, the rhizomes are used in bronchial troubles and as a carminative. They are also useful in vitiated conditions of *vata* and *kapha*, rheumatoid arthritis, inflammations, stomatopathy, pharyngopathy, cough, asthma, hiccough, dyspepsia, stomachalgia, obesity, diabetes, cephalagia, tubercular glands and intermittent fevers. It is one of the ingredients of medicated "*Pan*" used for removing the foul smell of the mouth and getting relief in throat inflammation. In Ayurveda, *"Rasna-saptak-kwath"* and *"Rasna-adikamath"* are used as antiinflammatory decoctions. In Unani, it is an ingredient of aphrodisiac preparations, *"Majun Mugawivi ma Mumsik"*, *"Majun Samagh"*, and antispasmodic nervine tonic *"Majun Chobchine"* and *"Lubab Motadil"*. It is also used in "*Arq Pan*" as a cardiac stimulant and carminative.

Distribution

The Java galangal is mainly distributed in Eastern Himalayas and South-West India. This is very common in West Bengal, Bihar, Assam, Kerala, Karnataka and throughout the Western Ghats. It is cultivated also in these places. They are also found in countries like Sri Lanka and Malaya.

Botany

Alpinia galanga (Linn.) Willd. belongs to the family Zingiberaceae. It is a perennial herb, about 2m high with lower portion covered with smooth leaf sheaths. The leaves are broadly lanceolate, 30-60cm long and 10-15cm broad. The flowers are arranged in erect, terminal panicles. composed of numerous spreading dichotomous branches each with two to six, pale greenish-white faintly fragrant flowers. Fruits 1.25 cm long, oblong, constricted in the middle or even pear shaped, three sided and deep orange red in colour. Seeds are ash coloured, three angled, finely striated towards the hilum. Both the seeds and rhizomes have pungent aroma.

Apinia calcarata (Linn.) Willd is another species of the genus with much medicinal importance. It is shorter in stature but stronger in aroma than *Alpinia galanga*.

Agrotechnology

Siamese Ginger comes up well in tropical climate. It grows on a wide range of climates and soils. Well drained hilly areas and places of 1400m high altitude are good for its cultivation. This is commercially propagated vegetatively by rhizomes. The field should be ploughed to a good tilth. All the stones and pebbles should be removed. Organic manures at 10t/ha are applied during land preparation. Seedbeds are prepared with 1m breadth, 2m length and 15cm height. Small pits are made at 25cm spacing above the seedbeds and 5cm long rhizomes are planted. Seedbeds are covered with dried leaves. It is irrigated immediately after planting. Regular weeding is needed during the initial stages of crop growth. This is cultivated also as an intercrop in coconut or rubber plantations. Rhizomes are

dug out after cutting the top portions when the crop reaches 1.5-2 years of maturity. The average yield is 10-15 tonnes of fresh rhizomes/ha and the driage is 25-30%. The collected rhizomes are washed and cut into pieces of 5cm long and dried in sun for 4 days before sale.

Properties and Activity

The rhizome contains tannins and flavonoids, some of which have been identified as kaempferide, galangin and alpinin. Seeds contain 1'-acetoxychavicol acetate and 1'-acetoxy eugenol acetate, antiulcer principles caryophyllenols I and II, n-pentadecane, 7-heptadecane and fatty acid methyl esters. Rhizomes yield essential oil containing methyl cinnamate, cineole and d-pinene and sesquiterpenoids. Fresh rhizome yielded 18 monoterpenoids of which α-pinene, β-pinene and limonene as major compounds and 17 oxygen containing monoterpenoids with cineol, terpinen-4-o1, and α-terpineol as minor compounds.

The rhizomes are bitter, acrid, thermogenic, aromatic, nervine tonic, stimulant, revulsive, carminative, stomachic, disinfectant, aphrodisiac, expectorant, broncho-dilator, antifungal, febrifuge, antiinflammatory and tonic. Rhizome is CVS and CNS active, diuretic, hypothermic. Seed is antiulcerative. Rhizome spray in ether, over a space showed high knock down values against houseflies. Alcohol (50%) extract of rhizome is anti-amphetaminic. Unani physicians consider it good for impotence.

COMMON INDIGO *Indigofera tinctoria* *Papilionaceae*

San:Nilini, Ranjani, Nilika, Neelam, Aklika, Asita, Bhadra; Ben, Guj:Nil; Hin:Gouli; Mal: Neelamari; Tam: Averi; Tel: Aviri, Nili; Kan: Nili; Mar: Nali; Ori: Neli

Importance

Common indigo or **Indian indigo** is a branching shrub which grows upto 2m high. Nili is a reputed drug produced from this plant which is used in ayurveda for the promotion of hair growth and it forms a major ingredient of preparations like *nilibhringadi oil*. This is the original source of natural indigo. Due to antitoxic property it is also a good remedy for poisons. According to Bhavaprakasa, nili is purgative in action, bitter, hot, cures giddiness, abdominal enlargement, vatarakta, gout and intestinal obstruction. The decoction or powder of the plant is used in whooping cough, bronchitis, palpitation of the heart, enlargement of the liver and spleen, dropsy, diseases of lungs and kidney, epilepsy and nervous disorders. A poultice of the leaves is recommended in skin diseases, piles, ulcer and haemorrhoids. A wine glass full juice of the leaves is administered in the morning with or without milk for three days to those who have been bitten by mad dogs. Root decoction is given in calculous diseases and used as an antidote to arsenic poisoning. The seed of the plant is powered and steeped in arrack or rum, yield a tincture, which is used to distroy lice. Indigo, the dye extracted from the leaves, is a soothing balm for burns and scalds, insect stings and animal bites. The synonyms *visaghni* and *sodhani* indicate the antitoxic and laxative properties of the drug nili, respectively (Aiyer and Kolammal, 1960).

Distribution

This plant is distributed in South and South East Asia, tropical Africa and is introduced in tropical America. In India, it is found almost throughout and cultivated in many parts.

Botany

Indigofera tinctoria Linn. syn. *I. summatrana* Gaertn, *Pigmentum indicum* belongs to Papilionaceae family. This is a branching shrub which grows upto 2m high. Stems and branches are green; branchlets silvery pubescent. Leaves are alternate, stipulate, imparipinnate and got 7-13 leaflets which are elliptic-oblong, membraneous,1.7x0.9cm, shortly mucronate, pale green or bluish. Flowers are small, rose-coloured in axillary racemes. Calyx 5-cleft, gamosepalous; corolla papilionaceous; stamens diadelphous; ovary sessile with a short incurved style ending in a capitate stigma. Pods are linear, cylindrical, 2-5cm long, deflexed having 8-12 seeds.

Agrotechnology

The Indian indigo requires good sunlight and grows well in hilly areas. This is usually propagated by seeds. Seeds are very small and the seed rate is 3kg/ha. Seeds require pretreatment for good germination as the seed coat is hard. Seeds are mixed with sand and ground gently to break the seed coat. An alternate method for enhancing germination is dipping the seeds in boiling water for a second. After pretreatment seeds are broadcasted. Broadcast the seeds preferably mixed with sand 2 or 3 times its volume to ensure uniform coverage. The seedbeds should be covered with straw and irrigated. Seeds germinate within 15 days. Seedlings are ready for transplanting after one month. For the land preparation, the soil is brought to fine tilth by ploughing 2 or 3 times. Cattle manure should be applied at the

rate of 10t/ha as basal dressing and incorporated into soil along with last ploughing. The best time for sowing is September-October. Weeding has to be done two times; 3 weeks after sowing and 6 weeks after sowing. Plants start flowering 2-3 months after sowing. Harvesting is done by cutting the plants at this time, at a height of about 10cm from ground level. Irrigate plants after harvest. Subsequent harvests can be made at 1.5-2 months interval. Four to five cuttings can be taken in an year depending on the growth. A few plants per plot are left without cutting to set seeds. Ripe pods are to be harvested in the early morning to prevent loss of seeds by shattering during harvest.

Properties and Activity

A blue dyestuff is obtained from the indigofera which does not exist ready formed, but is produced during fermentation from another agent existing in the plant, known as indocan. Indocan is yellow amorphous of a nauseous bitter taste with an acid reaction, readily soluble in water, alcohol and ether. An artificial product indigotine is manufactured chemically and used as a substitute. Indirubin is another component of the plant.

The plant is deobstruent, alterative, antitoxic, antiasthmatic and antiepileptic. Aerial part is hypoglycaemic, CNS depressant and antitoxic. The leaves, flowers and tender shoots are considered to be cooling, demulcent and alterative. Leaf is antiinflammatory. Root and stem is laxative, expectorant, antitumourous, febrifuge, anticephalalgic, antidote for snake bite, anthelmintic and promotes growth of hair. Root is divertic. Indirubin is antineoplastic and has toxicity. Nili is antitoxic, purgative and laxative. Indigo is said to produce nausea and vomiting.

MALABAR NUT *Adhatoda beddomei* *Acanthaceae*

San:Vasaka, Vasa; Hin:Adusa; Mal:Chittadalotakam; Tam:Adutota; Tel:Addasaramu

Importance

Malabar nut or **Adhatoda** is a large evergreen glabrous perennial shrub, 1.2m in height. It is cultivated for medicinal uses, fencing, manure and as an ornamental plant in pots also. The shrub is the source of the drug *vasaka* well known in the indigenous systems of medicines for bronchitis. Vasaka leaves, flowers, fruits and roots are extensively used for treating common cold, cough, whooping cough, chronic bronchitis and asthma. It has sedative, expectorant, antispasmodic and anthelmintic actions. The juice of the leaves cures vomiting, thirst, fever, dermatosis, jaundice, phthisis, haematenesis and diseases due to the morbidity of *kapha* and *pitta*. The leaf juice is especially used in anaemia and haemorrhage, in traditional medicine. Flowers and leaves are considered efficacious against rheumatic painful swellings and form a good application to scabies and other skin complaints. Many ayurvedic medicines are traditionally prepared out of vasaka *like vasarishtam, vasakasavam* and *vasahareethaki* which are effective in various ailments of respiratory system. The drug *VASA* prepared from this plant forms an ingredient of preparations like *Valiya rasnadi kasayam, Chyavanaprasam, Gulgulutiktakam ghrtam*, etc. The alkaloid ***vasicinone*** isolated from the plant is an ingredient in certain allopathic cough syrups also.

Distribution.

Vasaka is distributed all over India upto an altitude of 2000m. This plant grows on wasteland and sometimes it is cultivated also.

Botany

Adhatoda beddomei C.B.Clarke Syn. *Justicia beddomei* (Clark) Bennet belongs to the family Acanthaceae. This is a large glabrous shrub. Leaves are opposite, ovate, lanceolate and short petioled upto 15cm long, 3.75cm broad, main nerves about 8 pairs. Flowers are white with large bracts, flower heads short, dense or condensed spikes. Fruits are capsules with a long solid base.

Another plant *Adhatoda zeylanica* Medicus, syn. *Adhatoda vasica* Nees, *Justicia adhatoda* Linn. of the same genus is a very closely related plant which is most commonly equated with the drug *VASA*. This is seen growing wild almost throughout India while *A. beddomei* is seen more under cultivation. The latter is called *Chittadalodakam* because of its smaller stature, smaller leaves and flowers.

Agrotechnology

Vasaka is seen almost in all types of climate. It prefers loamy soils with good drainage and high organic content. It can be grown well both in hilly and plain lands. Commercial propagation is by using 15-20cm long terminal cuttings. This is either grown in polybags first, then in the field or planted directly. The plant is cultivated as a pure crop or mixed with plantation crops. The land is ploughed repeatedly to a good tilth and the surface soil is broken upto a depth of 15cm and mixed with fertilizers. The beds are prepared with 1m breadth and 3-4m length. The cuttings are planted during April-May into the beds at a spacing of 30x30cm. FYM is given at 5-10t/ha in the first year. Regular irrigation and weeding are necessary. Harvesting is at the end of second or third year. Roots are collected

by digging the seedbeds. Stems are cut 15cm above the root. Stems and roots are usually dried and stored.

Properties and Activity

Leaves yield essential oil and an alkaloid vasicine. Roots contain vasicinol and vasicinone. Roots also contain vasicoline, adhatodine, anisotine and vasicolinone. Several alkaloids like quinazoline and valicine are present in this plant.

The plant is bitter, astringent, refrigerant, expectorant, diuretic, antispasmodic, febrifuge, depurative, styptic and tonic. Vasicine is bronchodilator, respiratory stimulant and hypotensive in action, uterine stimulant, uterotonic, abortifacient comparable with oxytocin and methyligin. Uterotonic action of vasicine is mediated through the release of prostaglandins.

COOMB TEAK *Gmelina arborea* *Verbenaceae*

San: Gumbhari; Hin:Gamari, Jugani-chukar; Mal: Kumizhu, Kumpil; Guj: Shewan; Pun:Gumbar; Mar: Shivanasal; Kan: Kummuda; Tam: Uni, Gumadi; Tel: Gummadi;

Importance

Coomb teak, Candahar tree or **Kashmeeri tree** is a moderate sized, unarmed, deciduous tree which is a vital ingredient of the "***dasamula***" (group of ten roots). The whole plant is medicinally very important. It promotes digestive power, improves memory, overcomes giddiness and is also used as an antidote for snake bite and scorpion sting. Roots are useful in hallucination, fever, dyspepsia, hyperdipsia, haemorrhoids, stomachalgia, heart diseases, nervous disorders, piles and burning sensation. Bark is used in fever and dyspepsia. Leaf paste is good for cephalagia and leaf juice is a good wash for foul ulcers and is also used in the treatment of gonorrhoea and cough. Flowers are recommended for leprosy, skin and blood diseases. The fruits are used for promoting the growth of hair and in anaemia, leprosy, ulcers, constipation, strangury, leucorrhoea, colpitis and lung disease.

Wood is one of the best and most reliable timber of India. It is used for making furniture, planks, carriages, printing boxes, musical instruments, shafts, axles, picture frames, jute bobbins, calipers, ship buildings, artificial limbs and stethoscopes.

In south India the bark of the tree is used by arrack manufacturers to regulate the fermentation of toddy. The plant is also grown in garden or avenues (Dey, 1988; Sivarajan and Indira, 1994).

Distribution

The plant is found wild throughout India from the foot of Himalayas to Kerala and Anadamans, in moist, semideciduous and open forests upto an altitude of 1500 m. It is also distributed in Sri Lanka and Philippines.

Botany

Gmelina arborea Roxb. Syn. *Premna arborea* Roth. belongs to Family Verbenaceae. It is an unarmed deciduous tree growing up to 20m height with whitish grey corky lenticellate bark, exfloliating in thin flakes. Branchlets and young parts are clothed with fine white mealy pubescence. Leaves are simple, opposite, broadly ovate, cordate, glandular, glabrous above when mature and fulvous-tomentose beneath. Flowers brownish yellow in terminal panicle. Calyx campanulate, pubescent outside and with 5 lobes. Corolla showy brownish yellow with short tube and oblique limbs. Stamens 4, didynamous and included. Ovary is 4 chambered with one ovule each; style slender ending in a bifid stigma. Fruits are fleshy ovoid drupes, orange yellow when ripe. Seeds 1 or 2, hard and oblong.

Agrotechnology

Coomb teak is a sun loving plant. It does not tolerate drought. But it grows in light frost. Rainfall higher than 2000mm and loose soil are ideal. The best method of propagation is by seeds but rarely propagated vegitatevely by stem cuttings also. Seed formation occurs in May-June. Seeds are dried well before use. They are soaked in water for 12 hours before sowing. Seed rate is 3kg/ha. Seeds are sown in nursery beds shortly before rains. Seeds germinate within one month. Seedlings are transplanted in the first rainy season when they are

7-10cm tall. Pits of size 50cm cube are made at a spacing of 3-4m and filled with sand, dried cowdung and surface soil, over which the seedlings are transplanted. 20kg organic manure is given once a year. Irrigation and weeding should be done on a regular basis. The common disease reported is sooty mould caused by *Corticium salmonicolor* which can be controlled by applying a suitable fungicide. The tree grows fast and may be ready for harvesting after 4 or 5 years. This plant is coppiced and traded. The roots are also used for medicinal purposes. The tree may stand up to 25 years.

Properties and Activity

Roots and heart wood of Coomb teak are reported to contain gmelinol, hentriacontanol, n-octacosanol and β-sitosterol. The roots contain sesquiterpenoid and apiosylskimmin, a coumarin characterised as umbelliferone-7-apiosyl glucoside and gmelofuran. The heart wood gives ceryl alcohol, cluytyl ferulate, lignans, arboreol, gmelonone, 6”-bromo isoarboreol, lignan hemiacetal and gummidiol. Leaves yield luteolin, apigenin, quercetin, hentriacontanol, β-sitosterol, quercetogenin and other flavons. Fruits contain butyric acid, tartaric acid, and saccharine substances (Asolkar *et al*, 1992; Dey, 1988).

The roots are acrid, bitter, tonic, stomachic, laxative, galactogogue, demulcent, antibilious, febrifuge and anthelmintic. Bark is bitter, hypoglycaemic, antiviral, anticephalalgic and tonic. The leaves are demulcent, antigonorrhoeic and bechic. Flowers are sweet, refrigerant, astringent and acrid. Fruits are acrid, refrigerant, diuretic, astringent, aphrodisiac, trichogenous, alterant and tonic (Warrier *et al*; 1995).

INDIAN BEECH *Pongamia pinnata* *Papilionaceae*

San: Karanj; Hin: Karanja, Dittouri; Ben: Dehar karanja; Mal: Ungu, Pongu; Guj, Mar, Pun: Karanj; Kan: Hongae; Tel: Kangu; Tam: Puggam; Ass: Karchaw; Ori: Koranjo

Importance

Indian beech, **Pongam oil tree** or **Hongay oil tree** is a handsome flowering tree with drooping branches, having shining green leaves laden with lilac or pinkish white flowers. The whole plant and the seed oil are used in ayurvedic formulations as effective remedy for all skin diseases like scabies, eczema, leprosy and ulcers. The roots are good for cleaning teeth, strengthening gums and in gonorrhoea and scrofulous enlargement. The bark is useful in haemorhoids, beriberi, ophthalmopathy and vaginopathy. Leaves are good for flatulence, dyspepsia, diarrhoea, leprosy, gonorrhoea, cough, rheumatalgia, piles and oedema. Flowers are given in diabetes. Fruits overcomes urinary disease and piles. The seeds are used in inflammations, otalgia, lumbago, pectoral diseases, chronic fevers, hydrocele, haemorrhoids and anaemia. The seed oil is recommended for ophthalmia, haemorrhoids, herpes and lumbagoThe seed oil is also valued for its industrial uses. The seed cake is suggested as a cheap cattle feed. The plant enters into the composition of ayurvedic preparations like *nagaradi tailam, varanadi kasayam, varanadi ghrtam* and *karanjadi churna.*

It is a host plant for the lac insect. It is grown as a shade tree. The wood is moderately hard and used as fuel and also for making agricultural implements and cart-wheels.

Distribution

The plant is distributed throughout India from the central or eastern Himalaya to Kanyakumari, especially along the banks of streams and rivers or beach forests and is often grown as an avenue tree. It is distributed in Sri Lanka, Burma, Malaya, Australia and Polynesia.

Botany

Pongamia pinnata (Linn.) Pierre syn. *P. glabra* Vent., *Derris indica* (Lam.) Bennet, *Cystisus pinnatus* Lam. comes under family Papilionaceae. *P. pinnata* is a moderate sized, semi-evergreen tree growing upto 18m or more high, with a short bole, spreading crown and greyish green or brown bark. Leaves imparipinnate, alternate, leaflets 5-7, ovate and opposite. Flowers lilac or pinkish white and fragrant in axillary recemes. Calyx cup-shaped, shortly 4-5 toothed, corolla papilionaceous. Stamens 10 and monadelphous, ovary subsessile, 2-ovuled with incurved, glabrous style ending in a capitate stigma. Pod compressed, woody, indehiscent, yellowish grey when ripe varying in size and shape, elliptic to obliquely oblong, 4.0-7.5cm long and 1.7-3.2cm broad with a short curved beak. Seeds usually 1, elliptic or reniform, wrinkled with reddish brown, leathery testa.

Agrotechnology

The plant comes up well in tropical areas with warm humid climate and well distributed rainfall. Though it grows in almost all types of soils, silty soils on river banks are most ideal. It is tolerant to drought and salinity. The tree is used for afforestation, especially

in watersheds in the drier parts of the country. It is propagated by seeds and vegetatively by rootsuckers. Seed setting is usually in November. Seeds are soaked in water for few hours before sowing. Raised seed beds of convenient size are prepared, well rotten cattle manure is applied at 1kg/m^2 and seeds are uniformly broadcasted. The seeds are covered with a thin layer of sand and irrigated. One month old seedlings can be transplanted into polybags, which after one month can be planted in the field. Pits of size 50cm cube are dug at a spacing of 4-5m, filled with top soil and manure and planted. Organic manure are applied annually. Regular weeding and irrigation are required for initial establishment. The trees flower and set fruits in 5 years. The harvest season extends from November- June. Pods are collected and seeds are removed by hand. Seed, leaves, bark and root are used for medicinal purposes. Bark can be collected after 10 years. No serious pests and diseases are reported in this crop.

Properties and Activity

The plant is rich in flavonoids and related compounds. Seeds and seed oil, flowers and stem bark yield karanjin, pongapin, pongaglabrone, kanugin, desmethoxykanugin and pinnatin. Seed and its oil also contain kanjone, isolonchocarpin, karanjachromene, isopongachromene, glabrin, glabrachalcone, glabrachromene, isopongaflavone, pongol, 2'-methoxy-furano[2",3":7,8]-flavone and phospholipids. Stem-bark gives pongachromene, pongaflavone, tetra-O-methylfisetin, glabra I and II, lanceolatin B, gamatin, 5-methoxy-furano[2",3":7,8]-flavone, 5-methoxy-3',4'-methelenedioxyfurano[2",3":7,8]-flavone and α-sitosterol. Heartwood yields chromenochalcones and flavones. Flowers are reported to contain kanjone, gamatin, glabra saponin, kaempferol, γ-sitosterol, quercetin glycocides, pongaglabol, isopongaglabol, 6-methoxy isopongaglabol, lanceolatin B, 5-methoxy-3',4'-methelenedioxyfurano[8,7:4",5"]-flavone, fisetin tetramethyl ether, isolonchocarpin, ovalichromene B, pongamol, ovalitenon, two triterpenes- cycloart-23-ene,3β,25 diol and friedelin and a dipeptide aurantinamide acetate.

Roots and leaves give kanugin, desmethoxykanugin and pinnatin. Roots also yield a flavonol methyl ether-tetra-O-methyl fisetin. The leaves contain triterpenoids, glabrachromenes I and II, 3'-methoxypongapin and 4'-methoxyfurano[2",3":7,8]-flavone also. The gum reported to yield polysaccharides (Thakur *et al*, 1989; Husain *et al*, 1992).

Seeds, seed oil and leaves are carminative, antiseptic, anthelmintic and antirheumatic. Leaves are digestive, laxative, antidiarrhoeal, bechic, antigonorrheic and antileprotic. Seeds are haematinic, bitter and acrid. Seed oil is styptic and depurative. Karanjin is the principle responsible for the curative properties of the oil. Bark is sweet, anthelmintic and elexteric.

ECLIPTA *Eclipta prostrata*

Asteraceae

San: Bhrngarajah, Tekarajah; Hin: Bhamgra, Mocakand, Babri; Ben: Kesutthe, Kesraj; Mal: Kannunni, Kayyonni, Kayyunnni; Tam: Kayyantakara, Kaikeri; Kan: Kadiggagaraga; Tel: Guntagalijeran; Arab: Kadim-el-bint

Importance

Eclipta is one of the ten auspicious herbs that constitute the group *dasapuspam* which is considered to destroy the causative factors of all unhealthy and unpleasant features and bestow good health and prosperity. The members of this group cure wounds and ulcers as well as fever caused by the derangement of the *tridosas - vata, pitta and kapha*. It is used in hepatitis, spleen enlargements, chronic skin diseases, tetanus and elephantiasis. The leaf promotes hair growth and use as an antidote in scorpion sting. The root is used as an emetic, in scalding of urine, conjuctivitis and as an antiseptic to ulcers and wound in cattle. It is used to prevent abortion and miscarriage and also in cases of uterine pains after the delivery. The juice of the plant with honey is given to infants for expulsion of worms. For the relief in piles, fumigation with Eclipta is considered beneficial. A decoction of the leaves is used in uterine haemorrhage. The paste prepared by mincing fresh plants has got an antiinflammatory effect and may be applied on insect bites, stings, swellings and other skin diseases. In Ayurveda, it is mainly used in hair oil, while in Unani system, the juice is used in "*Hab Miskeen Nawaz*" along with aconite, *triphala, Croton tiglium, Piper nigium, Piper longum, Zingiber officinale* and minerals like mercury, sulphur, arsenic, borax, etc. for various types of pains in the body. It is also a constituent of "*Roghan Amla Khas*" for applying on the hair and of "*Majun Murrawah-ul-arwah*".

Distribution

This plant is widely distributed in the warm humid tropics with plenty of rainfall. It grows commonly in moist places as a weed all over plains of India.

Botany

Eclipta prostrata (Linn) Linn. syn. *E. alba* Hassk. is an annual, erect or postrate herb, often rooting at nodes. Leaves are sessile, 2.5-7.5cm long with white appressed hairs. Floral heads are 6-8 mm in diameter, solitary and white. Fruit is an achene, compressed and narrowly winged. Sometimes, *Wedelia calendulacea*, which resembles *Eclipta prostrata* is used for the same purpose.

Properties and Activity

The leaves contain stigmasterol, α-terthienylmethanol, wedelolactone, dismethylwedelolactone and dismethylwedelolactone-7-glucoside. The roots give hentriacontanol and heptacosanol. The roots contain polyacetylene substituted thiophenes. The aerial part is reported to contain a phytosterol, β-amyrin in the n-hexane extract and luteolin-7-glucoside, β-glucoside of phytosterol, a glucoside of a triterpenic acid and wedelolactone in polar solvent extract. The polypeptides isolated from the plant yield cystine, glutamic acid, phenyl alanine, tyrosine and methionine on hydrolysis. Nicotine and nicotinic acid are reported to occur in this plant.

The plant is anticatarrhal, febrifuge, antidontalgic, absorbent, antihepatic, CVS active, nematicidal, ovicidal and spasmolytic in activity. The alcoholic extract of entire plant has been reported to have antiviral activity against *Ranikhet* disease virus. Aqueous extract of the plant showed subjective improvement of vision in the case of refractive errors. The herbal drug *Trefoli*, containing extracts of the plant in combination with others, when administered to the patients of viral hepatitis, produced excellent results.

TERMINALIA *Terminalia spp.* *Combretaceae*

The genus *Terminalia* includes a large group of medicinally valuable trees. They belong to the family Combretaceae. The most important medicinal species of the genus *Terminalia* are the following.

1) *T. arjuna* (Roxb.ex DC) Wight & Arn.

San: Arjunah, Kakubhah; Hin: Arjun, Kahu, Kahua; Mal: Marutu, Nirmarutu, Venmarutu, Attumarutu, Pulamatti; Tam: Attumarutu, Nirmarutu, Vellaimarutu, Marutu; Kan: Maddi.

It is a large evergreen tree commonly found in Madhya Pradesh, Bihar and Peninsular and India. It has buttressed trunk and spreading crown with drooping branches. Bark is smooth, grey outside and flesh coloured inside, flaking off in large flat pieces. Leaves are simple, sub-opposite, oblong or elliptic, coriaceous, crenulate, pale dull green above, pale brown beneath, often unequal sided, nerves 10-15 pairs and reticulate. Flowers are white, arranged in panicles of spikes with linear bracteoles. Fruits are ovoid or oblong with 5-7 short, hard angles or wings, the lines on the wings oblique and curving upward (Warrier *et al* 1996).

The bark is useful in fractures, ulcers, urethrorrhoea, leucorrhoea, diabetes, vitiated conditions of *pitta*, anaemia, cardiopathy, fatigue, asthma, bronchitis, tumours, internal and external haemorrhages, cirrhosis of the lever and hypertension. It is used in fractures and the powdered bark is taken with milk. The bark powder is diuretic and has a general tonic effect in cases of cirrhosis of liver. The bark has been considered by the ayurvedic physicians as well as by modern practitioners as a cardiac tonic. It is given as a decoction with milk (NRF, 1998). In Ayurveda, "*Arjunaghrita*" and "*Arjunarishta*" are two important cardiotonic preparations of this drug.

Fruits contain flavanones - arjunone and 5,7,2', 4' - tetramethoxy flavone and a chalcone - cerasidin. Other constituents are β-sitosterol, friedelin, methyloleanolate, gallic acid, ellagic acid and arjunic acid. Bark gave a triterpene arjungenin, triterpene glucosides I, II and III. Stem bark gave flavones - baicalein and arjunolone characterised as 6,4' - dihydraxy - 7-methoxy flavone. Stem bark yields oxalic acid and tannins besides complex glycosides (Bhatra *et al*, 1980). Bark is alexertic, styptic, antidysenteric, astringent, antiasthmatic, febrifuge, expectorant, cardiotonic aphrodisiac and diuretic. Fruit is deobstruent. Stem-bark is CVS and CNS active, diuretic and abortifacient. Aerial part is CNS depressant and semen coagulant.

2) *T. alata* Heyne ex Roth. Syn. *T. tomentosa* (Roxb. Ex. Dc.) W & A.

San: Dharaphala, Saradru, Sajada; Hin. Ain; Ben: Asan, Paishal; Mal: Tehmbara; Tam: Karramarda, Karu Murutha, Marudam, Pudavam.

This tree is distributed in Himalaya from Kangra eastwords to Goalpara in Assam and southwards throughout the Peninsular India, upto 1200 m. The bark of the tree is widely used in ulcers, fractures, bronchitis and diarrhoea. Hydrolysis of the gum gives oligosaccharides, disaccharides and monosaccharides. Leaves and fruits give β-sitosterol. Bark is diuretic, antihaemorrhagic, styptic, cardiotonic and semen coagulant.

3) *T. bellirica* (Craertn.) Roxb.

San: Aksha, Anilaghanaka, Baheduka, Harya, Kalinda; Hin: Bulla, Sagona; Ben: Bahera, Baheri; Tam: Akkam, Kalanduri, Tani; Tel: Bhutavasamu Tadi, Tandra, Vibhutakamu.

Belliric Myrobalan is distributed throughout India, upto 900 m. Its bark is used in anaemia and leucoderma. The fruit is used in bronchitis, strangury, sore throat, diseases of eye, nose, heart and bladder, hoarseness and piles. It forms an important constituent of the ayurvedic drug '*triphala*'. Furits contain β-sitosterol, gallic and ellagic acids, ethyl gallate, galloyl glucose, chebulagic acid and a cardiac glucoside bellaricanin. Alcoholic extract of

the fruit possesses bile-stimulating activity. Alcoholic extract, 30 mg/kg does not affect blood pressure and respiration, but a higher dose of 60 mg/kg produces a fall in blood pressure. Furit has anticancerous and flower has spermicidal activity. Bark is mild diuretic. Fruit is astringent, antidropsical, antileprotic, antiinflammatory, antidiarrhoeal, antibilious, stomachic, antiasthmatic, tonic, anticephalgic, bechic, anthelmintic and attenuant. Kernel is narcotic. Semi-ripe fruit is purgative. Gum is demulcent (Husain *et al*, 1992)

4) *T. bialata* steud.

White Chugalam or silver grey wood is a common tree of Andaman Islands. Its bark is used as a cardiac stimulant.

5) *T. Catappa* Linn.

San: Grahadruma; Hin: Badam; Ben: Bangla Badam: Tam: Natuvdom, Vadhamkottai; Tel: Vedam, Voda Movettilla; Mar: Jangli Badama, Nat Badam.

Indian Almond or Tropical Almond is a popular tree cultivated throughout the warmer parts of India including Andaman Islands and other adjacent island. Oil from the kernel is a substitute for almond oil. The leaf is used in scabies and colic. Husk and endocarp contain tannins and pentosans. Oil from kernel contains oleic, linoleic, palmitic and stearic acids. Heart wood and stem bark contains β-sitosterol and its palmitate. Heartwood in addition contains terminolic acid and triterpenic methyl esters. The aerial part of the plant is diuretic. The bark is astringent, mild diuretic, cardiotonic and antidysenteric. Leaf is sudorific, antirheumatic, antileprotic and anticephalalgic.

6) *T. Coriacea* (Roxb.) syn. *T. tomentosa* (Roxb. ex. DC.) W. & A. var. *coriacea* (Roxb.) C. B. Clarke

Tam: Anaimikkuvam, Sadagam; Kan: Banapu; Tel: Tani.

Leathery Murdah is a tree commonly used as a cardiac stimulant. It is widely distributed in the drier and warmer parts of Andhra Pradesh and Tamil Nadu upto 1350 m and in Central India. Its bark is mainly used as a cardiac stimulant and in atonic diarrhoea and callous ulcer. It is also CVS active.

7) *T. myriocarpa* Heurck. & Muell. Arg.

Ben: Panisaj; Ass: Hollock, Jhalna.

Hollock is a tree of the Himalayas widely distributed from Nepal to Arunachal Pradesh and in Assam at 1000 m. The bark is cardiac stimulant and mild diuretic. Bark give β-sitosterol, fructose and 4,4',5,5',6,6' - hexadydroxy diphenic acid dilactone. Bark also contains tannis - ellagic, gallic, chebulinic and chebulagic acids.

8) *T. Pallida* Brandis.

Tam: Vellai Kadukkay; Tel: Tella Karaka, Velama Karka.

The plant is distributed throughout south India, upto 600m. Its bark is a mild diuretic.

9) *T. Paniculata* Roth.

Mal: Marutu, Pe Marutu, Ven Marutu; Tam: Pei Kadukai, Ven Maruthu, Ilai Kadukkay, Marudu, Pullatti; Tel: Nimiri, Pulamaddi, Putamanu, Pulanallamanu; Kan: Maruva, Matti.

Flowering Murdah is a tree which is widely used in opium poisoning. It is distributed in the Western and Eastern Ghats, upto 1200m. The bark is used in parotitis and flowers in opium poisioning. Heart wood give 3, 3'-0-di-methylellagic acid and 3,4,3'0-trimethyl flavellagic acid, β-sitosterol, an uncharacterized triterpene carboxylic acid; a glycoside - 3,3' di-0 - methyl ellagic acid - 4 - monoglucoside and 0 - penta methyl flavellogic acid. The stem bark is anticancerous, diuretic, cardiotonic CVS active and shows antagonism of amphetamine hyperactivity. Flower is anticholerin (Husain *et al*, 1992)

10) *Terminalia chebula* Retz. Syn. *Myrobalanus chebula* (Retz.) Gaertner

Eng: Chebulic myrobalan; San, Ben: Haritaki; Hindi:Harara, Harir, Har; Mal:Kadukka; Ass:Hilikha; Kan:Alale; Mar:Habra,Hirada; Ori:Harida; Guj:Hirdo; Pun:Helela; Tam:Amagola; Tel:Karaka

Chebulic myrobalan is a medium deciduous tree, the fruit of which is a common constituent of "*Triphala*" capable of imparting youthful vitality and receptivity of mind and sense. It is a major constituent in the ayurvedic preparations like *Abhayarishta, Abhaya modak, Haritaki khand, Triphaladi churnam and Agastya rasayanam*. In allopathy it is used in astringent ointments. In unani system, it is used as a blood purifier. The pulp of the fruit is given in piles, chronic diarrhoea, dysentery, costiveness, flatulence, asthma, urinary disorders, vomiting, hiccup, intestinal worms, ascites and enlarged spleen and liver. Powder of the fruit is used in chronic ulcers and wounds, carious teeth and bleeding ulceration of the gums. The bark is a good cardiac tonic. The fruit is valuable for its tannins and dyes. The wood is used for building purposes, agricultural implements, plywood and match box industries. It is also grown as a shade tree.

The plant is found throughout India chiefly in deciduous forests, on dry slopes upto 900m especially in Bengal, Tamil Nadu, West coast and Western Ghats. The plant is also reported in Sri Lanka, Nepal and Burma.

Terminalia chebula Retz. syn. *Myrobalanus chebula* (Retz.) Gaertner comes under family Combretaceae. It is a medium sized deciduous tree with a cylindrical bole, rounded crown, spreading branches with dark brown bark and brownish gray heartwood. Leaves are simple, alternate or subopposite, ovate or elliptic ovate with short petioles bearing 2 glands below the blades. Flowers pale yellow or white in 4-10cm long axillary spikes. Calyx tube hairy pale yellow and 5 lobed; no petals. Stamens consist of 10 filaments subulate, anthers small; ovary inferior, 1-celled with 2-3 pendulous ovule. Fruit is a drupe, ovoid glossy, glabrous, faintly angled and yellow to orange brown in colour. Seeds are hard and pale yellow.

Kernel oil of *Chebulic myrobalan* contains 6 fatty acids *viz*. Palmitic, stearic, oleic, linoleic, arachidic and behenic acid. The fruits contain chebulinic acid, tannic acid, gallic acid, chebulin and tannin. Leaves contain terpenes and saponins and β-sitosterol is present in the bark (Beri, 1970; Khalique and Nizamuddin, 1972; Miglani and Chawla, 1974). Fruits are astringent, purgative, tonic, carminative, alternative and antispasmodic. Flowers and fruits are antiviral and hypoglycaemic. Wood is oxytocic and hypothermic (Husain *et al*, 1992).

Agrotechnology

Terminalia species are, in general, subtropical trees. Young plants prefer shade while the matured plants tolerate light frost and drought. It grows well in hilly areas. This is propagated by seeds. Natural multiplication happens rarely due to the poor seeds germination. Seeds soaked in water for 48 hours before sowing in seedbeds which should be covered with straw after sowing. It is watered immediately. Usually it takes 3-5 months to germinate. It can be transferred to polybags at two-leaf stage. One-year-old seedlings are ready for transplanting. For transplanting, pits are made of 50cm cube at a spacing of 4m. Organic manure, added regularly, promotes growth. Irrigation is required during first year. Weeds should be removed regularly. This plant grows slowly. It fruits within 6-7 years. This is continued for many years. It is coppiced well. Fruits are collected immediately after falling down or covered with soil to protect it from pests. Fruits dried well in sun and used or stored. The hard seed coat is removed before sowing.

COLEUS *Coleus spp.*

Lamiaceae

The genus *Coleus* of the family Lamiaceae (Labiatae) comprises a number of herbaceous medicinal plants which are particularly employed in home remedies for various ailments. Three species are most popular and commonly cultivated. They are *Coleus aromaticus, C. vettiveroides and C. forkoshlii*.

1. *Coleus aromaticus* Benth. syn. *C. amboinicus* Lour., *Plectranthus amboinicus* (Lour.) Spreng.

Eng: Country borage, Indian borage; San: Karpuravalli, Sugandhavalakam;
Hin: Patharchur; Ben: Paterchur; Mal: Panikkurkka, kannikkurkka;
Tam: Karpuravalli; Kan: karpurahalli; Tel: Sugandhavalkam.

It is found through out the tropics and cultivated in homestead gardens. It is a large succulent aromatic perennial herb with hispidly villous or tomentose fleshy stem. Leaves are simple, opposite, broadly ovate, crenate and fleshy. Flowers are pale purplish in dense whorls at distant intervals in a long slender raceme. Fruits are orbicular or ovoid nutlets. The leaves are useful in cephalagia, otalgia, anorexia, dyspepsia, flatulence, colic, diarrhoea, cholera, halitosis, convulsions, epilepsy, cough, asthma, hiccough, bronchitis, strangury, hepatopathy and malarial fever (Warrier *et al*,1995).

2. *Coleus vettiveroides* K.C. Jacob, syn. *Plectranthus vettiveroides* (Jacob) Singh & Sharma.

San: Valakam, Hriberam; Hin: Valak; Mal: Iruveli; Tam: Karuver; Tel: Karuveru,

It is seen in tropical countries and cultivated in gardens. It is a small profusely branched, succulent aromatic herb with quadrangular stems and branches and deep straw coloured aromatic roots. Leaves are glandular hairy, broadly ovate with dentate margins and prominent veins on the bark. Blue flowers are borne on terminal racemes. Fruits are nutlets. The whole plant is useful in hyperdipsia, vitiated conditions of *pitta*, burning sensation, strangury, leprosy, skin diseases, leucoderma, fever, vomiting, diarrhoea, ulcers and as hair tonic.

3. *Coleus forskohlii* Briq. syn. *C. barbatus* Benth.

Hin: Garmai Kan: Maganiberu, Makandiberu Guj: Maimul

It is a perennial aromatic herb grown under tropical to temperate conditions for its carrot-like tubers which are used as condiments in the preparation of pickles. Its tuberous roots are an exclusive source of a diterpenoid forskolin which has the unique property of activating almost all hormone sensitive adenylate cyclase enzymes in a biological system. It is useful in the treatment of congestive heart failure, glaucoma, asthma, cancer and in preventing immature greying of hair (Hegde,1997).

Agrotechnology

The Coleus group of plants grows in tropical to subtropical situations and in warm temperate climatic zone on mountains of India, Nepal, Burma, Sri Lanka, Thailand and Africa. It comes up well on the sun exposed dry hill slopes from 300m to 1800m altitude. A well drained medium fertile soil is suitable for its cultivation. it is propagated vegetatively through stem and root cuttings. Vine cuttings to a length of 10-15cm from the top portion are most ideal for planting. The land is ploughed or dug to a depth of 15-20cm and ridges are formed 30cm apart. Vine cuttings are planted on the ridges at 30cm spacing after incorporating basal manure. 10t of FYM and NPK at 50:50:50kg/ha are incorporated into the soil. Top dressing of N and K is also suggested for improved yields. Weeding and earthing up at 45 days after planting along with topdressing is highly beneficial. Bacterial wilt and root knot nematode are reported in the crop. Drenching the soil with fungicide, deep ploughing in the summer, burning of crop residues and crop rotation are helpful to tide over the disease and pest problem. The crop can be harvested after 5-6 months.

Properties and Activity

The medicinal property of *Coleus amboinicus* is attributed to codeine, carvacrol, flavones, aromatic acids and tannins present in the plant. The essential oil from the plant contains carvacrol, ethyl salicylate, thymol, eugenol and chavicol. Leaves also contain cirsimaritin, β-sitosterol-β-D-glucoside and oxalacetic acid. Leaves are bitter, acrid, thermogenic, aromatic, anodyne, appetising, digestive, carminative, stomachic, anthelmintic, constipating, deodorant, expectorant, diuretic and liver tonic.

Coleus vettiveroides is bitter, cooling, diuretic, trichogenous and antipyretic.

Coleus forskohlii roots are rich in diterpenoids like forskolin, coleonols, coleons, barbatusin, cyclobutatusin, coleosol, coleol, coleonone, deoxycoleonol, 7-deacetylforskolin and 6-acetyl-7-deacetylforskolin. Its root is spasmolytic, CNS active, hypothermic and diuretic. Forskolin is bronchodialative and hypotensive (Hussain *et al*,1992). Forskolin is also useful in preventing the clotting of blood platelets, in reducing intraocular pressure in glaucoma and as an aid to nerve regeneration following trauma (Sharma, 1998)

TINOSPORA *Tinospora cordifolia*

Menispermaceae

San: Amrita, Guduchi; Hin, Ben: Giloe; Mal: Amritu, Chittamritu; Tam: Amridavalli Kan: Amritaballi; Tel: Tivantika, Tippatige; Pun: Batindu Ori: Gulochi

Importance

Tinospora is a common climbing shrub which is used in medicine, usually in the fresh state, though it is commercially available in the dried state. It is probably the most useful preparation acting as a tonic and aphrodisiac. As a tonic it is best given in infusion with or without milk. It is a popular remedy for snake-bite and leprosy. It is generally prescribed in general debility, diabetes, fever, jaundice, skin diseases, rheumatism, urinary diseases, dyspepsia, gout, gonorrhoea and leucorrhoea. It is a constituent of several preparations like *guduchayado churna, gududyadi kwath, guduchilouha, amritarista, sanjivanivati, guduchi taila, amiritastak kwath*, etc. The juice mixed with the pulp of long pepper and honey is a house hold remedy for gonorrhoea. Several oils for external applications are prepared with *amrita* and applied to skin diseases, rheumatic affections and other nervous complaints. A small quantity of bruised stem soaked for three hours in half a litre of water and strained combined with ammonium acetate is administered in intermittent and milder forms of fevers. It is rendered more agreeable with cinnamon, cloves and other aromatics. (Viswanathan, 1997).

Distribution

The plant is widely seen in tropical countries like India, Myanmar, Sri Lanka and in Andaman Islands. It is mostly found trailing on forest trees, fences and hedges along the boundaries.

Botany

Tinospora cordifolia (Willd) Miers ex Hk. f & Thoms. syn. *Menispermum cordifolium* Willd, *Cocculus cordifolius* (Willd) DC. belongs to the family Menispermaceae. It is a climbing shrub with rough corky bark. Leaves are glabrous, cordate 5-10cm broad, acute or accuminate. The plant is dioecious. Male flowers are in fascicles; sepals oval; petals half the length of sepals. Female flowers are usually solitary, having ovary on the fleshy receptacle. Fruits are red when ripe.

Agrotechnology

Giloe requires a warm humid tropical climate. It thrives well in deep fertile soils which are rich in organic matter. It is propagated vegetatively by stem cuttings. About 10-15cm long stem cuttings having at least 2 nodes are planted in the field or polybags. Treatment of cut ends with hormones gives better results. The usual planting time is with the onset of monsoon in May-June. Usually it is planted along boundaries or nearby tall trees and allowed to trail on the trees or hedges and hence regular spacing is not followed. While planting, adequate amounts of organic manure are applied. Once the plant is established no much management is needed. The stem is the most economic part. Harvesting can be commenced after one year and usually partial harvesting is followed depending on the necessity. The stem and root should be collected in hot season when the concentration of the bitter principle is the highest. A full grown well ramified plant may give 2-3kg vines, which are cut into smaller pieces and traded either fresh or after drying.

Properties and Activity

The plant contains cordifol, tinosporidine, tinosporide, perberilin, heptacosanol, β-sitosterol, cordifolone, tinosporon, tinosporic acid, tinosporol, cordifolide, tinosporine, magnoflorine and tembetarine (Husain *et al*,1992).

The plant is antigonorrhoric, stomachic, antispasmodic, antiinflammatory, stimulant, diuretic, emetic, antidiabetic, aphrodisiac, antiperiodic, antileprotic antirheumantic and tonic. The root is an emetic in large doses. The tincture and extract are alterative and tonic and in a less degree antiperiodic and diuretic. (Dey,1980).

DESMODIUM *Desmodium gangeticum*

Fabaceae

San: Anshumati, Salaparni; Hin, Ben: Salpani; Mal: Orila; Tam:Pulladi; Tel: Gitanaram Kan: Murelehonne; Mar: Darh; Guj: Salwan; Ori: Salaparni Pun: Shalpurhi

Importance

Desmodium is a small shrub which is the chief of the ten ingredients in the *Dasamula kwatha* of Hindu medicine. Roots are useful in vitiated conditions of *vata*, anorexia, dyspepsia, haemorrhoids, dysentery, strangury, fever, gout, inflammations, cough, asthma, bronchitis, cardiopathy and debility. The unani preparation "*Arq dashmul*" contains these roots. It is considered a curative for leucorrhoea and for pains due to cold (Warrier *et al*, 1995).

Distribution

The plant is widely distributed in the tropics and subtropics. It grows wild in the forests of India up to 1500m. It is also cultivated in the plains and in the lower Himalayas.

Botany

Desmodium gangeticum (Linn.) DC. syn. *Hedysarum gangeticum* Linn., *Desmodium gangeticum* var. *maculatum* (Linn.) Baker., belongs to the family Fabaceae (Papilionaceae). It is an erect diffusely branched undershrub, 90-120cm in height with a short woody stem and numerous prostrate branches provided with soft grey hairs. Leaves are unifoliate, ovate-lanceolate, membranceous and mottled with grey patches. Flowers are white, purple or lilac in elongate lax, terminal or axillary racemes. Fruits are moniliform, 6-8 jointed, glabrescent pods, joints of pods separately pubescent with hooked hairs, joint separating when ripe into indehiscent one seeded segments. Seeds are compressed and reniform.

Agrotechnology

Desmodium can grow in a variety of climate and soils. However, it prefers tropical and subtropical climatic conditions. Although it can grow on all types of soils, waterlogged and highly alkaline soils are not suitable. Light sandy loam is preferred for commercial cultivation.

It is propagated through seeds. Seeds can be planted directly in the field or seedlings raised on the nursery beds and transplanted. Transplanting always gives better results in commercial cultivation, as it gives assured crop stand. Planting is done at a spacing of 40x20cm on flat beds or ridges. Organic manures are applied at the time of land preparation and thoroughly mixed with the soil. A little quantity of phosphatic and nitrogenous fertilizers are also applied for better crop growth. The inter-row spaces between plants, both in the field and nursery should be kept free from weeds by frequent weeding and hoeing as the plant suffers from weed competition, especially during early stages of growth. Manual hand weeding is usually done. Irrigation of seedlings just after planting is good for crop establishment. Although it can be cultivated as a rainfed crop under humid tropical conditions, irrigation every month is beneficial during summer. The root is the economic part and harvesting can be commenced after 8-9 months. About 500- 700kg roots can be harvested from a hectare of land per year.

Properties and Activity

The root contains gangetin, gangetinin, desmodin, N,N-dimethyl tryptamine, hypaphorine, hordenine, candicine, N-methyl tyramine and β-phenyl ethyl amine. The total alkaloid fraction showed hypotensive activity. The root is bitter, antiinflammatory, analgesic, aphrodisiac, constipating, diuretic, cardiotonic, expectorant, astringent, antidiarrhoeal, carminative, antiemetic, febrifuge and anti-catarrhal (Thakur *et al*, 1989).

GARLIC *Allium sativum*

Liliaceae

San: Lasunah, Rasonah; Hin:Lasun, Lahasun; Ben: Lashan; Mal: Vellulli; Kan: Belluli; Tam: Vellaipuntu; Mar: Lasunas; Ass: Naharu; Tel:Vellulli, Tella-gadda; Guj: Lasan

Importance

Garlic is one of the important bulb crops used as a spice or condiment with medicinal value throughout the world. It possesses high nutritive value. Its preparations are useful in vitiated conditions of *kapha* and *vata*, cough, whooping cough, bronchitis, asthma, fever, facial paralysis, flatulence, colic, constipation, atonic dyspepsia, helminthiasis, duodenal ulcers, pulmonary and laryngeal tuberculosis, opthalmopathy, cardiopathy, fatigue, leucoderma, leprosy, hysteria, haemorrhoids, sciatica, otalgia, lumbago, swellings, splenopathy, hepatopathy, pneumonopathy, anthralgia, sore eyes, ear ache and dental caries (Kumar *et al*, 1997).

Distribution

Garlic is a native of Southern Europe and it is cultivated all over the world.. It is grown throughout India; Gujarat and Orissa being the leading states.

Botany

The genus *Allium* of Liliaceae family comprises a number of species. The important ones are the following:

A. sativum Linn. syn. *A. porrum* Linn.
A. cepa Linn.
A. ampeloprasum Linn.
A. ascalonicum Linn.
A. leptophyllum Wall.
A. macleanii Baker.
A. schoenoprasum Linn.
A. tuberosum Roxb.

Allium sativum is a scapigerous foetid perennial medicinal herb with underground compound bulbs covered over by outer white thin scales and with simple smooth, round stem, surrounded at the bottom by tubular leaf sheath. The leaves are simple, long, flat and linear. The flowers are small and white arranged in rounded umbels mixed with small bulbils. The entire umbel is enclosed in a tear-drop-shaped membranous spathe. Flowers are usually sterile (Warrier *et al*, 1993).

Agrotechnology

Garlic can be grown under a wide range of climatic conditions. It prefers moderate temperature in summer as well as in winter. Short days are very favourable for the formation of bulbs. Garlic requires well drained loamy soils rich in humus, with fairly good content of potash. Garlic is propagated by cloves or bulblets. In the hills, sowing is done in April and May. Types with bold and compact cloves and thick white covering sheath are preferred for planting. *Ootty-1* garlic is an improved variety by clonal selection released from TNAU, Coimbatore. Garlic may be broadcast, planted in furrows or dibbled at the rate of 150-200kg cloves/ha. In furrow planting, cloves are dropped 7.5-10cm apart in furrows 15cm deep and covered lightly with loose soil. Cloves may be dibbled 5 to 7.5cm deep and 7.5cm apart in rows which are 15cm apart with their growing end upwards and then covered with loose soil. A basal dose of 60kg N and 50kg each of P_2O_5 and K_2O are applied along with 25t/ha of FYM. 60kg N is given as topdressing 45 days after planting. First irrigation is given immediately after sowing and subsequent irrigations are given at 10-15 days interval depending upon the soil moisture availability. The last irrigation should be given 2-3 days before harvesting to facilitate easy harvest and minimum damage to bulbs. First weeding and hoeing is to be done at one month after sowing followed by a second weeding one month after first interculture. Hoeing at about two and a half months from sowing loosens the soil and helps in setting of bigger and well-filled bulbs. Garlic is attacked by *Thrips tabacii* which

causes withering of leaves. Application of methyl demeton 25EC or dimethoate 30EC at 1ml/l will check the pest incidence. Leaf spot caused by *Alternaria solanii* can be controlled by spraying Dithane M.45 at fortnightly intervals at 2.5g/l of water. Garlic is harvested when the tops turn yellowish or brownish and show signs of drying up. The plants are uprooted, tied into small bundles and kept in shade for 2-3 days for curing. Average yield of garlic is 6-8t/ha. (Kumar *et al*, 1997.)

Properties and activity

Garlic bulb is reported to contain volatile oil, alliin (S-allyl-L-cysteine sulfoxide), S-methyl-L-cysteine sulfoxide and allinase. It is rich in vitamins like thiamine, riboflavine and niacin. Volatile oil contains allicin (diallyl thiosulphinate), an active odour principle of garlic. Other major compounds present are diallyl disulphide, diallyl trisulphide, allyl methyl trisulphide and allyl methyl disulphide (Husain *et al*., 1992).

Garlic bulb is antirheumatic, stimulant, diaphoretic, expectorant, diuretic, antispasmodic, astringent, antiparalytic, antileprotic, aperient, febrifuge, carminative, stomachic, alterative and emmenagogue. The essential oil is hypocholestrolemic, hypotensive, antitumour and antidiabetic. Diallyl disulphide and diallyl trisulphide from essential oil have larvicidal action. Bulbs also have anti-bacterial, and anti-fungal activity.

POMEGRANATE *Punica granatum*

Punicaceae

San: Dadimah; Hin: Anar, Dhalim; Ben: Dalim; Tam: Madalai, Madalam; Mal: Urumampazham, Matalam, Talimatalam, Matalanarakam; Kan :Dalimbe; Tel: Dadima; Mar: Dalimba; Guj: Dadam; Ass: Dalin

Importance

Pomegranate has long been esteemed as food and medicine and as a diet in convalescence after diarrhoea. The rind of the fruit is highly effective in chronic diarrhoea and dysentery, dyspepsia, colitis, piles and uterine disorders. The powdered drug boiled with buttermilk is an efficacious remedy for infantile diarrohoea. The root and stem bark are good for tapeworm and for strengthening the gums. The flowers are useful in vomiting, vitiated conditions of *pitta*, ophthalmodynia, ulcers, pharyngodynia and hydrocele. An extract of the flowers is very specific for epistaxis. The fruits are useful in anaemia, hyperdipsia, pharyngodynia, ophthalmodynia, pectoral diseases, splenopathy, bronchitis and otalgia. The fruit rind is good for dysentery, diarrhoea and gastralgia. Seeds are good for scabies, hepatopathy and splenopathy. The important preparations using the drug are *Dadimadighrtam, Dadimastaka churnam, Hinguvacadi churnam, Hingvadi gulika, etc* (Sivarajan *et al*, 1994, Warrier *et al*, 1995).

Distribution

Pomegranate is a native of Iran, Afghanistan and Baluchistan. It is found growing wild in the warm valleys and outer hills of the Himalaya between 900m and 1800m altitude. It is cultivated throughout India, the largest area being in Maharastra.

Botany

Punica granatum Linn. belongs to the family Punicaceace. It is a large deciduous shrub up to 10m in height with smooth dark grey bark and often spinescent branchlets. Leaves are opposite, glabrous, minutely pellucid-punctuate, shining above and bright green beneath. Flowers are scarlet red or sometime yellow, mostly solitary, sometimes 2-4 held together. Stamens are numerous and inserted on the calyx below the petals at various levels. Fruits are globose, crowned by the persistent calyx. Rind is coriaceous and woody, interior septate with membraneous walls containing numerous seeds. Seeds are angular with red, pink or whitish, fleshy testa (Warrier *et al*, 1995).

Agrotechnology

Pomegranate is of deciduous nature in areas where winters are cold, but on the plains it is evergreen. A hot dry summer aids in the production of best fruits. Plants are grown from seeds as well as cuttings. Mature wood pieces cut into lengths of about 30cm are planted for rooting. The rooted plants are planted 4.5-6m apart. When planted close, they form a hedge which also yields fruits. Normal cultivation and irrigation practices are satisfactory for the pomegranate. An application of 30-45kg of FYM annually to each tree helps to produce superior quality fruits. The pomegranate may be trained as a tree with a single stem for 30-45cm or as a bush with 3 or 4 main stems. In either case suckers arising from the roots and similar growths from the trunk and main branches are removed once a year. Shortening of long slender branches and occasional thinning of branches should be done. The fruit has a tough rind and hence transportation loss is minimum (ICAR, 1966).

Properties and Activity

Pomegranate fruit rind gives an ellagitannin named granatin B, punicalagin, punicalin and ellagic acid. Bark contains the alkaloids such as iso-pelletierine, pseudopelletierine, methyl isopelletierine, methyl pelletierine, pelletierine as well as iso-quercetin, friedelin, D-mannitol and estrone. Flowers give pelargonidin-3, 5-diglucoside apart from sitosterol, ursolic acid, maslinic acid, asiatic acid, sitosterol-β-D-glucoside and gallic acid. Seeds give malvidin pentose glycoside. Rind gives pentose glycosides of malvidin and pentunidin. Fluoride, calcium, magnesium, vitamin C and phosphate are also reported from fruits. Leaves give elligatannins-granatins A and B and punicafolin.

Rind of fruit is astringent, fruit is laxative. Bark of stem and root is anthelmintic, and febrifuge. Rind of fruit and bark of stem and root is antidiarrhoeal. Pericarp possesses antifertility effect. Fixed oil from seeds are antibacterial. Bark, fruit pulp, flower and leaf are antifungal. Aerial part is CNS depressant, diuretic and hypothermic. The flower buds of pomegranate in combination with other plants showed excellent response to the patients of *Giardiasis* (Mayer *et al*, 1977; Singhal *et al*, 1983).

CURRY LEAF *Murraya Koenigii*

Rutaceae

San: Kalasakh, Kaidaryah Hin: Mithinim, Katnim Ben: Barsunga
Mal: Kariveppu, Karuveppu Tam: Kariveppilai, Karuveppu Kan: Kari Baeva
Tel: Karivepaku Ass: Narasingha, Bishahari

Importance

Curry leaf, a plant of homestead gardens has gained importance as a commercial crop and is cultivated for its culinary and medicinal value. The plant is highly esteemed for its leaves which promote appetite and digestion and destroy pathogenic organisms. It is reported to be useful in emaciation, skin diseases, hemopathy, worm troubles, neurosis and poisons. They are useful in vitiated conditions of *kapha* and *pitta*, hyperdipna, colic, flatulence, diarrhoea, dysentery, vomiting, inflammations and foul ulcers. "*Kaidaryah*" drug is prepared using this plant which improves voice, stimulates digestion and destroys concocted poisons in the system. The important preparations using the drug are *Kalasadi kasayam, Pamantaka tailam, Jatyadi tailam, Jatyadi ghrtam, etc* (Sivarajan *et al*,1994).

Distribution

Curry leaf is seen in the foot of the Himalaya and Bashahi eastwards to Sikkim and Peninsular India, upto 1700m. It is also found in Sri Lanka, Burma, Indo-China, South China and Hainan. Commercial cultivation in India is limited to Tamil Nadu and Karnataka states.

Botany

The genus *Murraya* of the family Rutaceae includes the following species:
M. Koenigii (Linn.) Spreng. syn. *Bergera koenigii* Linn.
M. Exotica Linn. syn. *M. paniculata* (Linn.) Jack.

Murraya koenigii is a small aromatic tree with dark grey bark and closely crowded spreading dark green foliage. Leaves are imparipinnate and alternate. Leaflets are alternate, obliquely ovate or somewhat rhomboid, gland dotted and strongly aromatic. Flowers are white, arranged in much branched terminal corymbose cymes and fragrant. Fruits are subglobose or ellipsoid berries, purplish black when ripe and 2-seeded (Warrier *et al*, 1995).

Agrotechnology

Curry leaf tree does not choose a specific climate and can come up even in dry climate too. In places where minimum temperature goes below 13°C, the growth of the shoot will be slightly affected. It comes up well in light textured red soils. *DWD-1* and *DWD-2* are two improved varieties released from UAS, Dharwad. Curry leaf is propagated by seed. Main field is to be ploughed repeatedly. A spacing of 90-120cm is followed on either side. Pits of size $30cm^3$ are dug out one month before planting and filled with top soil mixed with well decomposed FYM at the time of planting. Healthy seedlings are planted in the centre of the pits. Then long furrows are formed connecting all the pits to facilitate easy irrigation. The seedlings are irrigated once in 5-7 days upto 3 years and once in 15 days afterwards. The field should be kept free from weeds. Plants may be trained and pruned to maintain a bush of 1m in height. For better growth and yield, each plant is fertilised with 20kg of FYM besides 150:25:50g of N, P_2O_5, K_2O/ year. Attack of aphids in the vegetative stage can be controlled by spraying of dimethoate at 2ml/l of water. Leaves from such sprayed plants should be harvested only after 10 days. Spraying carbendazim at 1g/l can take care of leaf spot diseases. The crop comes to first harvest at the end of first year. The yield of leaves account to 400kg/ha at the end of first year, 2000 to 2200kg/ha in the second and third year harvested at an interval of four months and 2500kg/ha in the fourth year harvested at three months interval. From fifth year onwards it is harvested at 2.5-3 months interval giving an yield of 3500-5000kg/ha (Kumar *et al*, 1997).

Properties and Activity

All parts of the plant, especially the leaves are rich in carbazole alkaloids. These include members with (i) C_{13} - skeleton -murrayanin, mukoeic acid, mukonine and

mukonidine; (ii) C_{18} - skeleton including gerinimbine, koenimbine, murrayacine, koenigine and koenigicine (koenidine); and (iii) C_{23}- skeleton containing mahanimbine, mahanimbicine, iso-mahanimbicine, mahanine, mahanimbinine, murrayayazoline, murrayazolinine, murrayazolidine, cyclomahanimbine and bicyclomahanimbicine. Other carbazole bases include mukoline, mukolidine (C_{13} group, from roots), mukonicine (C_{18} from leaves), the biogenetically significant mukonal (C_{13}, stem-bark), mahanimboline (C_{23}, root-bark), iso-murrayazoline (C_{23}, stem-bark). The leaves gave a coumarin glucoside, scopolin also. Essential oil from leaves contained β-caryophylline, β-gurjunene, β-elemene, β-phellandrene, β-thujene as major constituents.

The roots, bark and leaves are bitter, acrid, astringent, cooling, aromatic, demulcent, depurative, anthelmintic, febrifuge, stomachic, appetising, carminative, antiinflammatory and antiseptic. Aerial part is spasmolytic and antiprotozoal. Root is antiprotozoal, CVS active and has effect on nictitating membrane. Leaf is hypoglycaemic (Hussain *et al*,1992).

COSTUS *Costus speciosus*

Zingiberaceae

San: Pushkara, Kashmeera, Kemuka; Hin: Kebu, Keyu, Kust; Ben: Keu, Kura
Mal: Channakkizhangu, Channakoova; Tam: Kostam; Mar: Penva; Tel: Kashmeeramu

Importance

Costus is one of the plants which contains diosgenin in its rhizome. It is widely used as starting material in the commercial production of steroidal hormones. The rhizomes are useful in vitiated conditions of *kapha* and *pitta*, burning sensation, flatulence, constipation, helminthiases, leprosy, skin diseases, fever, hiccough, asthma, bronchitis, inflammation and aneamia. It is used to make sexual hormones and contraceptives (Warrier *et al*,1994).

Distribution

The plant is widely distributed in Asia and other tropical countries like India, Nepal, Pakistan, Sri Lanka and China. In India, it occurs mostly in Arunachal Pradesh, Meghalaya, Nagaland, Tamil Nadu, Assam, Tripura and Kerala.

Botany

Costus speciosus (Koenig.) Sm. belonging to the family Zingiberaceae consists of two varieties viz., var. *nepalensis* Rose., found only in Nepal and Arunachal Pradesh and var. *argycophyllus* Wall., having a wide distribution in India.

The plant is a succulent herb with long leafy spirally twisted stems, 2-3m in height and horizontal rhizomes. Leaves are simple, spirally arranged, oblanceolate or oblong, glabrous above, silky pubescent beneath with broad leaf sheaths. Flowers are white, large, fragrant, arranged in dense terminal spikes. Bracts are bright red. The single stamen present is perfect, lip large with incurved margins. Fruits are globose or ovoid capsules with obovoid or sub- globose seeds (Warrier *et al*,1994).

Agrotechnology

Costus can be raised under a wide range of agroclimatic conditions. It prefers sandy loam soil for good growth. Propagation is by rhizomes. The best season for planting is April-May. The seed rate recommended is 2-2.4t/ha. The spacing adopted is 50x50cm. After an initial ploughing FYM or poultry manure should be applied at the rate of 30t/ha and the field is to be ploughed again irrigated and prepared to obtain a fine seed bed. Furrows are opened and the rhizome pieces are placed horizontally at a depth of 8-10cm and covered with soil. Care is taken to place the eye buds facing upwards. After 70-75 days about 90-95% sprouting is obtained. Desiccation of the young sprouts have been observed in the hot summer months, necessitating liberal water supply during the period. As September-November is the period of maximum tuberization at least two irrigations should be given at that time. One during the sprouting period of the crop followed by two more keeps the crop fairly free of weeds. Application of 37t/ha of poultry manure and fertilizers, 60kg P_2O_5 and 40kg K_2O /ha as a basal doze, along with 80kg N/ha applied in 3 equal split dozes will take care. Crop is harvested at the end of seven months. Harvesting includes 2 operations, cutting the aerial shoots and digging out the rhizomes. Cost of production of diosgenin ranges from Rs. 271-300/kg (Atal, *et al*,1982).

Properties and Activity

Tubers and roots contain diosgenin, 5α-stigmast-9(11)-en-3β ol, sitosterol-β-D-glucoside, dioscin, prosapogenins A and B of dioscin, gracillin and quinones. Various saponins, many new aliphatic esters and acids are reported from its rhizomes, seeds and roots. Seeds, in addition, contain α- tocopherol. Saponins from seeds are hypotensive and spasmolytic. Rhizomes possess antifertility, anticholinestrase, antiinflammatory, stimulant, depurative and anthelmintic activities (Hussain *et al*, 1992).

ECLIPTA *Eclipta prostrata*

Asteraceae

San: Bhrngarajah, Tekarajah; Hin: Bhamgra, Mocakand, Babri; Ben: Kesutthe, Kesraj; Mal: Kannunni, Kayyonni, Kayyunnni; Tam: Kayyantakara, Kaikeri; Kan: Kadiggagaraga; Tel: Guntagalijeran; Arab: Kadim-el-bint

Importance

Eclipta is one of the ten auspicious herbs that constitute the group *dasapuspam* which is considered to destroy the causative factors of all unhealthy and unpleasant features and bestow good health and prosperity. The members of this group cure wounds and ulcers as well as fever caused by the derangement of the *tridosas - vata, pitta and kapha*. It is used in hepatitis, spleen enlargements, chronic skin diseases, tetanus and elephantiasis. The leaf promotes hair growth and use as an antidote in scorpion sting. The root is used as an emetic, in scalding of urine, conjuctivitis and as an antiseptic to ulcers and wound in cattle. It is used to prevent abortion and miscarriage and also in cases of uterine pains after the delivery. The juice of the plant with honey is given to infants for expulsion of worms. For the relief in piles, fumigation with Eclipta is considered beneficial. A decoction of the leaves is used in uterine haemorrhage. The paste prepared by mincing fresh plants has got an antiinflammatory effect and may be applied on insect bites, stings, swellings and other skin diseases. In Ayurveda, it is mainly used in hair oil, while in Unani system, the juice is used in "*Hab Miskeen Nawaz*" along with aconite, *triphala*, *Croton tiglium*, *Piper nigium*, *Piper longum*, *Zingiber officinale* and minerals like mercury, sulphur, arsenic, borax, etc. for various types of pains in the body. It is also a constituent of "*Roghan Amla Khas*" for applying on the hair and of "*Majun Murrawah-ul-arwah*".

Distribution

This plant is widely distributed in the warm humid tropics with plenty of rainfall. It grows commonly in moist places as a weed all over plains of India.

Botany

Eclipta prostrata (Linn) Linn. syn. *E. alba* Hassk. is an annual, erect or postrate herb, often rooting at nodes. Leaves are sessile, 2.5-7.5cm long with white appressed hairs. Floral heads are 6-8 mm in diameter, solitary and white. Fruit is an achene, compressed and narrowly winged. Sometimes, *Wedelia calendulacea*, which resembles *Eclipta prostrata* is used for the same purpose.

Properties and Activity

The leaves contain stigmasterol, α-terthienylmethanol, wedelolactone, dismethylwedelolactone and dismethylwedelolactone-7-glucoside. The roots give hentriacontanol and heptacosanol. The roots contain polyacetylene substituted thiophenes. The aerial part is reported to contain a phytosterol, β-amyrin in the n-hexane extract and luteolin-7-glucoside, β-glucoside of phytosterol, a glucoside of a triterpenic acid and wedelolactone in polar solvent extract. The polypeptides isolated from the plant yield cystine, glutamic acid, phenyl alanine, tyrosine and methionine on hydrolysis. Nicotine and nicotinic acid are reported to occur in this plant.

The plant is anticatarrhal, febrifuge, antidontalgic, absorbent, antihepatic, CVS active, nematicidal, ovicidal and spasmolytic in activity. The alcoholic extract of entire plant has been reported to have antiviral activity against *Ranikhet* disease virus. Aqueous extract of the plant showed subjective improvement of vision in the case of refractive errors. The herbal drug *Trefoli*, containing extracts of the plant in combination with others, when administered to the patients of viral hepatitis, produced excellent results.

BRAHMI *Bacopa monnieri*

Scrophulariaceae

San: Brahmi, Sarasvati; Hin: Barami, Jalnim; Ben: Boihim-sak; Mal: Brahmi, Nirbrahmi; Tam: Nirpirami, Piramiyapundu; Kan, Mar: Nirbrahmi

Importance

Brahmi or **Thyme leaved gratiola** is an important drug in Ayurveda for the improvement of intelligence and memory and revitalisation of sense organs. It clears voice and improves digestion. It is suggested against dermatosis, anaemia, diabetes, cough, dropsy, fever, arthritis, anorexia, dyspepsia, emaciation, and insanity. It dispels poisonous affections, splenic disorders and impurity of blood. It is useful in vitiated conditions of *kapha* and *vata*, biliousness, neuralgia, ascites, flatulence, leprosy, leucoderma, syphilis, sterility and general debility. The whole plant is used in a variety of preparations like *Brahmighrtam, Sarasvataristam., Brahmitailam, Misrakasneham, etc.* In unani *Majun Brahmi* is considered as a brain tonic.

Distribution

The plant grows wild on damp places and marshy lands in the major part of the plains of India, Pakistan, Afghanistan, Nepal, Sri Lanka and other tropical countries.

Botany

Bacopa monnieri (Linn.) Pennell. syn. *Monniera cuneifolia* Michx., *Herpestis monniera* (Linn.) H.B. & K. belongs to the family Scrophulariaceae. It is a prostrate, juicy, succulent, glabrous annual herb rooting at the nodes with numerous ascending branches. Leaves are simple, opposite, decussate, sessile, obovate-oblong or spatulate, entire, fleshy, obscurely veined and punctate. Flowers are pale blue or whitish, axillary, solitary, arranged on long slender pedicels. Fruits are ovoid, acute, 2-celled, 2-valved capsules and tipped with style base. Seeds are minute and numerous (Warrier *et al*, 1993).

Agrotechnology

The plant grows throughout the warm humid tropics upto 1200m elevation. Brahmi gets established well in water logged fields. The plant is propagated vegetatively by stem cuttings. Land is prepared by ploughing 2 or 3 times. Two to three tonnes/ha of cowdung or compost is applied and the field is again ploughed and levelled. Stem cuttings, 10cm long are spread at a spacing of 20cm. Waterlogging to height of 30cm is always required. Rooting may start within 15-20 days. It will spread over the field within 6 months. Regular application of organic manure will take care of the manurial requirement. Weeding once in a month is required. Care should be taken to maintain water level at a height of 30cm during the growth period. No serious pests or diseases are noted in this crop. Harvesting commences from sixth months onwards. Brahmi leaves can be collected once a month. After 3 years, the whole crop is harvested and removed. Fresh cultivation can be carried out in the same field.

Properties and Activity

Earlier workers have reported the isolation of the alkaloids brahmine and hespestine and a mixture of 3 alkaloids from the leaves. Mannitol and saponins were reported later. Subsequent work described isolation of some C_{27}, C_{29}, and C_{31} hydrocarbons and betulic acid from this plant material. A systematic examination has resulted in the isolation and identification of two saponins designated as bacosides A and B. Bacoside A has chemical structure represented as 3-(α-L-arabinopyranosyl)-O-β-D-glucopyranoside-10, 20-dihydroxy-16-ketodammar-24-ene. The mixture of bacosides A and B on hydrolysis give four sapogenins, glucose and arabinose. The constitution of bacogenin A, has been established as 3β-30-dihydroxy-20(5)-25-epoxy-22-methyl-24-nor-dammar-22-en-16-one. Bacogenin A_2 has been shown to be an isomer of bacogenin A, differing in configuration at C-20. Bacogenin A_4 has been identified as ebelin lactone.

The plant is reported to have shown barbiturate hypnosis potentiation effect. The plant is anticancerous and improves learning ability. It is used as a tranquilliser. The plant is astringent, bitter, sweet, cooling, laxative, intellect promoting, anodyne, carminative, digestive, antiinflammatory, anticonvulsant, depurative, cardiotonic, bronchodialator, diuretic, emmenagogue, sudorfic, febrifuge and tonic (Basu *et al*, 1947; Rastogi *et al* 1960).

INDIAN CROCUS *Kaempferia rotunda*

Zingiberaceae

San: Bhumicampaka, Bhucampaka, Hallakah Hin: Abhuyicampa
Mal: Chengazhuneerkizhengu, Chengazhuneerkuva Tam: Nerppicin
Kan: Nelasampiga Tel: Bhucampakamu, Kondakaluva Mar: Bhuichampa

Importance

The tubers of Indian crocus are widely used as a local application for tumours, swellings and wounds. They are also given in gastric complaints. They help to remove blood clots and other purulent matter in the body. The juice of the tubers is given in dropsical affections of hands and feet, and of effusions in joints. The juice causes salivation and vomiting. In Ayurveda, the improvement formulations using the herb are *Chyavanaprasam, Asokarishtam, Baladthatryaditailam, Kalyanakaghritham, etc*. The drug "*HALLAKAM*" prepared from this is in popular use in the form of powder or as an ointment application to wounds and bruises to reduce swellings. It also improves complexion and cures burning sensation, mental disorders and insomnia (NRF, 1998; Sivarajan *et al*, 1994).

Distribution

The plant is distributed in the tropics and sub-tropics of Asia and Africa. The plant grows wild in shaded areas which are wet or humid, especially in forests in South India. It grows in gardens and is known for their beautiful flowers and foliage. It is also cultivated as an intercrop with other commercial crops.

Botany

Kaempferia rotunda Linn. belonging to the family Zingiberaceae is an aromatic herb with tuberous root-stalk and very short stem. Leaves are simple, few, erect, oblong or ovate-lanceolate, acuminate, 30cm long, 10cm wide, variegated green above and tinged with purple below. Flowers are fragrant, white, tip purple or lilac arranged in crowded spikes opening successively. The plant produces a subglobose tuberous rhizome from which many roots bearing small oblong or rounded tubers arise (Warrier *et al*, 1995).

Agrotechnology

The plant is a tropical one adapted for tropical climate. Rich loamy soil having good drainage is ideal for the plant. Laterite soil with heavy organic manure application is also well suited. Planting is done in May-June with the receipt of 4 or 5 pre-monsoon showers. The seed rate recommended is 1500-2000kg rhizomes/ha. Whole or split rhizome with one healthy sprout is the planting material. Well developed healthy and disease free rhizomes with the attached root tubers are selected for planting. Rhizomes can be stored in cool dry place or pits dug under shade plastered with mud or cowdung. The field is ploughed to a fine tilth, mixed with organic manure at 10-15t/ha. Seed beds are prepared at a size of 1m breadth and convenient length. Pits are made at 20cm spacing in which 5cm long pieces of rhizomes are planted. Pits are covered with organic manure. They are then covered with rotten straw or leaves. Apply FYM or compost as basal dose at 20 t/ha either by broadcasting and ploughing or by covering the seed in pits after planting. Apply fertilisers at the rate of 50:50:50 kg N, P_2O_5 and K_2O/ha at the time of first and second weeding. After planting, mulch the beds with dry or green leaves at 15 t/ha. During heavy rainy months, leaf rot disease occurs which can be controlled by drenching 1% Bordeaux mixture. The crop can be harvested after 7 months maturity. Drying up of the leaves is the indication of maturity. Harvest the crop carefully without cutting the rhizome, remove dried leaves and roots. Wash the rhizome in water. They are stored in moisture-proof sheds. Prolonged storage may cause insect and fungus attack (Prasad *et al*, 1997).

Properties and activity

The tubers contain crotepoxide and β-sitosterol. Tuber contains essential oil which give a compound with melting point 149^{o}C which yielded benzoic acid on hydrolysis.

The tubers are acrid, thermogenic aromatic, stomachic, antiinflammatory, sialagogue, emetic, antitumour and vulnerary.

SWEET FLAG *Acorus calamus*

Araceae

San: Vaca, Ugragandha, Bhadra; Hin: Bacc, Gorbacc; Ben: Bach; Mal:Vayampu; Tam: Vasampu; Kan: Bajai; Tel: Vasa Vadaja

Importance

The sweet flag is an important *medhya* drug, capable of improving memory power and intellect. It is used in vitiated conditions of *vata* and *kapha*, stomatopathy, hoarseness, colic, flatulence, dyspepsia, helminthiasis, amenorrhoea, dismenorrhoea, nephropathy, calculi, strangury, cough, bronchitis, odontalgia, pectoralgia, hepatodynia, otalgia, inflammations, gout, epilepsy, delirium, amentia, convulsions, depression and other mental disorders, tumours, dysentery, hyperdipsia, haemorrhoids, intermittent fevers, skin diseases, numbness and general debility. It is reportedly useful in improving digestion, clearing speech and curing diarrhoea, dysentery, abdominal obstruction and colic. It is also useful in infantile fever, cough bronchitis and asthma. The drug is reported to cure hysteria, insanity and chronic rheumatic complaints. The rhizome is an ingredient of preparations like *Vacaditaila, Ayaskrti, Kompancadi gulika, Valiya rasnadi kashaya, etc.*

Distribution

The plant is a native of Europe. It is distributed throughout the tropics and subtropics, especially in India and Sri Lanka. It is found in marshes, wild or cultivated, ascending the Himalayas upto 1800m in Sikkim. It is plentiful in marshy tracts of Kashmir and Sirmoor, in Manipur and Naga Hills.

Botany

Acorus calamus Linn. belonging to the family *Araceae* is a semi-aquatic rhizomatous perennial herb. Rhizome is creeping, much branched, cylindrical or slightly compressed, light brown or pinkish brown externally, white and spongy within. Leaves are bright green, distichous, ensiform, base equitant, thickened in the middle and with wavy margins. Flowers are light brown and densely packed in sessile cylindric spadix. Fruits are oblong, turbinate berries with a pyramidal top. Seeds are few and pendant from the apex of the cells (Warrier *et al*, 1993).

Another species belonging to the genus *Acorus* is *A. gramineus* Soland, the roots of which are used in tonic, antiseptics and insecticidal preparations (Chopra *et al*, 1956).

Agrotechnology

Acorus is a hardy plant found growing from tropical to subtropical climates. It needs a good and well distributed rainfall throughout the year. It needs ample sunlight during the growth period as well as after harvest for drying the rhizomes. It may be cultivated in any good but fairly moist soil. It is usually grown in areas where paddy can be grown. It comes up well in clayey soils and light alluvial soils of river bank. The field is laid out and prepared exactly as for rice, irrigated sufficiently and after ploughing twice, watered heavily and again ploughed in the puddle. Sprouted rhizome pieces are used for planting and pressed into the mud at a depth of about 5cm at a spacing of 30x30cm. The rhizomes are planted in such a way that the plants in the second row comes in between the plants of the first row and not opposite to them. FYM is to be applied at 25t/ha. Fertilisers are applied at 25:50:60 kg $N:P_2O_5:K_2O$/ha/yr. Whole of FYM and 1/3 of N, P_2O_5 and K_2O are to be added in the field during March - April as a basal dose. The remaining 2/3 of nutrients is to be given in two equal split doses at 4 months and 8 months after planting. The field is to be regularly irrigated. About 5 cm of standing water is to be maintained in the field in the beginning. Later, it is to be increased to 10 cm as the plant grows. The field is to be regularly weeded. About 8 weedings are to be carried out in all. At each weeding the plants are pressed into the soil. The plant is attacked by mealy bugs. Both shoot and root mealy bugs can be controlled by spraying the shoot and drenching the roots of grown up plants with 10 ml Methyl parathion or 15ml Oxydemeton methyl or 20ml Quinalphos in 10 litres of water. The crop is ready for harvest at the end of first year. The field is to be dried partially so that sufficient moisture is left in the

soil to facilitate deep digging. The leaves start turning yellow and dry, indicating maturity. The rhizome will be at a depth of 60cm and having about 30-60cm spread. Therefore, harvesting is to be done carefully. The rhizomes are to be cut into 5-7.5cm long pieces and all the fibrous roots are to be removed. Yield of rhizome is about 10t/ha (Farooqi *et al*, 1991).

Properties and Activity

Rhizomes, roots and leaves yield essential oil. The important constituents of the Indian oil are asarone and its β-isomer. Other constituents are α and β-pinene, myrcene, camphene, p-cymene, camphor and linalool, sesquiterpenic ketones like asarone, calamone, calacone, acolamone, iso-acolamone, acoragermacrone, epishyobunone, shyobunone and iso-shyobunone. Alcohol present is preisocalamendiol. Sesquiterpene hydrocarbons like elemene, elemane and calarene are also present. Tricyclic sesquiterpenes present are caryophyllene, humulene, guaiene, S-guaizulene, arcurcumene, δ-cadinene, cadinane, calamenene, calacorene, dihydrocalacorene(calamenene), cadalene and selinene. Roots yield acoric acid as a main constituent in addition to choline. Plant also yields a flavone diglycoside- luteolin 6,8-C-diglucoside. β-asarone is the major constituent of essential oil from rhizome (Dandiya *et al*, 1958,1959; Raquibuddoula, 1967).

Rhizome is insecticidal, pisicidal, spasmolytic, hypothermic, CNS active and analgesic. Essential oil is anticonvulsant. Rhizome is acrid, bitter, thermogenic, aromatic, intellect promoting, emetic, laxative, carminative, stomachic, anthelmintic, emmenagogue, diuretic, alexeteric, expectorant, anodyne, antispasmodic, aphrodisiac, antiinflammatory, sudorific, antipyretic, sialagogue, insecticidal, tranquillizer, sedative, analgesic, antithermic, antiasthmatic, hypotensive, respiratory depressant, aperitive and tonic.

CATECHU Acacia catechu

Mimosaceae

San:Khadirah; Hin:Khair, Khaira; Ben: Kuth; Mal: Karingali; Tam: Karunkali; Tel: Sandra, Khandiramu; Kan: Kaggali

Importance

Catechu is a medium deciduous tree commonly used as a blood purifier and for leoprosy and leucoderma. Catechu or Cutch tree bark is useful in melancholia, conjunctivitis and haemoptysis. It is useful in vitiated conditions of *kapha* and *pitta*, catarrh, cough, pruritus, leprosy, leucoderma, skin diseases, helminthiasis, anorexia, diarrhoea, dysentery, foul ulcers and wounds, haemoptysis, haematemesis, haemorrhages, intermittent fever, inflammations, odontopathy, anaemia, diabetes, splenomegaly and pharyngodyna. The gummy extract of the wood (*kath*) is useful in laryngopathy, flatulence, anorexia, ulcers, wounds, helminthiasis, leucoderma, leoprosy, skin diseases, urorrhea, colporrhagia, erysipelas and odontopathy. For leprosy, root, leaf, flower, bark and fruits are made into a decoction which is given orally as well as for external dressing. In Unani system it is used in "*Marham Kharish Jadid*" for skin diseases. "*Khadirarisht*" is an oral medicine, while "*Marham*" is for external application.

Distribution

It is widely distributed in tropical countries. In India, it is observed from the Indus eastwards to Assam and throughout Peninsular India.

Botany

The genus *Acacia* belonging to the family Mimosaceae consists of a number of species. The important ones are listed as below:

A. catechu Willd.
A. caesia Willd.
A. arabica Willd.
A. concinna DC.
A. farnesiana Willd.
A. ferruginea DC.
A. instia W. & A. syn. *A. caesia* Willd.
A. jacquemontii Benth.
A. leucophloea Willd.
A. modesta Wall.
A. pinnata (Linn.) Willd.
A. pycnantha Benth.
A. senegal Willd.
A. suma Buch-Ham. syn. *A. suma* Kurz.

A. catechu is a moderate sized deciduous tree, 9-12m in height with dark greyish or brown rough bark and hooked short spines. Leaves are bipinnately compound, leaflets 30-50 pairs, main rachis pubescent with a large conspicuous gland near the middle of the rachis. Flowers are pale yellow, sessile in peduncled axiallary spikes. Fruits are flat brown pods, shiny and with a triangular beak at the apex and narrowed at the base. Seeds are 3-10 per pod.

The gummy extract of the wood is commercially known as ' *Kath*' or '*Cutch*'. The cutch available in the market is brittle, of different shapes and dark brown in colour. On breaking, it is found to be shiny and form crystal like pieces (Warrier *et al*, 1993).

Agrotechnology

Catechu is suited to hilly areas and rocky places. The plant is propagated by seeds. Seeds are soaked in water for 6 hours and sown in seedbeds. Seeds germinate within a month. At four-leaf stage, seedlings are planted in polybags. Two months old seedlings from the polybags are used for transplanting. Pits of size 50cm cube are taken at a distance of 4-5m between plants and filled with topsoil, sand and dried cowdung in 1:1:1 ratio. Seedlings are planted in these pits. Application of organic manure every year during the rainy season is beneficial. Regular weeding is to be carried out. Pruning of branches and tender shoots

developing from the base of the plant can be done from second year onwards. Tree is to be grown as single stemmed one. Flowering and fruiting commences from fourth year onwards. At the end of tenth year, the tree can be cut and heartwood collected (Prasad *et al*, 1997).

Properties and Activity

Heartwood contains kaempferol, dihydro kaempferol, taxifolin, iso rhamnetin(+)-afzelchin, a dimeric procyanidin, quercetin, (-)epi-catechin, (-)catechin, fisetin, quercetagetin and (+)-cyanidanol. The main constituent of heartwood is catechin and catechu tannic acid. Catechin is a mixture of at least four isomers and L(-)epicatechin has been isolated and characterised (Rao *et al*,1948; Husain *et al*,1992).

The bark is anthelmintic, antipyretic, antiinflammatory and antileprotic. The flowers are antigonorrhoeic. The cutch from wood is anthelmintic, tonic and aphrodisiac. Bark and cutch are antidiarrhoeal, astringent and stomachic. Cyanidanol is hepatoprotective. The wood is hypoglycaemic, antiinflammatory and hypotensive. The stem is spasmolytic and antiviral (Husain *et al*, 1992).

SOLANUMS *Solanum spp.* *Solanaceae*

Solanums comprise a very important group of medicinal plants having multifarious uses. These plants belong to the family Solanaceae and genus *Solanum*. A number of species are reported to be medicinal which are briefly described below.

1. *S. anguivi* Lam. syn. *S. indicum* auct. non Linn.

Eng: Poison berry; San: Brhati, Simhi; Hin: Barhauta, Birhatta; Mal: Puthirichunda, Cheruchunda; Tam: Karimulli, Puthirichundai; Kan: Ramagulla; Tel: Cittimulaga, Tellamulaka

It is found throughout the tropics, in plains and at low elevations. It is much branched, very prickly undershrub, 0.3-1.5m in height. Leaves are simple, large, ovate, subentire, sinuate or lobed. Flowers are blue in extra-axillary cymes having stellately hairy and prickly peduncles. Fruits are globose berries, reddish or dark yellow with smooth or minutely pitted seeds. Its roots are useful in vitiated conditions of *vata* and *kapha*, odontalgia, dyspepsia, flatulence, colic, verminosis, diarrhoea, pruritus, leprosy, skin diseases, strangury, cough, asthma, bronchitis, amenorrhoea, dysmenorrhoea, fever, cardiac disorders and vomiting. Roots bitter, acrid, astringent, thermogenic, anodyne, digestive, carminative, anthelmintic, stomachic, constipating, resolvent, demulcent, depurative, diuretic, expectorant, aphrodisiac, emmenagogue, febrifuge and cardiotonic.

2. *S. dulcamara* Linn.

Eng: Bittersweet, Bitter night shade; San: Kakmachi; Pun: Rubabarik

It is found in tropical situations in India and Sikkim. The plant is rich in alkaloidal glycosides like solamarine, tomatidenol, solasodine and soladulcine. The berry and twig are alterative, antisyphilitic, diaphoretic, resolvent, narcotic, diuretic, antirheumatic and used in liver disorders and psoriasis.

3. *S. erianthum* D. Don, syn. *S. verbascifolium* auct. non Linn.

San: Vidari; Hin: Asheta; Mal: Malachunda; Tam: Malaichundai, Anaisundaikkai Pun: Kalamena; Tel: Rasagadi

The plant is distributed over the tropical and subtropical zones of India. The plant contains alkaloids and steroidal sapogenins. Leaves and fruits contain solasodine, solasodiene, solafloridine, diosgenin, vespertilin and pregnenolone. The plant is CNS depressant, antiinflammatory and useful in burns.

4. *S. melongena* Linn.

Eng: Brinjal, Egg plant; San: Varttaki; Hin: Bengan, Badanjan; Mal: Vazhuthina Tam: Kattirikkai; Kan: Badanekaya, Doddabadane; Tel: Vankaya, Niruvanga

It is mainly cultivated as a vegetable throughout the tropics and subtropics. It is an erect or suffrutescent, herbaceous, armed or unarmed perennial shrub. Leaves are simple, large, entire and lobed. Flowers are blue, in clusters of 2-5. Fruits are large, white, yellow or dark purple berries of different shapes capped with thick persistent calyx. Seeds are many, yellow or cream and discoid. The roots, leaves and unripe fruits are useful in cholera, bronchitis, asthma, odontalgia and fever. The roots are laxative, analgesic and cardiotonic. Leaves are sialagogue, narcotic and antiherpetic. The unripe fruits are bitter, acrid, sweet, aphrodisiac, cardiotonic and haematinic.

5. *S. melongena* var. *incanum* (Linn.) Prain syn. *S. incanum* Linn., *S. coagulens* Forsk.

San: Brihati; Hin: Baigan; Mal: Cheruvazhuthina

It is a herbaceous prickly plant found in warm humid tropics. It is grown almost throughout the year in the plains and during summer on the hills. It grows 0.6-2m in height. Leaves are simple, alternate lobed. Flowers are blue or white, 5 lobed, calyx with spines. Fruits are ellipsoid berries. The plant is a constituent of the *dasamoola* which helps to overcome vitiated *tridoshas* and cures dyspepsia, fever, respiratory and cardiac disorders,

skin ailments, vomiting, ulcers and poisonous affections. In Ayurveda the formulations like *Brihatyadi Kashaya, dashamoolarishta, Indukantaghritam, Dasamoolaharithaki*, etc are the important preparations with the roots. It is also used in the treatment of toothache and sore throat. The fruit is reported to stimulate the intrahepatic metabolism of cholesterol. Roots are antiasthmatic and stimulant. Leaves are used in cholera, bronchitis and asthma. Fruits are useful in liver complaints.

6. *S. nigrum* Linn. syn. *S. rubrum* Mill.

Eng: Black night shade; San: Kakamachi; Hin: Makoy, Gurkkamai; Mal: Karimthakkali; Tam: Manathakkali, Milagutakkali; Kan: Kakarndi; Tel: Kamachi, Kachi

It is seen wild throughout India. It is an erect, divaricately branched, unarmed, suffrutescent annual herb. Leaves are ovate or oblong, sinuate-toothed or lobed and glabrous. Flowers are 3-8 in extra-axillary drooping subumbellate cymes. Fruits are purplish black or reddish berries. Seeds are many, discoid, yellow, minutely pitted. The whole plant is useful in vitiated conditions of *tridosha*, rheumatalgia, swellings, cough, asthma, bronchitis, wounds, ulcers, flatulence, dyspepsia, strangury, hepatomegaly, otalgia, hiccough, opthalmopathy, vomiting, cardiopathy, leprosy, skin diseases, fever, splenomegaly, haemarrhoids, nephropathy, dropsy and general debility. The plant is bitter, acrid, emollient, antiseptic, antiinflammatory, expectorant, anodyne, vulnerary, digestive, laxative, diuretic, cardiotonic, depurative, diaphoretic, febrifuge, rejuvenating, sedative, alterant and tonic.

7. *S. spirale* Roxb.

Hin: Munguskajur

It is seen wild in Assam and Khasi hills in India. Its root is diuretic and narcotic.

8. *S. stramoniifolium* Jacq., syn. *S. ferox* auct. non Linn.

San: Garbhada; Hin: Rambaigan; Mal: Anachunda; Tam: Anaichundai; Tel: Mulaka

It is observed in India in the states of Assam, Maharashtra, Karnataka and Tamil Nadu. Its berries contain glycoalkaloids such as solasonine and solasodine. Its roots and berries are bechic, antiasthmatic, antirheumatic, antiviral, anticancerous and spermicidal.

9. *S. surattense* Burm. F. syn. *S. xanthocarpum* schrad. & Wendl., *S. jacquinii* Willd.

Eng: Yellow-berried nightshade; San: Kantakari, Nidigdhika; Hin: Remgani,Kateli; Mal: Kantakarichunda; Tam: Kantankattiri; Kan: Nelagulli; Tel: Callamulaga

It is found throughout India and Pakistan in dry situations as weed on roadsides and wastelands. It is prickly, diffuse, bright green, suffrutescent, perennial undershrub, with zigzag branches. Leaves are ovate-oblong, hairy on both sides and armed on the midrib and the nerves. Flowers are bluish purple, in extra-axillary cymes. Fruits are glabrous, globular drooping berry, yellow or white with green veins, surrounded by the calyx. Seeds are many, small, reniform, smooth and yellowish brown.

The whole plant is useful in vitiated conditions of *vata* and *kapha*, helminthiasis, dental caries, inflammations, flatulence, constipation, dyspepsia, anorexia, leprosy, skin diseases, hypertension, fever, cough, asthma, bronchitis, hiccough, lumbago, haemorrhoids and epilepsy. The plant is bitter, acrid, thermogenic, anthelmintic, antiinflammatory, anodyne, digestive, carminative, appetiser, stomachic, depurative, sudorific, febrifuge, expectorant, laxative, stimulant, diuretic, rejuvenating, emmenagogue and aphrodisac. Fruits contain solasonine, solamargine and solasodine.

10. *S. torvum* Sw.

Eng: West Indian Turkey Berry; Hin, Ben: Titbaigan; Mal: Kattuchunda; Kan: Kadu Sunde; Tam: Sundaikai, Amarakai; Tel: Kundavustic, Kotuvestu; Ass: Hathibhekuri

It is seen throughout tropical India, particularly in Orissa, Bihar and Manipur. The plant is CVS active and used in splenomegaly. Fruits and leaves contain solasonine, solasodine, jurubine, jurubidine, torvonin, torvogenin, chlorogenin, paniculogenin, sisalogenone, neosolaspigenin and solaspigenin.

11. *S. trilobatum* Linn.

Eng: Climbing Brinjal; San: Alarka; Mal: Tutavalam; Tam: Tuduvalai; Kan: Mullumusta; Tel: Telavuste

It is mostly seen in South and Western India. The plant contains alkamine and solamarine. The berry and flowers are bechic and used in bronchitis. The alkaloid solamarine is antibiotic and possesses antitumour activity.

12. *S. viarum* Dunal, syn. *S. Khasianum* C. B. Clarke

Hin: Kantakari

It is widely distributed in Khasi, Jaintia and Naga hills of Assam and Manipur upto 2000m and in Sikkim, West Bengal, Orissa and in the Niligiris. The plant and berries contain solasonine (which on hydrolysis yields solasodine), solamargine, khasianine, nantigenin, solasodine, diosgenin and saponin-solakhasianin. The plant is spasmolytic and CNS active. The berry is a source of solasodine used in the synthesis of corticosteroidal hormones.

Agrotechnology

The agrotechnology for the solanaceous group of plants are almost similar. They come up very well in tropical and subtropical climate upto 2000m altitude. They can be raised on a variety of soils good in organic matter. Propagation is by seeds. The seedlings are first raised in the nursery and transplanted to the main field 30-45 days after sowing when the plants attain 8-10cm height. During rainy season, planting is done on ridges while during summer in furrows, at a spacing ranging from 30-90cm depending upon the stature and spreading habit of the plant. The transplanted seedlings should be given temporary shade for 2-4 days during summer. FYM or compost at 20-25t/ha is applied at the time of land preparation. A moderate fertiliser dose of 75:40:40 N, P_2O_5, K_2O/ha may be given. P is given as basal dose, N and K are applied in 2-3 split doses. One or two intercultural operations are needed to control weeds. The plants need earthing up after weeding and topdressing. Irrigation is needed at 3-4 days interval during summer and on alternate days during fruiting period. Plants need staking to avoid lodging due to heavy bearing. Shoot borers, mealy bugs, leaf webbers and miners are noted on the crop, which can be controlled by spraying mild insecticides. Root knot nematode, wilting and mosaic diseases are also noted on the crop. Field sanitation, crop rotation and burning of crop residues are recommended.

STROBILANTHES *Strobilanthes ciliatus*

Acanthaceae

San: Sahacarah, Sairyakah; Hin: Karvi, Kara; Mal: Karimkurunji, Kurunji; Tam: Kurunji, Sinnakurunji

Importance

Strobilanthes is an important shrub used in the treatment of rheumatism. The roots are useful in rheumatalgia, lumbago, siatica, limping, chest congestion, strangury, fever, leucoderma, skin diseases, inflammations, cough, bronchitis, odontalgia and general debility. The leaves and bark are useful in whooping cough, fever, bronchitis, dropsy, leucoderma, leprosy, pouritus, inflammations, scrofula and fever (Warrier *et al*, 1995).

Distribution

It is distributed in tropical countries, such as India, Sri Lanka, Pakistan and in a few subtropical countries. It is observed in India, throughout the evergreen forests of Western Ghats upto 1200m. It is also cultivated.

Botany

The genus *Strobilanthes* belonging to the family Acanthaceae consists of 3 species namely,

S. ciliatus Nees.,syn. *Nilgirianthus ciliatus* (Nees) Bremek

S. auriculatus Nees. and

S. callisus Nees.

S. ciliatus is a slender shrub with subquandrangular white dotted dark green or purple stems and branches. Leaves are dark green, elliptic, accuminate at both ends, serrate, glabrous with 6-7 pairs of main nerves. Flowers are white to lilac, arranged in axillary slender glabrous spikes. Fruits are very rarely formed. Adventitious roots arise from a few basal nodes also. The main roots as well as the nodal roots are used as raw drugs (Warrier *et al*, 1995).

Agrotechnology

Strobilanthes prefers silty loam soil, mixed with sand, for good growth. It grows abundantly in river banks, lowlands and plains. The best season of planting is May-June. The field is to be ploughed to a fine tilth and mixed with 5-7t/ha of FYM/compost/dried cowdung. Seed beds of size 3m length, 0.5m width and 15cm height are to be made in which 10cm long stem cuttings are to be planted at a spacing of 30cm between plants. Rooting occurs within 20 days. Two weedings should be carried out at 2 months and 4 months after planting, followed by organic manure application. Irrigation is not a must but during summer months it is beneficial. The plant is not attacked by any serious pests or diseases. Harvesting can be done at the end of the second year. For this the plants are to be cut, roots dug out and collected. Roots are to be washed well, dried in sun and marketed. Roots, leaves and bark constitute the economic parts (Prasad *et al*, 1997).

Properties and Activity

The leaves and stem yield essential oil which is of good medicinal value. The roots are bitter, sweet, thermogenic, emollient, diuretic, febrifuge, diaphoretic, depurative, antiinflammatory and tonic. Leaves and bark are diaphoretic, expectorant, depurative and febrifuge.

FENUGREEK *Trigonella foenum-graecum* *Fabaceae*

San: Methika, Methi, Kalanusari; Hin: Meti, Mutti; Ben, Mar: Methi; Mal: Uluva; Tam: Ventayam; Kan: Mentya, Menlesoppu; Tel: Mentulu, Mentikura; Arab: Hulabaha

Importance

Fenugreek or Greek Hayes is cultivated as a leafy vegetable, condiment and as medicinal plant. The leaves are refrigerant and aperient and are given internally for vitiated conditions of *pitta*. A poultice of the leaves is applied for swellings and burns. Seeds are used for fever, vomiting, anorexia, cough, bronchitis and colonitis. In the famous Malayalam treatises like *'Padhyam' 'Kairali'* and *'Arunodhayam', uluva* is recommended for use as *kalanusari* in *Dhanvantaram* formulations of *'Astaghradayam'*. An infusion of the seeds is a good cool drink for small pox patients. Powdered seeds find application in veterinary medicine. An aqueous extract of the seeds possesses antibacterial property (Kumar *et al*, 1997; Warrier *et al*, 1995).

Distribution

Fenugreek is a native of South Eastern Europe and West Asia. In India fenugreek is grown in about 0.30 lakh ha producing annually about 30,000 tonnes of seeds. The major states growing fenugreek are Rajasthan, Madhya Pradesh, Gujarat, Uttar Pradesh, Maharashtra, Punjab and Karnataka. It is grown wild in Kashmir and Punjab.

Botany

Trigonella foenum-graecum Linn. belongs to family, Fabaceae. It is an annual herb, 30-60cm in height, leaves are light green, pinnately trifoliate, leaflets toothed, flowers are white or yellowish white, papilionaceous and axillary. Fruits are legumes, 5-7.5cm long, narrow, curved, tapering with a slender point and containing 10-20 deeply furrowed seeds per pod. There are two species of the genus Trigonella which are of economic importance viz. *T. foenum graecum*, the common *methi* and *T. corniculata*, the *Kasuri methi*. These two differ in their growth habit and yield. The latter one is a slow growing type and remains in rosette condition during most of the vegetative growth period (Kumar *et al*, 1997; Warrier *et al*, 1995).

Agrotechnology

Fenugreek has a wide adaptability and is successfully cultivated both in the tropics as well as temperate regions. It is tolerant to frost and freezing weather. It does well in places receiving moderate or low rainfall areas but not in heavy rainfall area. It can be grown on a wide variety of soils but clayey loam is relatively better. The optimum soil pH should be 6-7 for its better growth and development. Some of the improved cultivars available for cultivation are *CO1* (TNAU), *Rajendra Kanti* (RAU), RMt-1(RAU) and *Lam Selection-1* (APAU). Land is prepared by ploughing thrice and beds of uniform size are prepared. Broadcasting the seed on the bed and raking the surface to cover the seeds is normally followed. But to facilitate intercultural operations, line sowing is also advocated in rows at 20-25cm apart. Sowing in the plains is generally in September-November while in the hills it is from March. The seed rate is 20-25kg/ha and the seeds germinate within 6-8 days. Besides 15t of FYM, a fertiliser dose of 25:25:50kg NPK/ha is recommended. Entire P,K and half N are to be applied basally and the remaining half N 30 days after sowing. First irrigation is to be given immediately after sowing and subsequent irrigations at 7-10 days interval. Hoeing and weeding are to be done during the early stages of plant growth and thinning at 25-30 days to have a spacing of 10-15cm between plants and to retain 1-2 plants per hill. Root rot (caused by *Rhizoctonia solani*) is a serious disease and can be controlled by drenching carbendazim 0.05% first at the onset of the disease and another after one monthof first application. In about 25-30 days, young shoots are nipped off 5cm above ground level and subsequent cuttings of leaves may be taken after 15 days. It is advisable to take 1-2 cuttings before the crop is allowed for flowering and fruiting when pods are dried, the plants are pulled out, dried in the sun and seeds are threshed by beating with stick or by rubbing with

hands. Seeds are winnowed, cleaned and dried in the sun. They may be stored in gunny bags lined with paper. An yield of 1200-1500kg of seeds and about 800-1000kg of leaves may be obtained per hectare in crops grown for both the purposes (Kumar *et al*, 1997).

Properties and Activity

Seeds contain sapogenins-diosgenin, its 25-epimer(yamogenin), tigogenin, gitogenin, yuccagenin, 25-2-spirosta-3-5-diene and its β-epimer. Seeds also contain a C_{27}-steroidal sapogenin-peptide ester-fenugreekine. Seeds, in addition, contain 4-hydroxyleucine and saponins-fenugrins A-E:two furostanol glycoxides-trigonelloxide C and (255)-22-O-methyl-52-firostan-3β,22,26,triol-3-O-α-rhamnopyrans syl(1-2) C-β-D-glucopyranosyl (1-3)-β-D-glucopyranoxide-26-O-β-D-glucopyranoxide.

Other chemical constituents are sterols-β-sitosterol and cholesterol, flavone C-glycosides-vitexin, iso-vitexin, vitexin-2"-O-P-coumarate and vicenin-2. Flavonoids-quercetin and luteolin, flavonoid glycoside-vicenin-I. Invitro seedling callus culture gave flavonoids-luteolin and vitexin-1-glycoside. An essential oil is also reported from seeds. Leaves gave saponins-gracecunins A-G, flavonoids- kaempferol and quercetin; sterols-β-sitosterol, sapogenins-diosgenin, gitogenin coumarin-scopoletin is also reported from the plant.

Seeds are bitter, mucilaginous, aromatic, carminative, tonic, diuretic, thermogenic, galactagogue, astringent, emollient, amophrodisiac, antirheumatic, CNS depressant and antiimplantation. Fenugreekine is hypoglycaemic, diuretic, hypotensive, cardiotonic, antiphlogistic. It showed 80% inhibition of vaccina virus.

LEADWORT *Plumbago spp.*
Plumbaginaceae

The genus *Plumbago* belonging to the family Plumbaginaceae is a popular and medicinally very important group of medicinal plants. Three species, namely *P. rosea*, *P. zeylanica* and *P. auriculata* have been identified. Among these *P. rosea* and *P. zeylanica* are important ones.

Plumbago, in general is an esteemed remedy for leucoderma and other skin diseases. The synonyms of fire like *agnih, vahnih*, etc. are attributed to this drug to indicate the very burning action of the root, causing blisters on the skin (*daranah*). The drug is used only after adequate curing and purification. Root is the officinal part and it enters into the composition of preparations like *Citrakasavam, Dasamularista, Gulgulutiktaka kasaya, Yogarajachurna, etc.*

1. *P. rosea* Linn. syn. *P. indica* Linn.

Eng: Rosy-flowered Leadwort; San: Citrakah, Dhahanah; Hin: Lalcitra, Raktacitra; Ben: Lalchita; Mal: Kotuveli, Chettikkoduveli, Chuvannakotuveli;
Tam: Chenkotuveli, Cittiramulam; Kan: Kempacitramula; Tel: Yerracitramulam

Rosy-flowered leadwort or Fire plant is a native of Coromandel Coast. It is found throughout India, in moist situations as well as cultivated. The roots are useful in dyspepsia, colic, inflammations, cough, bronchitis, helmenthiasis, haemorrhoids, elephantiasis, chronic and intermittent fever, leprosy, leucoderma, ringworm, scabies, hepatosplenomegaly, amenorrhoea, odontalgia, vitiated conditions of *vata*, *kapha* and anaemia. It is a pretty subscandent perennial shrub with semi-woody striate stems and flexible branches. Leaves are simple, alternate oblong, short cuneate at the base passing into a very short amplexicaul, exauriculate, and reddish petiole. Flowers are bright red, arranged in long terminal spikes. The calyx ribs are covered with stipitate, bifarious and subsessile gland. Corolla tube is slender and four times as long as the calyx. The stout roots are cylindrical, irregularly bent, light yellowish brown with smooth surface having short transverse shallow fissures at the regions of the bents. A light yellowish juice excudes from the cut surface. A healthy plant may produce 18-20 stout roots (Warrier *et al*, 1995).

The chemical constituents include plumbagin and sitosterol glucoside. Clinical trials have demonstrated that plumbagin oil from *P. indica* is useful in common wart (Satyavati *et al*, 1987). The roots are acrid, astringent, thermogenic, anthelmintic, constipating, expectorant, antiinflammmatory, abortifacient, alterant, anti-periodic, carminative, digestive, sudorific, narcotic, gastric, nervous stimulant and rejuvenating. Root is a powerful sialogogue and vesicant.

2. *P. zeylanica* Linn.

Eng:White flowered Leadwort; San:Chitraka; Hin, Ben:Chitarak, Chitra; Mal:Vellakotuveli
Tam: Sittragam, Chittiramoolam; Kan: Vahini; Mar: Chitraka; Tel: Chitramulam

White flowered Leadwort or Chitarak is found wild in peninsular India and mostly in West Bengal. Root is used externally in leprosy and other skin diseases or obstinate character, aphthae, abscesses, influenza, piles and anasarca. Juice is used externally in scabies and ulcers. One of the important preparations of Chitrak is "*Yograjguggal*", prescribed for arthritis, rheumatism, etc. The other well known preparations are *"Chitrak Adivati"* and *" Chitraka Haritaki"*. In Unani system it is an ingredient of *"Aqaruva-i-Kabir", "Hab Ashkhar", "Ma'jun Baladur", "Ma'jun Raig Mahi"*, etc. It is a branched undershrub. Roots are long and tuberous. Stem is striate. Leaves are simple, alternate, short petioled, ovate or ovate-oblong, acute with entire or wavy margin, 7x3.8cm and glabrous. Flowers are white, arranged in terminal spikes. Calyx is tubular, glandular-hairy. Corolla tube is slender; limb rotate and 5 lobbed. Stamens are 5 on a disc. Style is slender with 5 stigmatic branches. Fruit is membranous capsule enclosed within the persistent calyx.

The roots of *P. zeylanica* have been exhaustively studied and naphthaquinones have been isolated, namely, plumbagin, 3-chlroplumbagin, droserone (Sidhu *et al*, 1971; Padhye *et*

al, 1973), 3,3'-biplumbagin(Chitranone), zeylanone and iso-zeylanone and a coumarin, elliptinone (Sankaram et al, 1976, 1979). It also contains 1,2(3)-tetrahydro-3,3'-biplumbagin and plumbazeylanone. The leaf is antirheumatic. Root is appetiser, sudorific, relieves pain, vasicant, diuretic, caustic, antidiarrhoeal and expellent of phlegmatic tumours. Root is uterine stimulant. Root and fruits have antiimplantation activity. Plumbagin induces antiimplantation, has abortifacient and antiovulatory activity and causes selective testicular lesions in dogs. It is also a mitotic inhibitor. In lower concentration it behaves like a spindle, poison but in higher concentration it exhibits radiomimetic, nucleotoxic and cyclotoxic effects. It also has antibacterial, antifungal and anticoagulant activities and shows antagonism to amphetamine hyperactivity in mice.

3. *P. auriculata* Lam. syn. *P. capensis*

Eng: Blue flowered Leadwort; Mal: Neelakotuveli

The blue flowered Leadwort is often grown in gardens throughout India (Moos, 1976; Chunekar, 1982; Sharma, 1983). It is a native of Cape Province in South Africa. It is a constituent of many Ayurvedic drugs (KAU, 1991). The plant is a subshrub growing to a height of 1-1.5m. Leaves are elliptic to obovate, 3-4 x 1.5-2cm. Inflorescence is a raceme of length 3-4cm. Corolla is blue to violet. Stamens are 5 in number. Flowers and fruits may be upto 12 in number (Matthew, 1995).

Agrotechnology

The plant is grown in tropical to subtropical ecosystems. Warm humid tropical climate is most suited. They come up well in almost all types of deep and well drained soils. It is propagated vegetatively by stem cuttings. Three stem cuttings of size 15cm long are planted in polybags of size 14x10cm. IAA and IBA treatments will improve rooting of cuttings. The land is to be ploughed well. About 4 tonnes of FYM are to be applied, mixed thoroughly and seed bed of size 50cm breadth, 1.5cm height and convenient length are to be prepared. On these beds pits are taken at a distance of 25cm and the rooted plants are transplanted from the polybags. Regular irrigation and weeding are to be carried out. In the second year with the onset of monsoon, seedbeds are again refreshed after adding about 4 tonnes of FYM. At the end of second year tubers are collected. Care should be taken to wear gloves, else the chemical plumbagin present in the roots will cause burning sensation. The collected tubers are washed, tied into bundles and marketed. Plumbago yields about 7-10t tubers/ha with good management (Prasad *et al*, 1997).

MESUA *Mesua nagassarium*

Clusiaceae

San: Nagapuspah, Nagakesarah; Hin: Nagakesar; Ben: Nagkesar, Nagesar; Mal: Nagappuvu, Nagachempakam, Nanku, Vayanavu, Churuli, Eliponku; Tam: Nagappu, Nanku; Kan: Nagasampige; Tel: Nagakesaramu, Gajapuspam; Mar, Guj: Nagchampa

Importance

Mesua or Ironwood tree, commonly known as *Nagapushpam* is an important medicinal plant which finds varied uses in Ayurveda, Siddha and Unani. Leaves are used in the form of poultice which is applied to head in severe colds. Bark and roots in decoction or infusion or tincture is a better tonic and are useful in gastritis and bronchitis. Fixed oil expressed from seeds is used as an application for cutaneous affections, sores, scabies, wounds, etc. and as an embrocation in rheumatism. Dried flowers powdered and mixed with ghee, or a paste made of flowers with addition of butter and sugar, are given in bleeding piles as well as dysentery with mucus. They are also useful in thirst, irritability of the stomach, excessive perspiration, cough with much expectoration, dyspepsia, etc. Leaves and flowers are used in scorpion stings. Syrup of the flower buds is given for the cure of dysentery (Nadkarni *et al*, 1976). In Ayurveda, it is an ingredient of "*Nagakeshara-adi-Churna*", used for bacillary dysentery and in "*Naga Keshara Yoga*", for piles. In Unani system, the drug is an ingredient of large number of recipes like, "*Jawarish Shehryaran*" a stomach and liver tonic, "*Hab Pachaluna*", an appetiser, *"Halwa-i-supari pack*" a general tonic, etc. (Thakur *et al*, 1989).

Distribution

The plant occurs in sub-tropical to tropical areas of East India, Andaman Islands and Western Ghats, upto an altitude of 1500m.

Botany

Mesua nagassarium (Burm.f.) Kosterm. syn. *M. ferrea* auct. non Linn. belongs to the family Clusiaceae. It is a medium sized to large evergreen tree, 18-30m in height and with reddish brown bark which peels off in thin flakes. Leaves are simple, opposite, thick, lanceolate, coriaceous, covered with waxy bloom underneath, and red when young, acute or acuminate and with inconspicuous nerves. Flowers are white, very fragrant, axillary or terminal, solitary or in pairs. Stamens are numerous, golden yellow, much shorter than the petals. Fruits are ovoid with a conical point surrounded by the enlarged sepals. Seeds are 1-4 in number, angular, dark brown and smooth (Warrier *et al*, 1995).

The flowers of *Ochrocarpus longifolius* are also sometimes referred to as Nagakesara. This tree is found in the West Coast of India (Thakur *et al*, 1989).

Agrotechnology

The plant prefers plains, riverbanks or places which do not experiences moisture stress for its luxuriant growth. Silty loam soil is suitable for its cultivation. The plant is propagated by seeds. Seed formation occurs in November-March. Seeds are to be collected and sown in seedbeds or polybags. 3-4 months old seedlings are used for transplanting. Pits of size 45cm cube are to be taken at a distance of 3-3.5m and filled with a mixture of 10kg FYM, sand and top soil and made into a mound. Seedlings are to be transplanted into small handpits taken on these mounds. FYM is to be applied twice a year. Regular irrigation and weeding are to be done. The tree flowers in the fourth year. Flowers can be collected, dried in the sun and marketed (Prasad *et al*,1997).

Properties and Activity

Seed oil gives 4-phenyl coumarin analogues-mesuol, mammeigin, mesuagin, mammeisin and mesuone. Bark gives ferruols A and B. Heartwood gives xanthones-euxanthone, mesuaxanthones A and B and a tetroxygenated xanthone named ferraxanthone. Stamens give α and β-amyrin, β-sitosterol, biflavonoids- mesuaferrones A and B, and mesuanic acid. Bark yields a lupeol-type triterpenoid also named guttiferol. Seed oil is rich in oleic, stearic and palmitic acids. Linoleic, arachidic and linolenic acids are also present.

Mesuaxanthones A and B and euxanthone are antiinflammatory, CNS depressant and antimicrobial. The essential oil from the stamens is antibacterial, antifungal, anthelmintic and that from fruit is antifungal. Oral administration of a compound preparation containing *Mesua ferrea* (flowers), *Foeniculum vulgare* (seeds), *Curcuma zeodaria* (tubers), *Nigella sativa* (seeds), *Terminalia chebula* (seeds) and *T. arjuna* (stem-bark) exhibited antiimplantation activity in rats. An Ayurvedic preparations containing *M. ferrea* has haemostatic and astringent properties and is particularly useful in uterine bleeding. Aerial part is CVS active, spasmolytic and diuretic. Phenol containing fraction of seed oil is antiasthmatic and antianaphylaxis. Bark is used as tonic after childbirth. Bark and unripe fruit is sudorific. Leaf and flower is an antidote for snakebite and scorpion sting. Flower bud is antidysenteric. Flower is stomachic and expectorant. Seed oil is antirheumatic. Unripe fruit and flower is astringent (Husain *et al*,1992).

BAUHINIA *Bauhinia variegata*
Caesalpiniaceae

San: Kancanarah, Kovidarah; Hin: Kancanar; Ben: Rakta Kanchan; Tam: Sigappu-mandarai
Mal: Mandaram, Chuvannamandaram, Malayakatti, Kongu, Kongumandaram;
Tel: Daeva Kanchanamu, Mandara; Kan: Ullipe, Kanchavala, Kempu Mandara

Importance

In traditional medicine, Bauhinia is extensively used in glandular diseases and as an antidote to poison. The drug is also reported to be useful in dysentery, diarrhoea, piles and worms (Kurup *et al*, 1979; Sharma *et al*, 1983). They are useful in vitiated conditions of *kapha* and *pitta*, diarrhoea, dysentery, skin diseases, leprosy, intestinal worms, tumours, wounds, ulcers, inflammations, scrofula, protoptosis, haemorrhoids, haemoptysis, cough, menorrhagia and diabetics. *Usirasavam* and *Candanasavam* are some of the preparations using the drug. An important Ayurvedic preparation, *"Kanchnar Guggal*" contains bark of this plant. In Unani system, the flowers are used in "*Hab Mussafi Khun*", for skin diseases, the bark is used in "*Sufuf Kalan*"-an aphrodisiac.

Distribution

The plant is distributed in the Sub-Himalayan tracts from the Indus eastwards and throughout the dry forests of India, ascending to 1300m. It is also cultivated throughout the plains.

Botany

Bauhinia variegata Linn. syn. *B. candida* Roxb. belonging to the family *Caesalpiniaceae* is a moderate sized deciduous tree with vertically cracked grey bark, wood moderately hard, greyish brown with irregular darker patches. Leaves are of 2 leaflets, connate for about two-thirds up. Leaflets are ovate with rounded apex, 10-15cm long, pubescent beneath when young and coriaceous. Flowers are white or pink, the uppermost petal darker and variegated usually appearing before the leaves in short axillary or terminal racemes. Stamens are 5 and stamenodes absent. Fruits are flat dehiscent pods with 10-15 seeds (Warrier *et al*, 1993).

Other important species of the genus *Bauhinia* are as follows.

1. *B. tomentosa* Linn.

It is the yellow or golden flowered one, commonly known as *Manja Mandaram*. It is found in Africa and Asia. In India it is found wild in dry deciduous forests and often cultivated. The plant is antidysenteric, antidote for snakebite and scorpion sting and also used in liver complaints. The bark is astringent. Root bark is vermifuge. Fruit is diuretic. Seed is tonic, wound healing and aphrodisiac.

2. *B. purpurea* Linn.

Pink Bauhinia or Camel's Foot tree is found in South and S. E. Asia. In India, it is found in deciduous forests. Root is carminative and tonic. Bark is astringent and antidiarrhoeal and is used in ulcer and goitre. Flowers are laxative. The experimental studies conducted by Sijoria and Prasad (1979) on animals indicate that *B. purpurea* is very effective in normalising the thyroid gland.

3. *B. racemosa* Lam.

The plant is found in Sub-Himalayan tracts, in U.P, West Bengal, Central and South India. The leaf is anticephalalgic and antimalarial. Bark is astringent, antidiarrhoeal. The seeds are antibacterial. Stem-bark is CVS and CNS active, hypothermic and anticancerous.

4. *B. malabarica* Roxb.

Malabar Mountain Ebony is found in Sub-Himalayan tracts, from Kumaon to West Bengal, ascending to 1350m, Assam, Bihar and South India. The flowers of this plant are antidysenteric.

5. *B. retusa* Roxb.

The plant is distributed in north-western Himalayas from the Beas eastwards, Himachal Pradesh, U.P., Orissa, M.P. and A.P. The gum of the plant is emmenagogue, diuretic and can be used externally in sores. The seed is hypoglycaemic and hypocholesterolaemic. The aerial part is CVS active and has effect on respiration.

6. *B. vahlii* W.&A.

Camel's Foot climber is found in Punjab, Bihar, Assam, Madhy Pradesh, Andra Pradesh and Tamil Nadu. Leaf is demulcent. Seed is tonic and aphrodisiac. Stem is CVS active, antiarrhythmic and spasmolytic.

Agrotechnology

Well drained hilly areas are ideal for the cultivation of Bauhinia. The plant is seed propagated. Seeds are formed in February-March. Seeds are to be collected from the dried pods, soaked in water for 12 hours before sowing in seedbeds. At four-leaved stage they are to be transferred to polybags. Two month old seedlings from polybags are used for field planting. Pits of size 60cm cube are to be taken and filled with 10kg dried cowdung mixed with topsoil and formed into a mound. On these seedlings are to be planted at a distance of 6-7.5m. Irrigation is to be given in the first year. Two weedings and application of organic manure once is required in a year. The plant is not attacked by any serious pests and diseases. The plant flowers on the third year. At the end of tenth year the tree can be cut and wood used for medicinal purposes (Prasad *et al*, 1997).

Properties and activity

Flowers contain flavanoids-kaempferol-3-galactoside and kaempferol-3-rhamnoglucoside. Stem bark yields hentriacontane, octacosanol and stigmasterol. Stem yields β-sitisterol, lupiol and a flavanone glycoside-5, 7-dimethoxy flavanone 4-O-α-L-rhamnopyranoside-β-D-glucopyranoside. Seeds possess human blood agglutinating activity. Stem bark is hypothermic, CNS active and depressant. Bud, flower, leaf and stembark are antibacterial. Stem possesses juvenoid activity. Bark is alterative, tonic, antileprotic and antirheumatic. Bud is antidysenteric. Root is carminative and antidote for snakebite. Bark, flower and root promote suppuration. Bark and bud are astringent and vermifuge (Husain *et al*, 1992).

GYMNEMA *Gymnema sylvestre*

Asclepiadaceae

San: Mesasrngi, Madhunasini; Hin: Gudmar, Merasimgi; Ben: Merasingi;
Mal: Chakkarakolli, Madhunasini; Tam: Sirukurumkay, Sakkaraikkolli;
Kan: Kadhasige; Tel: Podapatra; Mar: Kavali

Importance

Gymnema, Australian Cowplant, Small Indian Ipecacuanha or **Periploca of the woods** is a woody climber. It is reported to cure cough, dyspnoea, ulcers, *pitta, kapha* and pain in the eyes. The plant is useful in inflammations, hepatosplenomegaly, dyspepsia, constipation, jaundice, haemorrhoids, strangury, renal and vesical calculi, helminthiasis, cardiopathy, cough, asthma, bronchitis, intermittent fever, amenorrhoea, conjuctivitis and leucoderma. The fresh leaves when chewed have the remarkable property of paralysing the sense of taste for sweet and bitter substance for some time (Warrier et al, 1995). The drug is described as a destroyer of *madhumeha* (glycosuria) and other urinary disorders. Root has long been reputed as a remedy for snakebite. Leaves triturated and mixed with castor oil are applied to swollen glands and enlargement of internal viscera as the liver and spleen (Nadkarni, 1954). The drug is used to strengthen the function of heart, cure jaundice, piles, urinary calculi, difficult micturition and intermittent fevers (Sharma,1983). The drug enters into the composition of preparations like *Ayaskrti, Varunadi kasaya, Varunadighrtam, Mahakalyanakaghrtam,* etc. They suppress the activity of taste of tongue for sweet taste and for this reason it was considered that it destroys sugar, hence the name *Madhunashini* or *Gurmar* and has been prescribed as an anti-diabetic. The crude drug as well as its dried aqueous extract is mainly used in bronchial troubles.

Distribution

It is a tropical climber. It mainly grows in Western Ghats, Konkan, Tamil Nadu and some parts of Bihar. The plant is cultivated in plains of India but the drug is mainly important from Afghanistan and Iran.

Botany

Gymnema sylvestre (Retz.)R. Br. syn. *Asclepias germinata* Roxb. belonging to the family Asclepiadaceae is a large, woody much branched climber with pubescent young parts. Leaves are simple, opposite, elliptic or ovate, more or less pubescent on both sides, base rounded or cordate. Flowers are small, yellow and arranged in umbellate cymes. Fruits are slender and follicles are upto 7.5cm long (Warrier *et al*, 1995).

Two allied species, *G. hirsutum* found in Bundelkh and Bihar and Western Ghats and *G. montanum* growing wild in Eastern Ghats and Konkan are also used for the same purpose and are also called "*Gurmar*" (Thakur et al, 1989).

Agrotechnology

The plant can be propagated both by seeds and stem cuttings. Seedlings are to be raised in polybags. Pits of size 50cm cube are to be taken, filled with 10kg dried cowdung or FYM and covered with topsoil. On these pits about 3-4 months old seedlings are to be transplanted from polybags. Trailing can be facilitated by erecting poles and tying the plants to the poles. The plant will attain good spread within one year. Regular weeding, irrigation and organic manure application are beneficial. The plant is not attacked by any serious pests or diseases. Leaves can be collected from the first year onwards at an internal of one week. This can be continued for 10-12 years. Fresh or dried leaves can be marketed (Prasad *et al*, 1997).

Properties and Activity

Nonacosane and hentriacontane were isolated from the hexane extract of leaves. An attempt to isolate nitrogenous compounds led to the isolation of amino acids such as leucine, iso-leucine, valine, allanine and γ- amynobutyric acid. Isolation of trimethyl amine oxide was of particular interest. An alkaloid gynamine which is a trace constituent was isolated and identified (Sinsheimer *et al*, 1967). Antisweet constituent of the leaves has been found to be a

mixture of triterpene saponins. These have been designated as gymnemic acids A,B,C and D which have the gymnemagenin and gymnestrogenins as the aglycones of gymnemic acid A and B and gymnemic acid C and D respectively. These are hexahydroxy triterpenes the latter being partially acylated. The sugar residues are glucuronic acid and galacturonic acid while ferulic and angelic acids have been attached as the carboxylic acid.

Chewing of leaves reduces sensitivity to sweet substances. Effects of gymnema extracts had been variable. While verifying the effect of *G. sylvestre* leaves on detoxification of snake venom, it has been reported that a toxic component of venom ATP and gymnemate bind at the same site inhibiting venom ATP-ase. The active principles which have been identified as glycosides (7 gymnemic acids) suggest that the topical and selective anaesthetic effect of the plant might result from the competition of the receptor sites between glycosides and the sweet substances (Warren *et al*, 1969). The leaves are antidiabetic and insulinotropic. Gymnemic acid is antiviral. The plant is bitter, astringent, acrid, thermogenic, antiinflammatory, anodyne, digestive, liver tonic, emetic, diuretic, stomachic, stimulant, anthelmintic, alexipharmic, laxative, cardiotonic, expectorant, antipyretic and uterine tonic.

INDIAN SENNA *Cassia senna*

Caesalpiniaceae

San: Svarnapatri; Hin: Sanay, Sana Ka Patt; Ben: Sonamukhi; Mal: Sunnamukki, Chonnamukki, Nilavaka; Tam: Nilavirai, Nilavakai; Tel: Netatangedu

Importance

Indian Senna or **Tinnevelly senna** is a shrub very highly esteemed in India for its medicinal value. The leaves are useful in constipation, abdominal disorders, leprosy, skin diseases, leucoderma, splenomegaly, hepatopathy, jaundice, helminthiasis, dyspepsia, cough, bronchitis, typhoid fever, anaemia, tumours and vitiated conditions of *pitta* and *vata* (Warrier *et al*,1994). It is used in Ayurvedic preparations; "*Pancha Sakara Churna*", "*Shat Sakara Churna*" and "*Madhu Yastyadi Churna*" used for constipation. Its use is widespread in Unani system and some of the important products of this system containing senna are "*Itrifal Mulayyin*", "*Jawarish Ood Mulayyin*", "*Hab Shabyar*", "*Sufuf Mulliyin*", "*Sharbat Ahmad Shahi*", etc. used as a mild laxative (Thakur *et al*, 1989).

Distribution

The plant is of Mediterranean origin. It is found in Somalia, Saudi Arabia, parts of Pakistan and Kutch area of Gujarat. It is largely cultivated in Tirunelveli, Ramanathapuram, Madurai and Salem districts of Tamil Nadu.

Botany

The genus *Cassia*, belonging to the family *Caesalpiniaceae*, comprises of a number of species, namely,

C. senna Linn. syn. *C. angustifolia* Vahl.
C. absus Linn.
C. alata Linn.
C. auriculata Linn.
C. burmanni Wight. syn. *C. obovata* (Linn.) Collad.
C. glauca Lam.
C. javanica Linn.
C. mimosoides Linn.
C. obtusifolia Linn. syn. *C. tora* Linn.
C. occidentalis Linn.
C. pumila Lam.
C. slamea Lam.
C. acutifolia Delile.
C. sophera Linn.

C. senna is a shrub or undershrub, 60-75cm in height with pale subterete or obtusely angled erect or spreading branches. Leaves are paripinnate. Leaflets are 5-8 in number, ovate-lanceolate and glabrous. Flowers are yellowish, many and arranged in axillary racemes. Fruits are flat legumes, greenish brown to dark brown and nearly smooth (Chopra *et al*,1980, Warrier *et al*,1994).

In commerce, the leaves and pods obtained from *C. senna* are known as " *Tinnevelly Senna*" and those from *C. acutifolia* Delile. as "*Alexandrian Senna*". The leaves of *C. acutifolia* are narrower than *C. senna*, otherwise both resemble to a large extent (Thakur *et al*, 1989). All the true Sennas have the portions of their leaves unequally divided. In some kinds the lower part of one side is reduced to little more than a line in breadth, while the other is from a quarter to half an inch in breadth. The drug known under the name of East Indian Senna is nearly free from adulteration; and as its properties appear identical with those of the Alexandrian and the price being less, it probably will supersede it in general practice. Its size and shape readily identify it (Graves, 1996).

Agrotechnology

The plant requires a mild subtropical climate with warm winters which are free from frost for its growth. Semiarid areas with adequate irrigation facilities are ideal for

cultivation. Areas having high rainfall, humidity and poor drainage are not suitable. Light or medium loamy soils with adequate drainage and pH varying from 7.0-8.2 are preferable. In South India both summer and winter crops are possible. The plant is propagated by seeds. The seed rate required is 15-20kg/ha. Seeds are sown in October-November (winter rainfed crop) or in February-March (irrigated crop). Higher seed rate is required for unirrigated crop. Seeds are sown in lines 30cm apart. Application of 5-10t of FYM/ha before planting or raising a green manure crop is beneficial. About 40kg N and 25-50kg P_2O_5/ha applied as basal dressing and 40kg N/ha applied in 2 split dozes as top dressing gave better yield. While the rainfed crop is grown without irrigation, the irrigated crop requires 5-8 light irrigations during the entire growing season. The crop requires 2-3 weedings and hoeings in order to keep it free from weeds. *Alternaria alternata* causes leaf spot and dieback but the disease is not serious. In North India, the plant is attacked by the larvae of butterfly *Catopsilia pyranthe* which can be controlled by planting the crop in March-April instead of June-July. Under irrigated conditions, the first crop is obtained after 90 days of planting. The leaves are stripped by hand when they are fully green, thick and bluish-green in colour. The second crop is taken 4 weeks after the first harvest and the third 4-6 weeks after the second one. The last harvest of leaves is done when the entire crop is harvested along with the pods. Yield under irrigated conditions is nearly1.4t of leaves and 150kg pods/ha and under unirrigated conditions is 500-600kg leaves and 80-100kg pods/ha. The leaves are dried in thin layers under shade so as to retain the green colour and the pods are hung for 10-12 days to get dried. The leaves and pods are cleaned, graded and marketed (Husain *et al*, 1993).

Properties and Activity

Leaves contain glucose, fructose, sucrose and pinnitol. Mucilage consists of galactose, arabinose, rhamnose and galacturonic acid. Leaves also contain sennoside-C(8,8'-diglucoside of rhein-aloe-emodin-dianthrone). Pods contain sennosides A and B, glycoside of anthraquinones rhein and chrysophanic acid. Seeds contain β-sitosterol (Husain *et al*, 1992). Leaves and pods also contain 0.33% β-sterol and flavonols-kaempferol, kaempferin, and iso-rhamnetin. Sennoside content of *C. acutifolia* is higher ranging from 2.5% to 4.5% as compared to *C. angustifolia* ranging from 1.5 % to 2.5%.

The purgative activity of Senna is attributed to its sennosides. The pods cause lesser griping than the leaves. Leaf and pod is laxative. The leaves are astringent, bitter, sweet, acrid, thermogenic, cathartic, depurative, liver tonic, anthelmintic, cholagogue, expectorant and febrifuge.

NAGADANTI Baliospermum montanum Euphorbiaceae

San: Danti; Hin: Danti; Mal: Danti, Nagadanti; Tam: Nakatanti; Tel: Nelajidi

Importance

Danti or *Nagadanti* is a stout undershrub with numerous flowers. Root, which is the officinal part, is used in abdominal pain, constipation, calculus, general anasarca, piles, helminthic manifestations, scabies, skin disorders, suppurative ulcers and diseases caused by the morbidity of *kapha* and *pitta*. Root paste is applied to painful swellings and piles. Leaves cure asthma and seeds are used in snakebite (Kurup *et al*, 1979; Sharma, 1983). The drug forms an important constituent of preparations like *Dantyarishta, Dantiharitakileham, Kaisoraguggulu gulika*, etc.(Sivarajan *et al*, 1994).

Distribution

The plant is found throughout the sub-Himalayan tracts from Kashmir to Khasi Hills. It is common in West Bengal, Bihar and Central and Peninsular India.

Botany

Baliospermum montanum (Willd.) Muell-Arg. syn. *B. axillare* Bl., *B. polyandrum* Wt. belongs to the family *Euphrobiaceae*. It is a stout under-shrub 0.9-1.8m in height with herbaceous branches from the roots. Leaves are simple, sinuate-toothed, upper ones small, lower ones large and sometimes palmately 3-5 lobed. Flowers are numerous, arranged in axillary racemes with male flowers above and a few females below. Fruits are capsules, 8-13mm long and obovoid. Seeds are ellipsoid smooth and mottled (Warrier *et al*,1993).

Agrotechnology

The tropical plant is suited to almost all soils. It can be cultivated either as pure crop or intercrop. It is propagated vegetatively by cuttings. About 15-20cm long rooted cuttings are used for planting. Pits of size 50cm cube are to be taken at 3m spacing and filled with dried cowdung, sand and top soil and formed into a mound. On these mounds, rooted cuttings are to be planted at 2 cuttings/mound. Cuttings establish within one month. Weeding is to be carried out at this time. Application of organic manure after every 6 months is beneficial. Irrigation during summer months is preferable. The plant is not attacked by any serious pests or diseases. Roots can be collected at the end of second year. The roots are to be cut and dried in sun before marketing. The yield is about one tonne root/ha (Prasad *et al*,1997).

Properties and Activity

Roots contain diterpenes, baliospermin, montanin, phorbol-12-deoxy-13-O-palmitate, phorbol-12-deoxy-16-hydroxy-13-O-palmitate and phorbol-12-deoxy-5β-hydroxy-13 – myristate (Ogura *et al*, 1978). Alcoholic extract of plant showed hypotensive activity in experimental animals (Bhakuni *et al*, 1971). Antilukaemic and cytotoxic activities have been demonstrated in the esters of both 12-deoxyphorbol and 12-deoxy-16-hydroxyphorbol, isolated from B. montanum (King-horn, 1979). The roots are acrid, thermogenic, purgative, antiinflammatory, anodyne, digestive, anthelmintic, diuretic, diaphoretic, rubefacient, febrifuge and tonic. Seed is purgative, stimulant, rubefacient and antidote for snakebite. Seed oil is antirheumatic. Leaf is antiasthmatic and wound healing. Root and seed oil is cathartic and antidropsical. Stem is anti-dontalgic.

PURGING CROTON *Croton tiglium* *Euphorbiaceae*

San: Jepalah, Dantibijah Hin: Jamalgota Ben: Jaypal Mal: Nirvalam
Tam: Nervalam, Sevalamkottai Tel: Nepala

Importance

Purging croton or **croton oil plant**, a small evergreen tree with separate male and female flowers, is one among the seven poisons described in Ayurveda. The drug is well known for its drastic purgative property. The drug is found to be useful in ascites, anasarca, cold, cough, asthma, constipation, calculus, dropsy, fever and enlargement of the abdominal viscera. The seed paste is a good application for skin diseases, painful swellings and alopacia. The seed-oil is useful in chronic bronchitis, laryngeal affections, arthritis and lock jaw. Misraka-sneham is an important preparation using the drug (Nadkarni, 1954; Dey, 1980; Sharma, 1983).

Distribution

It is distributed throughout North India. It is cultivated in Assam, West Bengal and South India.

Botany

Croton tiglium Linn. belongs to the family *Euphorbiaceae*. It is a small evergreen tree, 4.5-6.0m in height with ash coloured smooth bark and young shoots sprinkled with stellate hairs. Leaves are oblong to ovate-lanceolate, obtuse or rounded at the 2-glanded box, acuminate, membraneous, yellowish green and minutely toothed. Flowers are small, unisexual, males on slender pedicels, females larger and on short thick pedicels. Fruits are ovoid or oblong trigonous capsules. Seeds are smooth, testa black and enclosing reddish brown oily endosperm (Warrier *et al*,1994). Other species belonging to the genus *Croton* are as follows:

C. aromaticus Linn.
C. caudatus Geisel
C. jouera Roxb.
C. malabaricus Bedd.
C. oblongifolius Roxb.
C. polyandrus Roxb. syn. *Baliospermum montanum* Muell-Arg.
C. reticulatus(Chopra *et al*, 1980)

Agrotechnology

The plant is propagated by seeds. Seeds are to be sown on seedbeds and about 2 months old seedlings are used for transplanting. Pits of size 50cm cube are to be taken at 3m spacing and filled with dried cowdung, sand and topsoil and formed into a mound. The seedlings are to be planted on these mounds. Irrigation during summer months is beneficial. Application of organic manure after every 6 months is desirable. Weeding is to be carried out one month after transplanting. The plant is not attacked by any serious pests or diseases. Fruits are formed at the end of first year. Fruits when ripen and start to crack are to be collected, dried in sun, then the outer shell is removed and again dried for one day before marketing (Prasad *et al*,1997).

Properties and activity

Oil contains phorbol myristate acetate (Husain *et al*, 1992). Seeds contain upto 20% protein and 30-50% lipids. Iso-guanine-D-ribose (crotoniside) and saccharose were isolated from the seeds. In fractionation of croton oil, liquid-liquid distribution procedures proved to be the separation tools of choice. The per hydrogenated parent hydrocarbon of phorbol is a perhydrocyclopropabenzulene called tigliane and phorbol is 1, 1aα, 1bβ, 4, 4a, 7aα, 7b, 8, 9, 9a-decahydro-4aβ, 7α, 9β, 9aα-tetrahydroxy-3-(hydroxymethyl)-1, 1, 6, 8α tetramethyl-5-H-cyclopropa[3,4] benz [1.2-e]azulen-5-one. Phorbol, a tetracylic diterpene with a 5, 7, 6 and 3- membered ring has 6 oxygen functions. Phorbol accounts for 3.4% and 4- deoxy- 4α- phorbol for 0.29% of the weight of croton oil. Twenty-five phorbol-12, 13-diesters have been detected (Hecker *et al*, 1974). A toxin croton 1, mol. wt 72,000 has been isolated from the seeds (Lin *et al*, 1978).

Phorbol myristate acetate activates nitroblue tetrazolium reduction in human polymorphs. Seed and oil is purgative, rubefacient and anti-dote for snakebite. The seeds and oil are acrid, bitter, thermogenic, emollient, drastic purgative, digestive, carminative, anthelmintic, antiinflammatory, vermifuge, deterent, diaphoretic, expectorant, vesicant, irritant and rubefacient.

ALSTONIA *Alstonia venenata*

Apocynaceae

San: Visaghni, Anadana; Mal: Analivegam; Tam: Sinnappalai; Kan: Addasarpa

Importance

Alstonia is a large shrub with straight bole and growing upto about 6m height. The roots are useful in skin diseases, erysipelas, leprosy, cobra bite and other venomous bites, epilepsy, fatigue, fever and otalgia. The fruits are useful in syphilis, insanity and epilepsy. The plant is believed to repel snakes.

Distribution

The plant is distributed throughout India in deciduous forests in areas up to 1800m elevation.

Botany

Alstonia venenata R.Br., belonging to the family *Apocynaceae*, is a large shrub to small tree up to 6m in height with greyish brown bark and bright yellow hard and woody root. Leaves are simple, arranged in whorls of 3-6, membranous, lanceolate, margins wavy, finely acuminate, main nerves numerous, close, parallel and united by inter marginal nerve. Flowers are white, arranged in terminal sub umbellate cymes or in racemes. Fruits are fusiform with stalked and beaked follicles, tapering at both ends. Seeds are many flattened with a tuft of hair at each end (Warrier *et al*, 1993). Other important species belonging to the genus *Alstonia* are the following.

1. *A. scholaris* R. Br.

This tree is common throughout India. The bark is valuable in debility and after effects of fever, chronic diarrhoea, dysentery and catarrhal fever. The milky juice is applied to ulcers and rheumatic pains, mixed with oil and dropped into ear to relieve earache. Ditanin is the active principle of the bark, possessing powerful febrifuge properties. The bark is astringent, tonic and febrifuge (Nadkarni, 1998).

2. *A. spectabilis* R. Br.

It is a large evergreen tree seen in tropical forests of Andamans. The bark contains alkaloids such as alstonamine, ditamine, echitamine and echitenine (Chopra *et al*,1980)

Agrotechnology

The plant is propagated mainly by seeds. Seeds are to be sown on seedbeds and germinated ones are to be transferred to polybags. About three months old seedlings are used for transplanting. If seeds are not available, thin stem cuttings can be planted in polybags and rooted cuttings used. Pits of size 60cm cube are to be taken at 3m spacing, filled with dried cowdung, sand and topsoil and made into a mound. To this mounds seedlings from polybags are to be transplanted. Irrigation is essential during early stages of growth. Application of organic manure every year is beneficial. Regular weeding is to be done. The plant is not attacked by any serious pests or diseases. Flowers are formed in the first year itself. It can be used for medicinal purposes after seven years of growth. Fruits and roots are the economical parts (Prasad *et al*,1997).

Properties and Activity

The plant is a rich source of indole alkaloids. Alkaloids are present in various parts. Stem bark and root contain venenatine, alstovenine, 3-dehydroalstovenine and reserpine. Stem bark contains venoxidine (venenatine N_b-oxide), anhydroalstonatine, kopsinine, venalstonine, venalstonidine(venalstonine-6,7-epoxide), echitovenine and veneserpine. Fruits contain echitovenidine, (+)minovincinine, echitoserpidine, echitoserpine, echitoveniline, 11-methoxy echitovonidine, 11-methoxy (-) minovinicinine, echitoserpiline, (-)vincadifformine, 11-methoxy(-)vincadifformine and venoterpine. Leaves contain echitovenaldine, echitoveniline, alstolenine, deacetylakuammiline, polynuridine, dihydropolynuridine and raucaffrininoline. The yellow tint in bark is because of the presence of Δ^3-alstovenine. A number of indole alkaloids have been further isolated from the plant. In addition to alkaloids fruits contain β-amyrin acetate and lupeol ester of β-hydroxy acid (Husain *et al*,1992).

The root is bitter, astringent, thermogenic, depurative, antitoxic, febrifuge and anodyne. The alkaloid alstovenine in lower doses exhibited monoamine oxidase inhibitor activity, while in higher doses it showed marked central stimulant effect. Veninatine exhibited reserpine like activity. Alcoholic extract of the fruits showed initial activation effect on acetylcholine esterase, followed alternately by inhibition and activation of the enzyme.

HOLOSTEMMA *Holostemma ada-kodien* *Asclepiadaceae*

San: Jivanti; Hin: Chirvel, Charivel; Mal: Atapathiyan, Atapotiyan, Atakotiyan; Tam: Palaikkirai; Tel: Palagurugu; Mar: Dudurli, Shidodi; Guj: Kharner, Khiravel

Importance

Holostemma is a twining shrub with large flowers. The roots of Holostemma are useful in ophthalmopathy, orchitis, cough, burning sensation, stomachalgia, constipation, fever and *tridoshas*. The leaves, flowers and fruits are eaten as vegetable. The root is also used in spermatorrhoea. It is used in preparations of *Vidaryadiganam, Dhanwandharam thaila, Manasamithravatakam, Balarishta* and *Anuthaila*. It is also useful in eye diseases and it imparts resistance to diseases.

Distribution

The plant occurs in tropical countries. In India, it is found in Himalayas, Dehradun, Konkan, Bombay, Deccan, Karnataka, Kerala and Tamilnadu. It grows over hedges and in open forests especially on the lower slopes of the hills. It is also distributed in Sri Lanka, Burma and W. China.

Botany

Holostemma ada-kodien Schult. syn. *Holostemma annulare* (Roxb.) K. Schum., *Holostemma rheedii* Wall. belongs to the family *Asclepiadaceae*. It is a laticiferous twining shrub with large conspicuous flowers. Leaves are simple, opposite and cordate. Flowers are purple, arranged in axillary umbellate cymes. Fruits are thick follicles, 9 cm long, cylindrical and bluntly pointed. The roots are long upto 1 m or more, irregularly twisted, thick and cylindrical. When dry it is yellowish brown to brown black in colour with nearly smooth surface bearing white scars and small depressions. A mature root is about 1-2 cm thick when extracted for use (Warrier *et al*, 1995).

Agrotechnology

Holostemma prefers a tropical climate. The plant is propagated vegetatively by stem cuttings, but mainly by seeds. The seeds are collected from the plant in November-December before being dispersed. Seeds are cleaned, dried and stored for sowing. The stored seeds after soaking in water for 4-5 hours are sown in the seedbeds. About one month old seedlings are then planted in polybags of size 14x10cm which are filled with soil, sand and dried cowdung in 1:1:1 ratio, respectively. Polybags should be kept in shade and irrigated. About 1-1.5 month old seedlings are ready for transplanting. Pits of 30cm cube size are taken at 1-1.2m distance and filled with 10kg dried cowdung and sand. This is covered with surface soil and formed into a mound. Seedlings are transplanted on to the mounds from the polybags carefully. Regular irrigation is to be given till flowering. To aid in trailing, staking is given one month after planting. Flowering and fruiting occurs in November-December. Harvesting can be done at the end of second year when the vines start drying up. Harvesting is done by digging up the tubers. The tubers are cut into pieces of 10cm length and dried in sun before sale (Prasad *et al*, 1997).

Properties and activity

Holostemma tubers give α-amyrin, lupeol and β-sitosterol. Alanine, aspartic acid, glycine, serine, threonine and valine were detected chromatographically (Hussain *et al*, 1992). The root is antidiabetic, antigonorrhoeic, bechic, alterative, tonic, lactative, ophthalmic, emollient, stimulant, aphrodisiac, expectorant and galactagogue.

ASHOKA *Saraca asoca*

Caesalpiniaceae

San:Asoka, Gatasokah; Hin:Asok, Asoka; Ben:Ashok; Mal:Asokam; Tam: Asogam; Kan:Asokada, Aksunkara; Tel: Asokamu, Vanjalamu

Importance

Ashoka, the sacred tree of Hindus and Buddhists, possesses varied medicinal uses. The bark is useful in dyspepsia, fever, dipsia, burning sensation, visceromegaly, colic, ulcers, menorrhagia, metropathy, leucorrhoea and pimples. The leaf juice mixed with cumin seeds is used for treating stomachalagia. The floweres are considered to be uterine tonic and are used in vitiated conditions of *pitta*, syphilis, cervical adinitis, hyperdipsia, burning sensation, haemorrhoids, dysentery, scabies in children and inflammation. The well-known Ayurvedic preparations are "*Ashokarishta*" and "*Ashokaghrita*". *Ashokarishta* is prescribed in leucorrhoea, haematuria, menorrhagia and other diseases of genitourinary system of females.

Distribution

Ashoka is found almost throughout India, except North-Western India, upto 750m. It is also found in the Andaman Islands.

Botany

Saraca asoca (Roxb.) de Wilde. syn. *S. indica* auct. non Linn. is a medium sized evergreen tree growing upto 9m height with numerous spreading and drooping glabrous branches. Leaves are pinnate, 30-60cm long having 2-3 pairs of lanceolate leaflets. Flowers are orange or orange yellow, arranged in dense corymbs and very fragrant. Fruits are flat black pods, leathery and compressed with 4-8 seeds/pod. Seeds are ellipsoid oblong and compressed. The bark is dark brown to grey or black with a warty surface. The thickness varies from 5mm to 10mm. The entire cut surface turns reddish on exposure to air. *Polyalthia longifolia* (*Annonaceae*) is equated with the name *Asoka* by some (Kapoor & Mitra, 1979; Chunekar, 1982) and is often used as an adulterant of the genuine *Asoka* bark or as a substitute (Warrier *et al*,1996).

Agrotechnology

Asoka grows well in areas with well distributed rainfall and in slightly shady areas. *Asoka* requires soil rich in organic mater and moisture. The best season of planting is June-July. It is also grown in summer, if irrigation facilities are available. The plant is seed propagated. Seeds are formed usually during February-April. Seeds are collected when they are ripen and fall down and are sown after soaking in water for 12 hours on the prepared beds. Seeds germinate within 20 days. The seeds are then planted in polybags. 2-month-old seedlings from the polybags are used for transplanting. Square shaped pits of 60cm depth are taken at 3m spacing and filled with topsoil, sand and dried cowdung. On this the seedlings are planted. Application of FYM at 10kg/tree/year is highly beneficial. Chemical fertilisers are not usually applied. Irrigation during summer months is essential. No serious pests or diseases are generally noted in this crop. If properly cultivated, *Asoka* can be cut after 20 years and the bark collected. It is cut at a height of 15cm from the soil level. If given irrigation and fertilisers, the cut wood will sprout again and harvested again after 5 years. This can be continued. When it is difficult to cut the tree, the bark can be peeled off from one side first. When the bark grows and cover that part, the other side can be peeled off. This is also continued (Prasad *et al*, 1997; Karshakasree, 1998).

Properties and Activity

Flowers give β-sitosterol, flavonoids and flavone glycosides-quercetin, kaempferol-3-O-β-D-glucoside, quercetin-3-O-β-D-glucoside. The anthocyanins present are pelargonidin-3, 5-diglucoside and cyanadin-3, 5-diglucoside. Bark yields catechol and sterols-(24ζ)-24-methyl cholest-5-en-3β-ol, (22E, 24ζ)-24-ethylcholesta-5, 22-dien-3 β-ol and (24ζ)-24-ethyl cholest-5-en-3β-ol, a wax containing n-alkanes, esters and free primary alcohols. Alcoholic extract and glycoside P_2 from stem bark is oxytoxic. Aerial part is CNS active, hypothermic, CNS depressant and diuretic. Stem bark is anticancerous, has spasmodic action on rabbit intestine and cardiotonic action in frog and dog. Seed is antifungal. Stem bark is astringent, antileucorrhoeic, antibilious and uterine sedative. Flower is uterine tonic, antidiabetic and antisyphilitic. Stem bark and flower is antibilious (Husain *et al*, 1992).

GARDEN RUE *Ruta chalepensis*

Rutaceae

San: Gucchapatra; Hin: Pismaram, Sadab, Satari; Ben: Ermul; Mal: Aruta, Nagatali; Tam: Aruvadam, Arvada; Kan: Sadabu, Nagadali; soppu, Simesdanu; Tel: Sadapa, Aruda

Importance

Common rue or **Garden rue** also known as **Herb of Grace** due to its service in the Roman Catholic Church for sprinkling the holy water among the congregation, is an aromatic perennial herb. The plant is useful in vitiated conditions of *kapha* and *vata*, strangury, fever, flatulence, colic, amenorrhoea, epilepsy and hysteria. The oil acts as a stimulant for uterine and nervous systems. The fresh leaves are used for rheumatalgia. The juice obtained from the leaves is given to children for helminthic infections and is good for odontalgia and otalgia (Warrier *et al*, 1996). The dried leaves, powdered and combined with aromatics, are given as a remedy for dyspepsia and with the fresh leaves a tincture is made which is used as an external remedy in the first stages of paralysis (Nadkarni, 1998).

Distribution

The plant is a native of South Europe and it is found in subtropical countries. It is commonly cultivated in Indian gardens.

Botany

Ruta chalepensis Linn.syn. *R. graveolens* Linn. var. *angustifolia* Sensu Hook. f. belongs to the family *Rutaceae*. It is an aromatic perennial herb growing upto 75cm height. Leaves are compound, shortly petiolate with ultimate segments oblong or obovate-oblong. Flowers are yellow. Fruits are capsules and shortly pedicelled (Warrier *et al*, 1996).

Agrotechnology

The plant is suited to areas which are about 1000m above mean sea level and with moderate rainfall and sunlight. The plant can be propagated either by seeds or stem cuttings. Seeds are to be sown in seedbeds. Stem cuttings of length 20-25cm are to be planted in polybags for rooting. About 3-4 months old seedlings can be transplanted to pots and harvested when plants attain 6-8 months age. In highlands land is to be ploughed to a fine tilth, mixed with organic manure and seedlings are to be transplanted at a spacing of 45cm between plants. Irrigation is essential during summer months. Regular weeding is to be done. The plant is not attacked by any serious pests and diseases. Harvesting commences from sixth month onwards. The economic part is the whole plant and the oil extracted from it (Prasad *et al*, 1997).

Properties and Activity

Roots contain coumarins-xanthyletin and (-)-byakangelicin. The alkaloids are rutacridone-epoxide, gravacridonol and its monomethyl ether, gravacridonchlorine, furacridone, 1-hydroxy-3-methoxy-N-methylacridone, iso-gravacridonechlorine, dictamine, r-fragarine and skimmianine. Skimmianine is also present in leaves and stem. Leaves and stem also contain graveolinine (1-methyl-2(3',4'-methylenedioxyphenol)-4-methoxy-quinoline). Aerial parts give coumarins bergapten, xanthotoxin and psoralen. Coumarin-imperatin has also been reported from the plant. Herb contains alkaloids such as kokusagenine, rutamine(methylgraveoline) and graveoline(1-methyl-2(3',4'-methylenedioxyphenyl)-4-quinoline). Tissue culture of the plant gives furacridone alkaloids-1-hydroxyrutacridone-epoxide, rutagravin and gravacridonol. Gravacridondiol and its glucoside have been obtained from the root tissue culture. The essential oil from leaves, stem and root yielded aliphatic ketones including 2-nonanone (10-35%), undecyl-2-acetate (0.5-15%), 2-nonyl acetate (trace-10%), nonylacetate, nonanol, 2-nonylpropionate, 2-nonylpropionate, 2-undecanol and its esters. The oil from roots gave pregeijerene also.

The plant is spasmolytic which is due to the presence of bergapten, xanthotoxin, the essential oil and a coumarin. It is also antispasmodic, emmenagogue, irritant, abortifacient and anti-bacterial. Leaf is analgesic, antirheumatic, antihysteric and anthelmintic (Husain *et al*, 1992).

GREEN CHIRETTA Andrographis paniculata Acanthaceae

San: Bhunimbah, Kiratatiktah Hin: Kakamegh, Kalpanath Ben: Kalmegh
Mal: Nilaveppu, Kiriyattu Tam: Nilavempu Kan: Kreata

Importance

Kalmegh, the Great or **Green Chiretta** is a branched annual herb. It is useful in hyperdipsia, burning sensation, wounds, ulcers, chronic fever, malarial and intermittent fevers, inflammations, cough, bronchitis, skin diseases, leprosy, pruritis, intestinal worms, dyspepsia, flatulence, colic, diarrhoea, dysentery, haemorrhoids and vitiated conditions of *pitta* (Warrier *et al*, 1993). It is used to overcome *sannipata* type of fever, difficulty in breathing, hemopathy due to the morbidity of *kapha* and *pitta*, burning sensation, cough, oedema, thirst, skin diseases, fever, ulcer and worms. It is also useful in acidity and liver complaints (Aiyer and Kolammal, 1962). The important preparations using the drug are *Tiktakagheta, Gorocandi gulika, Candanasava, Panchatiktam kasaya*, etc. (Sivarajan *et al*, 1994). A preparation called "*Alui*" is prepared by mixing powdered cumin (*Cuminium cyminum*) and large cardamom (*Amomum subulatum*) in the juice of this plant and administered for the treatment of malaria (Thakur *et al*, 1989). It is also a rich source of minerals.

Distribution

The plant is distributed throughout the tropics. It is found in the plains of India from U.P to Assam, M.P., A.P, Tamil Nadu and Kerala, also cultivated in gardens.

Botany

Andrographis paniculata (Burm.f.) Wall ex. Nees belongs to the family *Acanthaceae*. It is an erect branched annual herb, 0.3-0.9m in height with quadrangular branches. Leaves are simple, lanceolate, acute at both ends, glabrous, with 4-6 pairs of main nerves. Flowers are small, pale but blotched and spotted with brown and purple distant in lax spreading axillary and terminal racemes or panicles. Calyx-lobes are glandular pubescent with anthers bearded at the base. Fruits are linear capsules and acute at both ends. Seeds are numerous, yellowish brown and sub-quadrate (Warrier *et al*,1993).

Another species of Andrographis is *A. echioides* (Linn.) Nees. It is found in the warmer parts of India. The plant is a febrifuge and diuretic. It contains flavone-echiodinin and its glucoside-echioidin (Husain *et al*, 1992).

Agrotechnology

The best season of planting Andrographis is May-June. The field is to be ploughed well, mixed with compost or dried cowdung and seedbeds of length 3m, breadth 1/2m and 15cm height are to be taken at a distance of 3m. The plant is seed propagated. Seeds are to be soaked in water for 6 hours before sowing. Sowing is to be done at a spacing of 20cm. Seeds may germinate within 15-20 days. Two weedings, first at one month after planting and the second at 2 month after planting are to be carried out. Irrigation during summer months is beneficial. The plant is not attacked by any serious pests or diseases. Flowering commences from third month onwards. At this stage, plant are to be collected, tied into small bundles and sun-dried for 4-5 days. Whole plant is the economic part and the yield is about 1.25t dried plants/ha (Prasad *et al*, 1997).

Properties and Activity

Leaves contain two bitter substances lactone "andrographolid" and "kalmeghin". The ash contains sodium chloride and potassium salts. Plant is very rich in chlorophyte. Kalmeghin is the active principle that contains 0.6% alkaloid of the crude plant. The plant contains diterpenoids, andrographolide, 14-deoxy-11-oxo-andrographolide, 14-deoxy-11,12-dihydroandrographolide, 14-deoxy andrographolide and neoandrographolide (Allison *et al*, 1968). The roots give flavones-apigenin-7,4-dio-O-methyl ether, 5-hydroxy-7,8,2',3'-tetramethoxyflavone, andrographin and panicolin and α-sitosterol (Ali *et al*, 1972;

Govindachari *et al*, 1969). Leaves contain homoandrographolide, andrographosterol and andrographone.

The plant is vulnerary, antipyretic, antiperiodic, anti-inflammatory, expectorant, depurative, sudorific, anthelmintic, digestive, stomachic, tonic, febrifuge and cholagogue. The plant is antifungal, antityphoid, hepatoprotective, antidiabetic and cholinergic. Shoot is antibacterial and leaf is hypotensive(Garcia *et al*, 1980). This is used for the inflammation of the respiratory tract. In China, researchers have isolated the andrographolide from which soluble derivative such as 14-deoxy-11, 12-dehydro-andrographolide which forms the subject of current pharmacological and clinical studies. Apigenin 7,4'-O-dimethyl ether isolated from *A. paniculata* exhibits dose dependent, antiulcer activity in shay rat, histamine induced ulcer in guinea pigs and aspirin induced ulcers in rats. A crude substance isolated from methanolic extract of leaves has shown hypotensive activity. Pre-treatment of rats with leaf (500mg/kg) or andrographolide (5mg/kg) orally prevented the carbon tetrachloride induced increase of blood serum levels of glutamate-oxaloacetate transaminase in liver and prevented hepatocellular membrane.

WORM KILLER Aristolochia bracteolata Aristolochiaceae

San: Kitamari Hin: Kiramar, Kitamar Mal: Attuthottappala, Atuthinnappala Tam: Atutinnappalai

Importance

The **bracteated birthwort** or **worm killer** is a perennial prostrate herb. As the name suggests it is a killer of intestinal worms especially roundworms. It is also used in vitiated conditions of *kapha* and *vata*, constipation, inflammations, amenorrhoea, dysmenorrhoea, foul ulcers, boils, syphilis, gonorrhoea, dyspepsia, colic, skin diseases, eczema, artheralgia and intermittent fevers. The plant is an insect repellent due to the presence of aristolochic acid, which is poisonous to man and livestock. Plant is also used against scorpion sting. Seeds ground in water to form a lotion and used for softening hair. Powdered root is used in fertility control.

Distribution

The plant is found in Sri Lanka, Arabian countries and tropical Africa. In India, the plant is grown in Deccan and Carnatic Plateau.

Botany

Aristolochia bracteolata Lam. syn. *A. bracteata* Retz. belongs to the family *Aristolochiaceae*. It is a perennial prostrate herb with weak, glabrous stems. Leaves are simple, alternate, reniform or broadly ovate, cordate at the base with a wide sinus upto 7.5cm in diameter, reticulately veined. Flowers are solitary with a large sessile orbicular bract at the base. Perianth tube is cylindric with dark purple tip having revolute margins. Fruits are oblong-ellipsoid 12-ribbed glabrous capsules. Seeds are deltoid with slightly cordate base (Warrier *et al*, 1993)

Another important species belonging to the genus *Aristolochia* is *A. indica* Linn. The plant grows wild throughout the low hills and plains of India from Nepal to West Bengal and South India. It is a valuable anti-dote to snake bite and to bites of poisonous insects as scorpion, etc. It is given in cases of cholera and diarrhoea after macerating with black pepper corns. The juice of the leaves has stimulant, tonic and antiperiodic properties.

Agrotechnology

Shady areas and well-drained soils are most suited to *Aristolochia*. The plant can be seed propagated. 3-month-old seedlings raised in polybags are required for transplanting. Pits of size 50cm cube are to be taken at a distance of 3m and filled with sand, topsoil and dried cowdung. To these pits, the seedlings are to be transplanted. Regular irrigation and organic manure application is beneficial. The plant is to be trailed on iron wires tied to poles. The plant is not attacked by any serious pests or diseases. Plant attains good spread within one year. Leaves can be collected for the next 10 years. Roots and leaves constitute the economic parts (Prasad *et al*, 1997).

Properties and Activity

Leaves and fruits yield ceryl alcohol, β-sitosterol and aristolochic acid. Root contains aristolochic acid. Seeds give an alkaloid magnoflorine, aristolochic acid, fatty oil comprising palmitic, stearic, lignoseric and oleic acids and β-sitosterol.

The plant is anthelmintic, cathartic, antiperiodic and emmenagogue. Leaf is antigonorrhoeic, larvicidal and used in eczema on children's leg and ulcers. The plant is oxytocic (Husain *et al*,1992).

FICUS *Ficus spp.*

Moraceae

The genus *Ficus* constitutes an important group of trees with immense medicinal value. It is a sacred tree of Hindus and Buddhists. Among the varied number of species, the most important ones are the four trees that constitute the group "*Nalpamaram*", namely, *F .racemosa, F. microcarpa, F. benghalensis and F. religiosa* (*Athi, Ithi, Peral and Arayal* respectively).

1. *Ficus racemosa* Linn. syn. *F. glomerata* Roxb.

Eng: Cluster fig, Country fig San: Udumbarah, Sadaphalah Hin: Gular, Umar Ben: Jagya dumur Mal, Tam, Kan: Athi Tel: Udambaramu, Paidi

Gular fig, Cluster fig or Country fig, which is considered sacred, has golden coloured exudate and black bark. It is distributed all over India. Its roots are useful in treating dysentery. The bark is useful as a wash for wounds, highly efficacious in threatened abortions and recommended in uropathy. Powdered leaves mixed with honey are given in vitiated condition of *pitta*. A decoction of the leaves is a good wash for wounds and ulcers. Tender fruits (figs) are used in vitiated conditions of *pitta*, diarrhoea, dyspepsia and haemorrhages. The latex is administered in haemorrhoids and diarrhoea (Warrier *et al*, 1995). The ripe fruits are sweet, cooling and are used in haemoptysis, thirst and vomiting (Nadkarni, 1954; Aiyer *et al*, 1957; Moos, 1976). *Nalpamaradi coconut oil, Candanasava, Valiya Arimedastaila, Dinesavalyadi Kuzhambu, Abhrabhasma, Valiya candanaditaila*, etc. are some important preparations using the drug (Sivarajan *et al*, 1994).

It is a moderate to large-sized spreading laticiferous, deciduous tree without many prominent aerial roots. Leaves are dark green and ovate or elliptic. Fruit receptacles are 2-5cm in diameter, sub-globose or pyriform arranged in large clusters on short leafless branches arising from main trunk or large branches. Figs are smooth or rarely covered with minute soft hairs. When ripe, they are orange, dull reddish or dark crimson. They have a pleasant smell resembling that of cedar apples. The bark is rusty brown with a fairly smooth and soft surface, the thickness varying from 0.5-2cm according to the age of the trunk or bark. Surface is with minute separating flakes of white tissue. Texture is homogeneously leathery (Warrier *et al*, 1995).

Stem-bark gives gluanol acetate, β-sitosterol, leucocyanidin-3-O-β-D-glucopyrancoside, leucopelargonidin-3-O-β-D-glucopyranoside, leucopelargonidin -3-O-α-L-rhamnopyranoside, lupeol, ceryl behenate, lupeol acetate and α-amyrin acetate. Stem- bark is hypoglycaemic and anti-protozoal. Gall is CVS active. Bark is tonic and used in rinder pest diseases of cattle. Root is antidysenteric and antidiabetic. Leaf is antibilious. Latex is antidiarrhoeal and used in piles. Bark and syconium is astringent and used in menorrhagia (Husain *et al*, 1992).

2. *Ficus microcarpa* Linn. f. syn. *F. retusa* auct. Non. Linn.

San: Plaksah; Hin, Ben: Kamarup; Mal: Ithi, Ithiyal; Tam: Kallicci, Icci; Kan: Itti; Tel: Plaksa

Plaksah is the Ficus species with few branches and many adventitious roots growing downward. It is widely distributed throughout India and in Sri Lanka, S. China, Ryuku Isles and Britain. *Plakasah* is one of the five ingredients of the group *panchvalkala i.e*, five barks, the decoction of which is extensively used to clear ulcers and a douche in leucorrhoea in children. This decoction is administered externally and internally with satisfactory results. *Plaksah* is acclaimed as cooling, astringent, and curative of *raktapitta doshas*, ulcers, skin diseases, burning sensation, inflammation and oedema. It is found to have good healing property and is used in preparation of oils and ointments for external application in the treatment of ulcers (Aiyer and Kolammal, 1957). The stem-bark is used to prepare *Usirasava, Gandhataila, Nalpamaradi taila, Valiya marmagulika*, etc. (Sivarajan et al, 1994). The bark and leaves are used in wounds, ulcers, bruises, flatulent colic, hepatopathy, diarrhoea, dysentery, diabetes, hyperdipsia, burning sensation, haemaorrhages, erysipelas, dropsy, ulcerative stomatitis, haemoptysis, psychopathy, leucorrhoea and coporrhagia (Warrier *et al*,1995)

F. microcarpa is a large glabrous evergreen tree with few aerial roots. Leaves are short-petioled, 5-10cm long, 2-6cm wide and apex shortly and bluntly apiculate or slightly emarginate. Main lateral nerves are not very prominent and stipules are lanceolate. Fruit receptacles are sessile and globose occurring in axillary pairs. It is yellowish when ripe without any characteristic smell. Bark is dark grey or brown with a smooth surface except for the lenticels. Outer bark is corky and crustaceous thin and firmly adherent to inner tissue. Inner bark is light and flesh coloured with firbrous texture (Warrier et al, 1995). It is also equated with many other species of the genus. *viz. F.*

infectoria Roxb., *F. arnottiana* Miq, *F. lacor* Buch-Ham and *F. talboti* King (cf. Nadkarni, 1954, Singh and Chunekar, 1972; Kapoor and Mitra, 1979; Sharma, 1983).

The bark contains tannin, wax and saponin. Bark is antibilious. Powdered leaves and bark is found very good in rheumatic headache. The bark and leaves are astringent, refrigerant, acrid and stomachic.

3. *Ficus benghalensis* Linn.

Eng: Banyan tree; San: Nyagrodhah, Vatah; Hin: Bat, Bargad; Ben: Bar, Bot; Mar: Vada; Mal: Peral, Vatavriksham; Tam: Alamaram, Peral; Kan: Ala; Tel: Peddamarri; Guj: Vad

Banyan tree is a laticiferous tree with reddish fruits, which is wound round by aerial adventitious roots that look like many legs. It is found in the Sub-Himalayan tract and Peninsular India. It is also grawn throughout India. It is widely used in treatment of skin diseases with pitta and rakta predominance. Stem-bark, root -bark, aerial roots, leaves, vegetative buds and milky exudate are used in medicine. It improves complexion, cures erysepelas, burning sensation and vaginal disorders, while an infusion of the bark cures dysentery, diarrhoea, leucorrhoea, menorrhagia, nervous disorders and reduces blood sugar in diabetes. A decoction of the vegetative buds in milk is beneficial in haemorrhages. A paste of the leaves is applied externally to abcesses and wounds to promote suppuration, while that of young aerial roots cure pimples. Young twigs when used as a tooth brush strengthen gum and teeth (Nadkarni, 1954; Aiyer and Kolammal, 1957; Mooss,1976). The drug forms an important constituent of formulations like *Nalpamaradi Coconut oil, Saribadyasava, Kumkumadi taila, Khadira gulika, Valiyacandanadi taila, Candanasava, etc*. (Sivarajan et al, 1994). The aerial roots are useful in obstinate vomiting and leucorrhoea and are used in osteomalacia of the limbs. The buds are useful in diarrhoea and dysentery. The latex is useful in neuralgia, rheumatism, lumbago, bruises, nasitis, ulorrhagia, ulitis, odontopathy, haemorrhoids, gonorrhoea, inflammations, cracks of the sole and skin diseases (Warrier *et al*, 1995).

It is a very large tree up to 30m in height with widely spreading branches bearing many aerial roots functioning as prop roots. Bark is greenish white. Leaves are simple, alternate, arranged often in clusters at the ends of branches. They are stipulate, 10-20cm long and 5-12.5cm broad, broadly elliptic to ovate, entire, coriaceous, strongly 3-7 ribbed from the base. The fruit receptacles are axillary, sessile, seen in pairs globose, brick red when ripe and enclosing male, female and gall flowers. Fruits are small, crustaceous, achenes, enclosed in the common fleshy receptacles. The young bark is somewhat smooth with longitudinal and transverse row of lenticels. In older bark, the lenticels are numerous and closely spaced; outer bark easily flakes off. The fresh cut surface is pink or flesh coloured and exudes plenty of latex. The inner most part of the bark adjoining the wood is nearly white and fibrous (Warrier *et al*, 1995).

The bark yields flavanoid compounds A, B and C; A and C are identified as different forms of a leucoanthocyanidin and compound B a leucoanthocyanin. All the 3 were effective as hypoglycaemic agents. Leaves give friedelin, β-sitosterol, flavonoids- quercetin-3-galactoside and rutin. Heart wood give tiglic acid ester of ψ taraxasterol. Bark is hypoglycemic, tonic, astringent, antidiarrhoeal and antidiabetic. Latex is antirheumatic. Seed is tonic. Leaf is diaphoretic. Root fibre is antigonorrhoeic. Aerial root is used in debility and anaemic dysentery (Husain *et al*, 1992).

.4. *Ficus religiosa* Linn.

Eng:Peepal tree, Sacred fig; San:Pippalah, Asvatthah; Hin:Pippal, Pipli, Pipar; Mal:Arayal Ben: Asvatha; Tam: Arasu, Asvattam; Kan: Aswatha; Tel: Ravi; Mar: Ashvata, Pimpala

Peepal tree or **Sacred fig** is a large deciduous tree with few or no aerial roots. It is common throughout India, often planted in the vicinity of the temples. An aqueous extract of the bark has an antibacterial activity against *Staphylococcus aureus* and *Escherichia coli*. It is used in the treatment of gonorrhoea, diarrhoea, dysentery, haemorrhoids and gastrohelcosis. A paste of the powdered bark is a good absorbent for inflammatory swellings. It is also good for burns. Leaves and tender shoots have purgative properties and are also recommended for wounds and skin diseases. Fruits are laxative and digestive. The dried fruit pulverized and taken in water cures asthma. Seeds are refrigerant and laxative. The latex is good for neuralgia, inflammations and haemorrhages (Warrier *et al*, 1995). Decoction of the bark if taken in honey subdues *vatarakta* (Nadkarni, 1954; Aiyer and Kolammal, 1957; Mooss, 1976; Kurup *et al*, 1979). The important preparations using the drug are *Nalpamaradi taila, Saribadyasava, Candanasava, Karnasulantaka, Valiyamarma gulika etc* (Sivarajan *et al*, 1994).

It is a large deciduous tree with few or no aerial roots. It is often epiphytic with the drooping branches bearing long petioled, ovate, cordate shiny leaves. Leaves are bright green, the apex produced into a linear-lanceolate tail about half as long as the main portion of the blade. The receptacles occurring in pairs and are axillary, depressed globose, smooth and purplish when ripe. The bark is grey or ash coloured with thin or membranous flakes and is often covered with crustose lichen patches. The outer bark is not of uniform thickness, the middle bark in sections appear as brownish or light reddish brown. The inner part consists of layers of light yellowish or orange brown granular tissue (Warrier *et al*, 1995).

Bark gives β-sitosterol and its glucoside. Bark is hypoglycaemic. Stem bark is antiprotozoal, anthelmintic and antiviral. Bark is astringent, antigonorrheic, febrifuge, aphrodisiac and antidysenteric. Syconium, leaf and young shoot is purgative (Husain *et al*, 1992).

Agrotechnology

Ficus species can be cultivated in rocky areas, unused lands, or other wastelands of the farmyard. The plant is vegetatively propagated by stem cuttings. A few species are also seed propagated. Stem cuttings of pencil thickness taken from the branches are to be kept for rooting. Rooted cuttings are to be transplanted to prepared pits. No regular manuring is required. Irrigation is not a must as a plant is hardy. The plant is not attacked by any serious pests or diseases. Bark can be collected after 15 years. *Ficus* species generally has an economic life span of more than hundred years. Hence bark can be regularly collected from the tree. Root, bark, leaves, fruits and latex form the economic parts (Prasad *et al*,1995).

WEST INDIAN MEDLAR *Mimusops elengi* *Sapotaceae*

San: Bakulah Hin: Bakul, Maulsiri Ben: Bakul Mal: Ilanji, Elanji **Tam: Magilam, Ilanci Tel: Pogada Kan: Pagademara Guj: Barsoli, Bolsari**

Importance

Spanish cherry, West Indian Medlar or **Bullet wood tree** is an evergreen tree with sweet-scented flowers having ancient glamour. Garlands made of its flowers are ever in good demand due to its long lasting scent. Its bark is used as a gargle for odontopathy, ulitis and ulemorrhagia. Tender stems are used as tooth brushes. It is also useful in urethrorrhoea, cystorrhoea, diarrhoea and dysentery. Flowers are used for preparing a lotion for wounds and ulcers. Powder of dried flowers is a brain tonic and is useful as a snuff to relieve cephalgia. Unripe fruit is used as a masticatory and will help to fix loose teeth. Seeds are used for preparing suppositories in cases of constipation especially in children (Warrier *et al*,1995). The bark and seed coat are used for strengthening the gum and enter into the composition of various herbal tooth powders, under the name of "*Vajradanti*", where they may be used along with tannin-containing substances like catechu (*Acacia catechu*), pomegranate (*Punica granatum*) bark, etc. The bark is used as snuff for high fever accompanied by pains in various parts of the body. The flowers are considered expectorant and smoked in asthma. A lotion prepared from unripe fruits and flowers is used for smearing on sores and wounds. In Ayurveda, the important preparation of *Mimusops* is "*Bakuladya Taila*", applied on gum and teeth for strengthening them, whereas in Unani system, the bark is used for the diseases of genitourinary system of males (Thakur *et al*, 1989).

Distribution

It is cultivated in North and Peninsular India and Andaman Islands. It is grown as an avenue tree in many parts of India.

Botany

Mimusops elengi Linn. belongs to the family *Sapotaceae*. It is an evergreen tree with dark grey fissured bark and densely spreading crown. Leaves are oblong, glabrous and leathery with wavy margins. Flowers are white, fragrant, axillary, solitary or fascicled. Fruits are ovoid or ellipsoid berries. Seeds are 1-2 per fruit, ovoid, compressed, greyish brown and shiny (Warrier *et al*, 1995). Other important species belonging to the genus *Mimusops* are *M. hexandra* Roxb. and *M. kauki* Linn. syn. *Manilkara kauki* Dub.(Chopra *et al*, 1980).

Agrotechnology

Mimusops prefers moist soil rich in organic matter for good growth. The plant is propagated by seeds. Fruits are formed in October-November. Seeds are to be collected and dried. Seeds are to be soaked in water for 12 hours without much delay and sown on seedbeds. Viability of seeds is less. After germination they are to be transferred to polybags. Pits of size 45cm cube are to be taken and filled with 5kg dried cowdung and top soil. To these pits, about 4 months old seedlings from the polybags are to be transplanted with the onset of monsoon. Addition of 10kg FYM every year is beneficial. Any serious pests or diseases do not attack the plant. Flowering commences from fourth year onwards. Bark, flowers, fruit and seeds are the economic parts.

Properties and Activity

β-sitosterol and its glucoside, α-spina-sterol, quercitol, taraxerol and lupeol and its acetate are present in the aerial parts as well as the roots and seeds. The aerial parts in addition gave quercetin, dihydroquercetin, myricetin, glycosides, hederagenin, ursolic acid, hentriacontane and β-carotene. The bark contained an alkaloid consisting largely of a tiglate ester of a base with a mass spectrum identical to those of laburinine and iso-retronecanol and a saponin also which on hydrolysis gave β-amyrin and brassic acid. Seed oil was comprised of capric, lauric, myristic, palmitic, stearic, arachidic, oleic and linoleic acids.

Saponins from seed are spermicidal and spasmolytic. The aerial part is diuretic. Extract of flower (1mg/kg body weight) showed positive diuretic action in dogs. Bark is tonic and febrifuge. Leaf is an antidote for snakebite. Pulp of ripe fruit is antidysenteric. Seed is purgative. Bark and pulp of ripe fruit is astringent (Husain *et al*, 1992).

CASTOR *Ricinus communis* *Euphorbiaceae*

San: Erandah, Pancangulah; Hin: Erandi, Erand; Ben: Bherenda; Mal: Avanakku; Tam: Amanakku, Kootaimuttu, Amanakkam Ceti; Kan: Haralu, Manda, Oudla; Tel: Erandamu, Amudamu

Importance

Castor is a perennial evergreen shrub. The Sanskrit name *erandah* describes the property of the drug to dispel diseases. It is considered as a reputed remedy for all kinds of rheumatic affections. They are useful in gastropathy such as gulma, *amadosa*, constipation, inflammations, fever, ascitis, strangury, bronchitis, cough, leprosy, skin diseases, vitiated conditions of *vata*, colic, coxalgia and lumbago. The leaves are useful in burns, nyctalopia, strangury and for bathing and fermentation and vitiated conditions of *vata*, especially in rheumatoid arthritis, urodynia and arthralgia. Flowers are useful in urodynia and arthralgia and glandular tumours. Seeds are useful in dyspepsia and for preparing a poultice to treat arthralgia. The oil from seeds is a very effective purgative for all ailments caused by *vata* and *kapha*. It is also recommended for scrotocele, ascites, intermittent fever, gulma, colonitis, lumbago, coxalgia and coxitis (Warrier *et al*, 1996). Oil is also used for soap making. Fresh leaves are used by nursing mothers in the Canary Island as an external application to increase the flow of milk. Castor oil is an excellent solvent of pure alkaloids and as such solutions of atropine, cocaine, etc. is used in ophthalmic surgery. It is also dropped into the eye to remove the after-irritation caused by the removal of foreign bodies.

Distribution

It is a native of N. E. tropical Africa. It is found throughout India, cultivated and found wild upto 2400m.

Botany

Ricinus communis Linn. belongs to the family *Euphorbiaceae*. It is a monoecious evergreen shrub growing upto 4m. Leaves are alternate, palmatifid, 6-10 lobed, each 1-nerved with many lateral nerves and peltate. Lobes are lanceolate, thinly pubescent below, margin serrate and apex acuminate. Paniculate racemes are terminal with male flowers below, female ones above. Perianth is cupular, splitting into 3-5 lobes, laceolate, valvate, margin inrolled and acuminate. Filaments of stamen are connate and repeatedly branched with divergent anther cells. Sepals are 5, sub-equal, lanceolate, valvate and acute. Ovary is globose, echinate, 3-locular with 3 ovules and pendulous. Styles are 3, stout, papillose, stigmatiferous. Capsules are 3-lobed and prickly with oblong seeds having smooth testa and marbled, shiny and carunculate. *R. bronze* King and *R. africanus* are two good garden varieties which are known as Italian and East Indian Castors, respectively (Mathew, 1983, Grieve and Leyel, 1992).

Agrotechnology

Castor is cultivated both in the plains and the hills. As it has deep root system it is hardy and capable of resisting drought. It does not withstand waterlogging and frost. It requires hard dry climate for proper development of fruits and seeds. It requires a well-drained soil, preferably sandy loam or loamy sand. High soil fertility is of less importance as compared to the good physical condition of the soil. It cannot tolerate alkalinity. It is generally grown in red loamy soils, black soils and alluvial soils. The plant is seed propagated. The seed rate required is 5-12 kg/ha (pure crop) and 3 kg/ha (mixed crop). Seeds are to be sown on a hot bed early in March. When the plants come up individual plant is to be planted in a separate pot filled with light soil and plunged into a fresh hot bed. The

young plants are to be kept in glass houses till early June where they are hardened and kept out. The suitable season of growing is *kharif* season. The crop is usually sown in April and planting is done in early July. The land is to be ploughed 2-3 times with the onset of rains and is repeated after rain. The spacing recommended is 60X90cm in case of pure crop but it is seldom cultivated pure. It is usually grown mixed with crops such as jowar, arhar, chilly, groundnut, cowpea, cotton, etc. 10-15t FYM/ha and 50kg N, 50kg P_2O_5 and 20kg K_2O/ha will be sufficient. Addition of neem cake is beneficial as it increases oil content. There should be sufficient moisture in the field at the time of sowing. A month after planting, weeding and earthing up is to be done. The plant is attacked by hairy caterpillar, castor semi-looper, castor seed caterpillar, etc. which can be managed by integrated pest management measures. The leaf blight disease occurring in castor can be controlled by spraying with Bordeaux mixture 2-3 times at 15 days interval. Harvesting of ripe fruits can be done from the end of November till the end of February. The fruit branches are picked when they are still green to avoid splitting and scattering of the seeds. The pods are to be heaped up in the sun to dry. Then the seeds are to be beaten with stick and winnowed. Roots, leaves, flowers, seeds and oil constitute the economic parts. The average yield is 500-600kg/ha (Thakur, 1990).

Properties and Activity

The beancoat yielded lupeol and 30-norlupan-3β-ol-20-one. Roots, stems and leaves contain several amino acids. Flowers gave apigenin, chlorogenin, rutin, coumarin and hyperoside. Castor oil is constituted by several fatty acids (Husain *et al*, 1992). Seed coat contained 1. 50-1. 62% lipids and higher amounts of phosphatides and non-saponifiable matter than seed kernel. Fresh leaves protected against liver injury induced by carbon tetra chloride in rats while cold aqueous extract provided partial protection (Rastogi *et al*, 1991). Root and stem is antiprotozoal and anticancerous. Root, stem and seed are diuretic. The roots are sweet, acrid, astringent, thermogenic, carminative, purgative, galactagogue, sudorific, expectorant and depurative. Leaves are diuretic, anthelmintic and galactagogue. Seeds are acrid, thermogenic, digestive, cathartic and aphrodisiac. Oil is bitter, acrid, sweet, antipyretic, thermogenic and viscous (Warrier *et al*, 1996). Castor oil forms a clean, light-coloured soap, which dries and hardens well and is free from smell. The oil varies much in activity. The East Indian is the more active, but the Italian has the least taste. Castor oil is an excellent solvent of pure alkaloids. The oil furnishes sebacic acid and caprylic acid. It is the most valuable laxative in medicines. It acts in about 5 hours, affecting the entire length of the bowel, but not increasing the flow of bile, except in very large doses. The mode of its action is unknown. The oil will purge when rubbed into the skin (Grieve and Leyel, 1992).

CUCURBITS
Cucurbitaceae

The family *Cucurbitaceae* includes a large group of plants which are medicinally valuable. The important genera belonging to the family are *Trichosanthes, Lagenaria, Luffa, Benincasa, Momordica, Cucumis, Citrullus, Cucurbita, Bryonopsis* and *Corallocarpus*. The medicinally valuable species of these genera are discussed below.

1. *Trichosanthes dioica* Roxb.

Eng: Wild Snake-gourd; San: Meki,Pargavi, Parvara, Patola; Hin: Palval, Parvar
Ben: Potol; Mal: Kattupatavalam, Patolam; Tam: Kombuppudalai; Tel: Kommupotta

Wild snake-gourd is a slender-stemmed, extensively climbing, more or less scabrous and woolly herb found throughout the plains of N. India, extending to Assam and W. Bengal. Tendrils are 2-4 fid. Leaves are 7.5x5cm in size, ovate-oblong, cordate, acute, sinuate-dentate, not lobed, rigid, rough on both surface and with a petiole of 2cm. Flowers are unisexual. Male flowers are not racemed but woolly outside. Calyx tube is 4.5cm long, narrow, teeth linear and erect. Anthers are free. Fruit is 5.9cm long, oblong or nearly spherical, acute, smooth and orange-red when ripe. Seeds are half-ellipsoid, compressed and corrugated on the margin (Kirtikar and Basu, 1988). The unripe fruit of this is generally used as a culinary vegetable and is considered very wholesome and specially suited for the convalescent. The tender shoots are given in decoction with sugar to assist digestion. The seeds are useful for disorders of the stomach. The leaf juice is rubbed over the chest in liver congestion and over the whole body in intermittent fevers (Nadkarni, 1998). The fruit is used as a remedy for spermatorrhoea. The fresh juice of the unripe fruit is often used as a cooling and laxative adjunct to some alterative medicines. In bilious fever, a decoction of *patola* leaves and coriander in equal parts is given. The fruit in combination with other drugs is prescribed in snakebite and scorpion sting (Kirtikar and Basu, 1988).

Fruits contain free amino acids and 5-hydroxy tryptamine. Fatty acids from seeds comprise elaeostearic, linoelic, oleic and saturated acids. The aerial part is hypoglycaemic. Leaf and root is febrifuge. Root is hydragogue, cathartic and tonic. Unripe leaf and fruit is laxative (Husain *et al*, 1992). The plant is alterative and tonic. Leaves are anthelmintic. Flower is tonic and aphrodisiac. The ripe fruit is sour to sweet, tonic, aphrodisiac, expectorant and removes blood impurities.

The other important species belonging to the genus *Trichosanthes* are as follows.
T. palmata Roxb.
T. cordata Roxb.
T. nervifolia Linn.
T. cucumerina Linn.
T. anguina Linn.
T. wallichiana Wight. syn. *T. multiloba* Clarke

2. *Lagenaria vulgaris* Ser. syn. *Cucurbita Lagenaria* Linn. ; Roxb.

Eng: Bottle gourd San: Alabu Hin: Lauki, Jangli-khaddu Ben: Lau, Kodu
Mal: Katuchuram, Churakka Tam: Soriai-kay Tel: Surakkaya

Bottle gourd is a large softly pubescent climbing or trailing herb which is said to be indigenous in India, the Molucas and in Abyssinia. It has stout 5-angled stems with bifid tendrils. Leaves are ovate or orbiculate, cordate, dentate, 5-angular or 5-lobed, hairy on both surfaces. Flowers are large, white, solitary, unisexual or bisexual, the males long and

females short peduncled. Ovary is oblong, softly pubescent with short style and many ovules. Fruits are large, usually bottle or dumb-bell-shaped, indehiscent and polymorphous. Seeds are many, white, horizontal, compressed, with a marginal groove and smooth. There are sweet fruited and bitter-fruited varieties (Kirtikar and Basu, 1988). The fruit contains a thick white pulp which, in the cultivated variety (*kodu*) is sweet and edible, while in the smaller wild variety (*tamri*) it is bitter and a powerful purgative. The seeds yield clear limpid oil which is cooling and is applied to relieve headache. The pulp of the cultivated forms is employed as and adjunct to purgatives and considered cool, diuretic and antibilious, useful in cough, and as an antidote to certain poisons. Externally it is applied as a poultice. The leaves are purgative and recommended to be taken in the form of decoction for jaundice (Nadkarni, 1998). In the case of sweet-fruited variety, the stem is laxative and sweet. The fruit is sweet oleagenous, cardiotonic, general tonic, aphrodisiac, laxative and cooling. In the case of bitter-fruited variety, the leaves are diuretic, antibilious; useful in leucorrhoea, vaginal and uterine complaints and earache. The fruit is bitter, hot, pungent, emetic, cooling, cardiotonic, antibilious; cures asthma, *vata*, bronchitis, inflammations ulcers and pains.

3. *Luffa acutangula* (Linn.) Roxb.

Eng: Ridged gourd; San: Dharmargavah, Svadukosataki; Hin: Tori, Katitori; Ben: Ghosha
Mal: Peechil, Peechinga; Tam: Pikangai, Prikkangai; Tel: Birakaya; Kan: Kadupadagila

Ridged gourd or ribbed gourd is a large monoecious climber cultivated throughout India. It is with 5-angled glabrous stems and trifid tendrils. Leaves are orbicular-cordate, palmately 5-7 lobed, scabrous on both sides with prominent veins and veinlets. Flowers are yellow, males arranged in 12-20 flowered axillary racemes. Female flowers are solitary, arranged in the axils of the males. Ovary is strongly ribbed. Fruits are oblong-clavate with 10-sharp angles 15-30cm long, tapering towards the base. Seeds are black, ovoid-oblong, much compressed and not winged (Warrier *et al*, 1995). The leaves are used in haemorrhoids, leprosy, granular-conjunctivitis and ringworm. The seeds are useful in dermatopathy. The juice of the fresh leaves is dropped into the eyes of children in granular conjunctivitis, also to prevent the lids from adhering at night on account of excessive meihomian secretion (Nadkarni, 1998). Fruits are demulcent, diuretic, tonic, expectorant, laxative and nutritive. The seeds are bitter, emetic, cathartic, expectorant and purgative.

The other important species of the genus *Luffa* are:
L. aegyptiaca Mill.
L. acutangula var. *amara* Clarke
L. echinata Roxb.

4. *Benincasa hispida* (Thumb.) Cogn. syn. *B. cerifera* Savi.

Eng: Ash gourd, White gourd melon; San: Kusmandah; Hin: Petha, Raksa; Ben: Kumra
Mal: Kumpalam; Tam: Pusanikkai; Kan: Bile Kumbala; Tel: Bodigummadi

Ash gourd or White gourd melon is a large trailing gourd climbing by means of tendrils which is widely cultivated in tropical Asia. Leaves are large and hispid beneath. Flowers are yellow, unisexual with male peduncle 7.5-10cm long and female peduncle shorter. Fruits are broadly cylindric, 30-45cm long, hairy throughout and ultimately covered with a waxy bloom. The fruits are useful in asthma, cough, diabetes, haemoptysis, hemorrhages from internal organs, epilepsy, fever and vitiated conditions of *pitta*. The seeds are useful in dry cough, fever, urethrorrhea, syphilis, hyperdipsia and vitiated conditions of *pitta* (Warrier *et al*,1993). It is a rejuvenative drug capable of improving intellect and physical strength. In Ayurveda, the fresh juice of the fruit is administered as a specific in haemoptysis and other haemorrhages from internal organs. The fruit is useful in insanity, epilepsy and other nervous diseases, burning sensation, diabetes, piles and dyspepsia. It is a

good antidote for many kinds of vegetable, mercurial and alcoholic poisoning. It is also administered in cough, asthma or respiratory diseases, heart diseases and catarrah. Seeds are useful in expelling tapeworms and curing difficult urination and bladder stones. The important formulations using the drug are *Kusmandarasayana, Himasagarataila, Dhatryadighrita, Vastyamantakaghrita, Mahaukusmandakaghrita*, etc. (Sivarajan *et al*, 1994).

Fruits contain lupeol, β-sitosterol, n-triacontanol, vitamin B, mannitol and amino acids. The fruit is alterative, laxative, diuretic, tonic, aphrodisiac and antiperiodic. Seed and oil from seed is anthelmintic (Husain *et al*, 1992).

5. *Momordica charantia* Linn.

Eng: Bitter gourd, Carilla fruit San: Karavellam Hin: Karela, Kareli
Mal: Kaypa, Paval Tam: Pavakkai, Paval, Pakar Tel: Kakara

Bitter gourd or Carilla fruit is a branched climbing annual which is cultivated throughout India. It is a monoecious plant with angled and grooved stems and hairy or villous young parts. Tendrils are simple, slender and elongate. Leaves are simple, orbicular, cordate and deeply divided into 5-7 lobes. Flowers are unisexual, yellow and arranged on 5-10cm long peduncles. Fruits are 5-15cm long with 3-valved capsules, pendulous, fusiform, ribbed and beaked bearing numerous triangular tubercles. Seeds are many or few with shining sculptured surface. The roots are useful in coloptosis and ophthalmopathy. The leaves are useful in vitiated conditions of *pita*, helminthiasis, constipation, intermittent fever, burning sensation of the sole and nyctalopia. The fruits are useful in skin diseases, leprosy, ulcers, wounds, burning sensation, constipation, anorexia, flatulence, colic, helminthiasis, rheumatalgia, gout, diabetes, asthma, cough, dysmenorrhoea, impurity of breast milk, fever and debility. Seeds are useful in the treatment of ulcers, pharyngodynia, and obstructions of the liver and spleen. The leaves and fruits are used for external application in lumbago, ulceration and bone fractures and internally in leprosy, haemorrhoids and jaundice (Warrier *et al*, 1995). The drug improves digestion, calms down sexual urge, quells diseases due to *pitta* and *kapha* and cures anaemia, anorexia, leprosy, ulcers, jaundice, flatulence and piles. Fruit is useful in gout, rheumatism and complaints of liver and spleen (Nadkarni, 1954; Aiyer and Kolammal, 1966; Mooss, 1976; Kurup *et al*, 1979). *Kaccoradi taila* is an important preparation using the drug (Sivarajan *et al*, 1994).

The seeds give triterpene glycosides, named momordicosides A, B, C, D and E, which are glycosides of cucurbit-5-en-triol, tetraol or pentaol. Leaves and vines give tetracyclic triterpenes-momordicines I, II and III (bitter principles). Immature fruits give several non-bitter and 2 bitter cucurbitacin glycosides. Four of the non-bitter glycosides, momordicosides F_1, F_2, G and I and the bitter momordicosides; K and L have also been characterized. Fruits, seeds and tissue culture give a polypeptide which contained 17 types of amino acids and showed hypoglycaemic activity. Fruits also give 5-hydroxy tryptamine and a neutral compound charantin (a steroidal glucoside), diosgenin, cholesterol, lanosterol and β-sitosterol. Leaf is emetic, purgative and antibilious. Fruit is stomachic, tonic, carminative, febrifuge, antirheumatic and hypoglycaemic. Root is astringent. Fruit and leaf is anti-leprotic. Fruit, leaf and root are abortifacient and anti-diabetic. Leaf and seed is anthelmintic. Seed oil possesses antifeeding and insecticidal properties. Unsaponifiable matter from seed oil exhibited pronounced inhibitory activity against gram negative bacteria. Seed and fruit are hypoglycaemic, cytotoxic and anti-feedant (Husain *et al*, 1992).

Other important species belonging to the genus *Momordica* are as follows.

M. dioica Roxb.
M. cochinchinensis Spreng.
M. tuberosa Cogn.
M. balsamina Linn.

6. *Cucumis melo* Linn. syn. *C. melo* Linn. var. *cultis* Kurz., *C. pubescens* Willd., *C. callosus* (Rottl.) Cogn.

Eng: Sweet melon San, Hin: Kharbuja Ben: Kharmul Mal: Mulam
Tam: Chukkari-kai, Thumatti-kai, Mulampazham Tel: Kharbuja-dosha

Sweet melon is a creeping annual extensively cultivated throughout India, found wild in India, Baluchistan and tropical Africa. The stem is creeping, angular and scabrous. Leaves are orbicular-reniform in outline, 5-angled or lobed, scabrous on both surfaces and often with soft hairs. Lobes of leaves are not very deep nor acute and with 5cm long petiole. Female peduncle is 5cm. Fruit is spherical, ovoid, elongate or contorted, glabrous or somewhat hairy, not spinous nor tuberculate.

Cucumis melo includes two varieties, namely,
C. melo var. *momordica* syn. *C. momordica* Roxb.
C. melo var. *utilissimus* Duthie & Fuller. syn. *C. utilissimus* Roxb.

The fruit is eaten raw and cooked. Its pulp forms a nutritive, demulcent, diuretic and cooling drink. It is beneficial as a lotion in chronic and acute eczema as well as tan and freckles and internally in cases of dyspepsia. Pulp mixed with cumin seeds and sugar candy is a cool diet in hot season. Seeds yield sweet edible oil which is nutritive and diuretic, useful in painful discharge and suppression of urine. The whole fruit is useful in chronic eczema (Kirtikar & Basu, 1988).

Seeds contain fatty acids-myristic, palmitic, oleic, linoleic; asparagine, glutamine, citrulline, lysine, histidine, arginine, phenylalanine, valine, tyrosine, leucine, iso-leucine, methionine, proline, threonine, tryptophan and crystine. Seed is tonic, lachrymatory, diuretic and urease inhibitor. Fruit pulp is eczemic. Fruit is tonic, laxative, galactagogue, diuretic and diaphoretic. The rind is vulnerary (Husain *et al*, 1992).

7. *Cucumic sativus* Linn.

Eng: Cucumber, Common cucumber; San: Trapusah; Hin, Ben: Khira; Mal: Vellari
Tam: Vellarikkai, Pippinkai; Kan: Mullusavte; Tel: Dosekaya

Cucumber is a climbing annual which is cultivated throughout India, found wild in the Himalayas from Kumaon to Sikkim. It is a hispidly hairy trailing or climbing annual. Leaves are simple, alternate, deeply cordate, 3-5 lobed with both surfaces hairy and denticulate margins. Flowers are yellow, males clustered, bearing cohering anthers, connective crusted or elevated above the cells. Females are solitary and thickly covered with very bulbous based hairs. Fruits are cylindrical pepo of varying sizes and forms. Seeds are cream or white with hard and smooth testa. The fruits are useful in vitiated conditions of *pitta*, hyperdipsia, burning sensation, thermoplegia, fever, insomnia, cephalgia, bronchitis, jaundice, haemorrhages, strangury and general debility. The seeds are useful in burning sensation, *pitta*, constipation, intermittent fevers, strangury, renal calculus, urodynia and general debility (Warrier *et al*, 1994). The leaves boiled and mixed with cumin seeds, roasted, powdered and administered in throat affections. Powdered and mixed with sugar, they are powerful diuretic (Nadkarni, 1998). The fruits and seeds are sweet, refrigerant, haemostatic, diuretic and tonic. Other important species belonging to the genus are:

C. trigonus Roxb. syn. *C. pseudo-colocynthis*
C. prophetarum Linn.

8. *Citrullus colocynthis* (Linn.) Schrader. syn. *Cucumis colocynthis* Linn.

Eng: Colocynth, Bitter apple; San: Visala, Mahendravaruni; Hin: Badi indrayan, Makkal Ben: Makhal; Mal: Kattuvellari (Valutu), Valiya pekkummatti; Tel: Etti-puchcha Tam: Paitummatti, Petummatti;

Colocynth or Bitter apple is found, cultivated and wild, throughout India in warmer areas. It is an extensively trailing annual herb with bifid tendrils angular branching stems and wooly tender shoots. Leaves are deeply divided, lobes narrow thick, glabrous or somewhat hairy. Flowers are unisexual, yellow, both males and females solitary and with pale-yellow corolla. Fruit is a globose or oblong fleshy indehiscent berry, 5-7.5cm in diameter and variegated with green and white. Seeds are pale brown. The fruits are useful in tumours, ascites, leucoderma, ulcers, asthma, bronchitis, urethrorrhea, jaundice, dyspepsia, constipations, elephantiasis, tubercular glands of the neck and splenomegaly (Warrier *et al*, 1994). It is useful in abnormal presentations of the foetus and in atrophy of the foetus. In addition to the above properties, the root has a beneficial action in inflammation of the breasts, pain in the joints; externally it is used in ophthalmia and in uterine pains. The fruit and root, with or without is rubbed into a paste with water and applied to boils and pimples. In rheumatism, equal parts of the root and long pepper are given in pill. A paste of the root is applied to the enlarged abdomen of children (Kirtikar and Basu, 1988). The fruit is useful in ascites, biliousness, jaundice, cerebral congestion, colic, constipation dropsy, fever, worms and sciatica. Root is given in cases of abdominal enlargement, cough, asthma, inflammation of the breast, ulcers, urinary diseases and rheumatism. Oil from seeds is used for poisonous bites, bowel complaints, epilepsy and also for blackening the hair (Nadkarni, 1954; Dey, 1980). The important formulations using the root and fruit are *Abhayarista*, *Mahatiktakam kasaya*, *Manasamitravatakam*, *Cavikasava*, *Madhuyastyadi taila*, etc. (Sivarajan *et al*, 1994). The powder is often used as an insecticide. The extract should never be given without some aromatic to correct its griping tendency (Nadkarni, 1998).

Fruit contains a glycoside- colocynthin, its aglycone-α-elaterin, citrulluin, citrullene and citrullic acid. Unripe fruit contains p-hydroxy benzyl methyl ester. Roots contain α-elaterin and hentriacontane (Husain *et al*, 1992). Colocynth is, in moderate doses, drastic, hydrogogue, cathartic and diuretic. In large doses, it is emetic and gastro-intestinal irritant and in small doses, it is expectorant and alterative. Colocynthin is a cathartic and intensely bitter principle. It has a purgative action. All parts of the plant are very bitter. The fruit has been described as cathartic (Nadkarni, 1982).

9. *Citrullus vulgaris* Schrad. syn. *C. lanatus* (Thunb.) Mats. & Nakai.

Eng: Water melon; San: Tarambuja; Hin: Tarbuj; Ben: Tarbuz
Mal: Thannimathan; Tam: Pitcha, Dharbusini

Watermelon is an extensively climbing annual which is largely cultivated throughout India and in all warm countries. It has thick angular branching stems. Tendrils are bifid, stout and pubescent. Leaves are long, deeply divided or moderately lobed, glabrous or somewhat hairy and hardly scabrous. Petiole is a little shorter than the limb and villous. Calyx-lobes are narrowly lanceolate, equalling the tube. Corolla is yellow within, greenish outside and villous. Lobes are ovate-oblong, obtuse and prominently 5-nerved. Fruit is sub-globose or ellipsoid, smooth, greenish or clouded, often with a glaucous waxy coating. Flesh is juicy, red or yellowish white. Seeds are usually margined. *C. vulgaris* var. *fistulosus* Duthie & Fuller. syn. *C. fistulosus* has its fruit about the size of small turnip, the seeds of which are used medicinally. The fruit is tasteless when unripe and sweet when ripe. The unripe fruit is used to cure jaundice. Ripe fruit cures *kapha* and *vata* and causes biliousness. It is good for sore eyes, scabies and itching. The seeds are tonic to the brain and used as a cooling

medicine. An emulsion of the seeds is made into a poultice with the pounded leaves and applied hot in cases of intestinal inflammations (Kirtikar and Basu, 1988). Fruit juice is good in quenching thirst and it is used as an antiseptic in typhus fever with cumin and sugar. It is used as a cooling drink in strangury and affections of urinary organs such as gonorrhoea; in hepatic congestion and intestinal catarrh. The bitter watermelon of Sind is known as "*Kirbut*" and is used as a purgative.

Seeds yield a fixed oil and proteids; citrullin. Seeds are cooling, demulcent, diuretic, vermifuge and nutritive. Pulp is cooling and diuretic. Fruit-juice is cooling and refreshing (Nadkarni, 1982).

10. *Curcurbita pepo* Linn. syn. *Pepo vulgaris* et *P. verrucosus* Moench Meth.

Eng: Pompion, Pumpkin, Vegetable Marrow; San: Karkaru, Kurkaru, Kushmandi
Hin, Ben: Kadimah, Konda, Kumra, Safedkkadu; Mal: Mathan, Matha
Tel: Budadegummadi, Pottigummadi

Pompion or Pumpkin is a climbing herb which is considered to be a native of America and cultivated in many parts of India. The stem and leaves are with a harsh prickly armature. Foliage is stiff, more or less rigid and erect. Leaves are with a broad triangular pointed outline and often with deep lobes. Corolla is mostly with erect or spreading (not drooping) pointed lobes, the tube narrowing towards the base. Peduncle is strongly 5-angled and little or much expanding near the fruit. The fruit is cooling and astringent to the bowels, increases appetite, cures leprosy, '*kapha* and *vata'*, thirst, fatigue and purifies the blood. The leaves are used to remove biliousness. Fruit is good for teeth, throat and eyes and allays thirst. Seeds cure sore chests, haemoptysis, bronchitis and fever. It is good for the kidney and brain. The leaves are used as an external application for burns. The seeds are considered anthelmintic. The seeds are largely used for flavouring certain preparations of Indian hemp, and the root for a nefarious purpose, viz., to make the preparation more potent. The seeds are taeniacide, diuretic and demulcent. The fruit is cooling, laxative and astringent. The leaves are digestible, haematinic and analgesic.

The other important species belonging to the genus *Cucurbita* is *C. maxima* Duchena, the seeds of which are a popular remedy for tape-worm and oil as a nervine tonic (Kirtikar & Basu, 1988).

11. *Corallocarpus epigaeus* Benth. ex Hook. f. syn. *Bryonia epigaea* Wight.

San: Katunahi; Hin: Akasgaddah; Mal: Kadamba, Kollankova
Tam: Akashagarudan, Gollankovai; Tel: Murudonda, Nagadonda

Corallocarpus is a prostrate or climbing herb distributed in Punjab, Sind, Gujarat, Deccan, Karnataka and Sri Lanka. It is monoecious with large root which is turnip-shaped and slender stem which is grooved, zigzag and glabrous. Tendrils are simple, slender and glabrous. Leaves are sub-orbicular in outline, light green above and pale beneath, deeply cordate at the base, angled or more or less deeply 3-5 lobed. Petiole is long and glabrous. Male flowers are small and arranged at the tip of a straight stiff glabrous peduncle. Calyx is slightly hairy, long and rounded at the base. Corolla is long and greenish yellow. Female flowers are usually solitary with short, stout and glabrous peduncles. Fruit is stalked, long, ellipsoid or ovoid. Seeds are pyriform, turgid, brown and with a whitish corded margin. It is prescribed in later stages of dysentery and old veneral complaints. For external use in chronic rheumatism, it is made into a liniment with cumin seed, onion and castor oil. It is

used in case of snakebite where it is administered internally and applied to the bitten part. The root is given in syphilitic rheumatism and later stages of dysentery. The plant is bitter, sweet, alexipharmic and emetic. The root is said to possess alterative and laxative properties (Kirtikar and Basu, 1988). Root contains a bitter principle like Breyonin (Chopra *et al*, 1980).

Agrotechnology

Cucurbits can be successfully grown during January-March and September-December. For the rainfed crop, sowing can also be started after the receipt of the first few showers. The seed rate and spacing recommended for the cucurbits are given below:

Plants	**Seed rate (kg/ha)**	**Spacing (m)**
Bitter gourd	5.0-6.0	2.0x2.0
Snake gourd	3.0-4.0	2.0x2.0
Bottle gourd	3.0-4.0	3.0x3.0
Ash gourd	0.75-1.00	4.5x2.0
Pumpkin	1.0-1.5	4.5x2.0
Cucumber/Melon	0.5-0.75	2.0x1.5
Water melon	1.0-1.5	2.0x3.0

Pits of 60cm diameter and 30-45cm depth are to be taken at the desired spacing. Well rotten FYM or vegetable mixture is to be mixed with topsoil in the pit and seeds are to be sown at 4-5/pit. Unhealthy plants are to be removed after 2 weeks and retained 2-3 plants/pit. FYM is to be applied at 20-25t/ha as basal dose along with half dose of N (35kg/ha) and full dose of P (25kg) and K (25kg). The remaining dose of N (35kg) can be applied in 2 equal split doses at fortnightly intervals. During the initial stages of growth, irrigation is to be given at an interval of 3-4 days and at alternate days during flowering and fruiting periods. For trailing cucumber, pumpkin and melon, dried twigs are to be spread on the ground. Bitter gourd, bottle gourd, snake gourd and ash gourd are to be trailed on Pandals. Weeding and raking of the soil are to be conducted at the time of fertilizer application. Earthing up may be done during rainy season. The most dreaded pest of cucurbits is fruit flies which can be controlled by using fruit traps, covering the fruits with polythene, cloth or paper bags, removal and destruction of affected fruits and lastly spraying with Carbaryl or Malathion 0. 2% suspension containing sugar or jaggery at 10g/l at fortnightly intervals after fruit set initiation. During rainy season, downy mildew and mosaic diseases are severe in cucurbits. The former can be checked by spraying Mancozeb 0.2%. The spread of mosaic can be checked by controlling the vectors using Dimethoate or Phosphamidon 0.05% and destruction of affected plants and collateral hosts. Harvesting to be done at least 10 days after insecticide or fungicide application (KAU,1996).

MEDICINAL YAMS *Dioscorea spp.* *Dioscoreaceae*

The growing need for steroidal drugs and the high cost of obtaining them from animal sources led to a widespread search for plant sources of steroidal sapogenins, which ultimately led to the most promising one. It is the largest genus of the family constituted by 600 species of predominantly twining herbs. Among the twining species, some species twine clockwise while others anti-clockwise (Miege, 1958). All the species are dioceous and rhizomatous. According to Coursey (1967), this genus is named in honour of the Greek physician Pedenios Dioscorides, the author of the classical Materia Medica Libri Quinque. Some of the species like *D. alata* and *D. esculenta have* been under cultivation for a long time for their edible tubers. There are about 15 species of this genus containing diosgenin. Some of them are the following (Chopra *et al*, 1980).

D. floribunda Mart. & Gal.
D. composita Hemsl; syn. *D. macrostachya* Benth.
D. deltoidea Wall. ex Griseb; syn. *D. nepalensis* Sweet ex Bernardi.
D. aculeata Linn. syn. *D. esculenta*
D. alata Linn. syn. *D. atropurpurea* Roxb.
D. Globosa Roxb; *D. purpurea* Roxb; *D. rubella* Roxb.
D. bulbifera Linn. syn. *D. crispata* Roxb.
D. pulchella Roxb.; *D. sativa* Thunb. Non Linn.
D. versicolor Buch. Ham. Ex Wall.
D. daemona Roxb. syn. *D. hispida* Dennst.
D. oppositifolia Linn.
D. pentaphylla Linn. syn. *D. jacquemontii* Hook. f.
D. triphylla Linn.
D. prazeri Prain & Burkil syn. *D. clarkei* Prain & Burkill
D. deltoidea Wall. var. *sikkimensis* Prain
D. sikkimensis Prain & Burkill

Among the above said species, *D. floribunda*, *D. composita* and *D. deltoidea* are widely grown for diosgenin production.

1. *D. floribunda* Mart. & Gal

D. floribunda Mart. & Gal. is an introduction from central America and had wide adaptation as it is successfully grown in Karnataka, Assam, Meghalaya, Andaman and Goa. The vines are glabrous and left twining. The alternate leaves are borne on slender stems and have broadly ovate or triangular ovate, shallowly cordate, coriaceous lamina with 9 nerves. The petioles are 5-7cm long, thick and firm. Variegation in leaves occurs in varying degrees. The male flowers are solitary and rarely in pairs. Female flowers have divericate stigma which is bifid at apex. The capsule is obovate and seed is winged all round. The tubers are thick with yellow coloured flesh, branched and growing upto a depth of 30cm (Chadha *et al*, 1995).

2. *D. composita* Hemsl.

D. composita Hemsl. according to Knuth (1965) has the valid botanical name as *D. macrostachya* Benth. However, *D. composita* is widely used in published literature. It is a Central American introduction into Goa, Jammu, Bangalore, Anaimalai Hills of Tami Nadu and Darjeeling in W. Bengal. The vines are right twinning and nearly glabrous. The alternate leaves have long petioles, membraneous or coriaceous lamina measuring upto 20x18cm, abruptly acute or cuspidate-acuminate, shallowly or deeply cordate, 7-9 nerved. The fasciculate-glomerate inflorescence is single or branched with 2 or 3 sessile male

flowers having fertile stamens. Male fascicle is 15-30cm long. The female flowers have bifid stigma. Tubers are large, white and deep-rooted (upto 45cm) (Chadha *et al*, 1995).

3. *D. deltoidea* Wall. ex. Griseb.

D. deltoidea Wall. ex. Griseb. is distributed throughout the Himalayas at altitudes of 1000-3000m extending over the states of Jammu-Kashmir, H. P, U. P, Sikkim and further into parts of W. Bengal. The glabrous and left twining stem bears alternate petiolate leaves. The petioles are 5-12 cm long. The lamina is 5-15cm long and 4-12cm wide widely cordate. The flowers are borne on axillary spikes, male spikes 8-40cm long and stamens 6. Female spikes are 15cm long, 3. 5cm broad and 4-6 seeded. Seeds are winged all round. Rhizomes are lodged in soil, superficial, horizontal, tuberous, digitate and chestnut brown in colour (Chadha *et al*, 1995). *D. deltoidea* tuber grows parallel to ground covered by small scale leaves and is described as rhizome. The tubers are morphologically cauline in structure with a ring of vascular bundles in young tubers which appear scattered in mature tubers (Purnima and Srivastava, 1988). Visible buds are present unlike in *D. floribunda* and *D. composita* where the buds are confined to the crown position (Selvaraj *et al*, 1972).

Importance of Diosgenin

Diosgenin is the most important sapogenin used as a starting material for synthesis of a number of steroidal drugs. For commercial purposes, its β-isomer, yamogenin is also taken as diosgenin while analysing the sample for processing. Various steroidal drugs derived from diosgenin by artificial synthesis include corticosteroids, sex hormones, anabolic steroids and oral contraceptives. Corticosteroids are the most important group of steroidal drugs synthesized from diosgenin. First group of corticosteroids regulates carbohydrate and protein metabolism. The second group consists of aldosterone, which controls balance of potassium, sodium and water in the human body. The glucocorticoids in the form of cortisone and hydrocortisone are used orally, intramuscularly or topically for treatment of rheumatoid arthritis, rheumatic fever, other collegen diseases, ulcerative colitis, certain cases of asthma and a number of allergic diseases affecting skin, eye and the ear. These are also used for treatment of gout and a variety of inflammations of skin, eye and ear and as replacement therapy in Addison's diseases. The minerato corticoides, desoxycorticosterone or desoxycortone are used in restoring kidney functions in cases of cortical deficiency and Addison's disease.

Both male and female sex hormones are also synthesized from disosgenin. The main male sex hormone (androgen) which is produced from disogenin is testosterone. The main female sex hormones produced are oestrogen and progesterone. Recently oestrogen has also been used in cosmetic lotions and creams to improve the tone and colour of skin. One of the main uses of progesterone during recent years has been as antifertility agent for oral contraceptives. These artificial steroids have increased oral activity and fewer side effects, as they can be used in reduced doses. Oral contraceptives are also used for animals like pigs, cows and sheep to control fertility and to give birth at a prescribed period in a group of animals at the same time. These compounds are also used to reduce the interval between the lactation periods to have more milk and meat production. Anti-fertility compounds are also used as a pest-control measure for decreasing the multiplication of pests like rodents, pigeons and sea gulls (Husain *et al*, 1979).

Although yam tubers contain a variety of chemical substances including carbohydrates, proteins, alkaloids and tannins, the most important constituents of these yams are a group of saponins which yield sapogenins on hydrolysis. The most important sapogenin found in *Dioscorea* are diosgenin, yamogenin and pannogenin. Diosgenin is a steroid drug precursor. The diogenin content varies from 2-7% depending on the age of the tubers. Saponins including 5 spirastanol glucoside and 2 furostanol glucoside, 4 new steroid saponins, floribunda saponins C, D, E and F. Strain of A and B are obtained from *D. floribunda* (Husain *et al*, 1979). Rhizomes of *D. deltoidea* are a rich source of diosgenin

and its glycoside. Epismilagenin and smilagenone have been isolated from *D. deltoidea* and *D. prazeri* (Chakravarti *et al*, 1960; 1962). An alkaloid dioscorine has been known to occur in *D. hispida* (Bhide *et al*,1978). Saponin of *D. prazeri* produced a fall of blood pressure when given intravenously and saponin of *D. deltoidea* has no effect on blood pressure (Chakravarti *et al*,1963). Deltonin, a steroidal glycoside, isolated from rhizomes of *D. deltoidea* showed contraceptive activity (Biokova *et al*, 1990).

Agrotechnology

Dioscorea species prefer a tropical climate without extremity in temperature. It is adapted to moderate to heavy rainfall area. *Dioscorea* plants can be grown in a variety of soils, but light soil is good, as harvesting of tubers is easier in such soils. The ideal soil pH is 5.5-6.5 but tolerates fairly wide variation in soil pH. *Dioscorea* can be propagated by tuber pieces, single node stem cuttings or seed. Commercial planting is normally established by tuber pieces only. Propagation through seed progeny is variable and it may take longer time to obtain tuber yields. IIHR, Bangalore has released two improved varieties, FB(c)-1, a vigorously growing strain relatively free from diseases and Arka Upkar, a high yielding clone. Three types of tuber pieces can be distinguished for propagation purpose, viz. (1) crown (2) median and (3) tip, of which crowns produce new shoots within 30 days and are therefore preferred. Dipping of tuber pieces for 5 minutes in 0.3% solution of Benlate followed by dusting the cut ends with 0.3% Benlate in talcum powder in moist sand beds effectively checks the tuber rot. The treatment is very essential for obtaining uniform stand of the crop. The best time of planting is the end of April so that new sprouts will grow vigorously during the rainy season commencing in June in India. Land is to be prepared thoroughly until a fine tilth is obtained. Deep furrows are made at 60cm distance with the help of a plough. The stored tuber pieces which are ready for planting is to be planted in furrows with 30cm between the plants for one year crop and 45cm between the plants for 2 year crop at about 0.5 cm below soil level. The new sprouts are to be staked immediately. After sprouting is complete, the plants are to be earthed up. Soil from the ridges may be used for earthing up so that the original furrows will become ridges and vice versa. *Dioscorea* requires high organic matter for good tuber formation. Besides a basal doze of 18-20t of FYM/ha, a complete fertilizer dose of 300kg N, 150kg P_2O_5 and K_2O each are to be applied per hectare. P and K are to be applied in two equal doses one after the establishment of the crop during May-June and the other during vigorous growth period of the crop (August-September). Irrigation may be given at weekly intervals in the initial stage and afterwards at about 10 days interval. *Dioscorea* vines need support for their optimum growth and hence the vines are to be trailed over *pandal* system or trellis. Periodic hand weeding is essential for the first few months. Intercropping with legumes has been found to smother weeds and provide extra income. The major pests of *Dioscorea* are the aphids and red spider mites. Aphids occur more commonly on young seedlings and vines. Young leaves and vine tips eventually die if aphids are not controlled. Red spider mites attack the underside of the leaves at the base near the petiole. Severe infestations result in necrotic areas, which are often attacked by fungi. Both aphids and spider mites can be very easily controlled by Kelthane. No serious disease is reported to infect this crop. The tubers grow to about 25-30 cm depth and hence harvesting is to be done by manual labour. The best season for harvesting is Feb-March, coinciding with the dry period. On an average 50-60t/ha of fresh tubers can be obtained in 2 years duration. Diosgenin content tends to increase with age, 2.5% in first year and 3-3.5% in the second year. Hence, 2 year crop is economical (Kumar *et al*, 1997).

IPECAC *Cephaelis ipecacuanha* *Rubiaceae*

Importance

Ipecac is a small evergreen herb with much branched beaded roots. It is used in powdered form or as liquid total extract, syrup and tincture. Ipecac syrup in small doses is used as an expectorant, as it is well tolerated by children. It is used in treatment of whooping cough. Ipecac with opium as in Dover's powder is used as a diaphoretic, tincture and syrup. Emetine hydrochloride in the form of injection is used for treatment of amoebic dysentery. Emetine bismuth iodide is also given orally for amoebic dysentery. Ipecac is also used as gastric stimulant and as an anti-inflammatory agent in rheumatism.

Distribution

The plant is a native of Bolivia and Brazil. It is cultivated in Mungpoo, near Darjeeling and on the Nilgiris, especially New Kallar, and at the Rungbee Cinchona plantation in Sikkim.

Botany

Cephaelis ipecacuanha (Brot.) A. Rich. syn. *Psychotria ipecacuanha* Stokes. belongs to the family *Rubiaceae*. The plant grows upto 0.7m high, with slender cylindrical stem. When mature the roots are dark brown and have transverse furrows giving it a beaded appearance. Above ground stem is quadrangular and trailing with few or new branches. Leaves are opposite near the top of the plant and alternate below, 5-10x3-6cm area, dark green above and pale green underneath. Flowers are white, sessile, funnel-like, less than 1cm wide and are borne in dense clusters. Fruit is purple with two stones containing single seed (Husain, 1993).

Agrotechnology

Ipecac prefers an average rainfall ranging between 2000-3000mm and evenly distributed. Maximum temperature should not exceed 38°C and the minimum not below 10°C. It thrives well in tropical mild humid climates similar to Malaysian rain forests. Virgin forest soils rich in humus are ideal for Ipecac. It prefers deep medium fertile soils which are acidic and rich in humus, potash and magnesium. Soil should be well drained and protected from wind and storm. As Ipecac grows only in shade, it can be cultivated as an intercrop, or planted in artificially shaded beds. The plant is propagated both by seeds and vegetatively by root, stem and leaf cuttings. Vegetative propagation is preferred to maintain genetic uniformity of the plant. Most of the commercial plantations are raised by seeds. Raised seed beds of 2x6m size are made and are mixed with well rotten leaf compost and sand. These are provided with shade on the top as well as on the sides. Seeds are drilled or broadcasted in the beds and watered regularly. Seeds take 3-5 months to germinate. Seed treatment with limewater for 48 hours or H_2O_2 improves germination. It has been observed that providing mulch or black polythene in nursery beds improves germination as well as results in control of weeds. The suitable season of planting is January-March in West Bengal. Seedlings are planted in production beds at a spacing of 10x10cm after they are 8-12 weeks old. In West Bengal, it is a practice to transfer seedlings to other nursery beds before being transferred to final production seedbeds. FYM and leaf compost application is required during second and third year. Super phosphate applications is found to improve root growth. Frequent irrigation is required. Waterlogging should be avoided. Both the seedbeds

and production beds should be kept free from weeds. Seedlings are often attacked by damping off fungi like *Rhizoctonia* sp. in nursery. It is better to treat the seeds with a suitable seed dressing fungicide before planting. *Fusarium* wilt caused by *F. moniliforme* has been reported from India. The plants are ready for harvesting after 4 years. The roots should be dug out, washed and dried in the sun. Rhizome and root are the economical parts (Husain, 1993).

Properties and Activity

Ipecac root contains 2.2-2.5% total alkaloids. The main alkaloids are cephaeline and emetine. In addition, it also contains psychotrine and psychotrine ethyl ether. The drug also contains a crystalline glucosidal tannin, starch and calcium oxalate (60-70% of the alkaloids is emetine). Root contains minor amounts of O-methyl psychotrine, emetamine, protoemetine and others. Other constituents of ipecac include choline, glycoside-ipecoside, saponins, resins, tannins-ipecacuanhin, an allergen composed of mixture of glycoproteins, ipecacuanhic acid, a neutral monoterpene acid and calcium oxalate. Cephaeline could be converted into emetine on methylation.

The powdered dried rhizome and root cause severe asthmatic attacks and vasomotorrhinitis. Emetine hydrochloride is anti-amoebic. Root is emetic, expectorant and diaphoretic (Husain *et al*, 1992).

CURCUMA *Curcuma spp.*
Zingiberaceae

The genus C*urcuma* belonging to the family Z*ingiberaceae* comprises of a number of species which are medicinally very important. Among them, the most important species are described below.

1. *C. amada* Roxb.

English: Mango ginger San: Amrardrakam, Karpuraharida Hin: Ama-haldi
Mal: Mangainchi Tam: Mankayinci Tel: Mamidi Allam

Mango ginger is cultivated in Gujarat and found wild in parts of West Bengal, U. P, Karnataka and Tamil Nadu. It is a rhizomatous aromatic herb with a leafy tuft and 60-90cm in height. Leaves are long, petiolate, oblong-lanceolate, tapering at both ends, glabrous and green on both sides. Flowers are white or pale yellow, arranged in spikes in the centre of tuft of the leaves. Lip is semi-elliptic, yellow, 3-lobbed with the mid lobe emarginate. The rhizomes are useful in vitiated conditions of *pitta*, anorexia, dyspepsia, flatulence, colic, bruises, wounds, chronic ulcers, skin diseases, pruritus, fever, constipations, strangury, hiccough, cough, bronchitis, sprains, gout, halitosis, otalgia and inflammations (Warrier *et al*, 1994). The fresh root possesses the smell of green mango and hence the name *mango ginger*. The rhizomes are used externally in the form of paste as an application for bruises and skin diseases generally combined with other medicines. Tubers rubbed with the leaf-juice of *Caesalpinia bonduc* is given for worms (Nadkarni, 1982).

The essential oil contains α-pinene, α-and β-curcumene, camphor, cuminyl alcohol, myristic acid and turmerone. Car-3-ene and cis-ocimene contribute the characteristic mango odour of the rhizome. Rhizome is CNS active, hypothermic and it shows potentiation of amphetamine toxicity. Tuber is trypsin inhibitor and is effective against *Vibrio cholerae* (Husain *et al*, 1992). The rhizomes are bitter, sweet sour, aromatic, cooling, appetiser, carminative, digestive, stomachic, demulcent, vulnerary, febrifuge, alexertic, aphrodisiac, laxative, diurectic, expectorant, antiinflammatory and antipyretic (Warrier *et al*, 1994).

2. *C. aromatica* Salisb.

Eng: Wild turmeric; San: Aranyaharidra, Vanaharidra; Hin: Ban-haridra, Jangli-haldi;
Ben: Ban Haland; Mal, Tam: Kasturimanjal, Kattumanjal; Tel: Adavi-pasupu;
Kan: Kadarasina

Wild turmeric or Cochin turmeric or Yellow zeodoary is found wild throughout India and cultivated in Bengal and Kerala. It is a perennial tuberous herb with annulate, aromatic yellow rhizome which is internally orange-red in colour. Leaves are elliptic or lanceolate-oblong, caudate-acuminate, 30-60cm long, petioles as long or even longer, bracts ovate, recurved, more or less tinged with red or pink. Flowers are pink, lip yellow, obovate, deflexed, sub-entire or obscurely three lobed. Fruits are dehiscent, globose, 3-valved capsules. Rhizomes are used in combination with astringents and aromatics for bruises, sprains, hiccough, bronchitis, cough, leucoderma and skin eruptions (Warrier *et al*, 1994). The rhizomes have an agreeable fragrant smell and yield a yellow colouring matter like turmeric, and the fresh root has a camphoraceous odour. The dried rhizome is used as a carminative and aromatic adjunctant to other medicines (Nadkarni, 1998).

Essential oil contains α-and -β-curcumene, d-camphene and p-methoxy cinnamic acid. The colouring matter is curcumin. Numerous sesquiterpenoids of germacrone and guaiane skeletons have been identified recently. Rhizome has effect on respiration. It is spasmolytic and shows antagonism of amphetamine hyperactivity. Rhizome is an anti-dote for snakebite and carminative (Husain *et al*, 1992).

3. *C. longa* Linn. syn. *C. domestica* Valeton.

Eng: Turmeric; San: Haridra, Varavarnini; Hin: Haldi, halda; Ben: Haldi; Mal: Manjal, Pachamanjal, Varattumanjal; Tam: Mancal; Kan: Haldi, Arasina; Tel: Pasapu

Turmeric is cultivated all over India, particularly in W. Bengal, T. N and Maharashtra. It is a perennial herb, 60-90cm in height, with a short stem and tufts of erect leaves. Rhizome is cylindric, ovoid, orange coloured and branched. Leaves are simple, very large, petiole as long as the blade, oblong-lanceolate, tapering to the base upto 45cm long. Flowers are pale yellow, arranged in spikes concealed by the sheathing petioles and flowering bracts are pale green (Warrier *et al*, 1994). Turmeric occupies an important position in the life of Indian people as it forms an integral part of the rituals, ceremonies and cuisine. Due to the strong antiseptic properties, turmeric has been used as a remedy for all kinds of poisonous affections, ulcers and wounds. It gives good complexion to the skin and so it is applied to face as a depilatory and facial tonic. The drug cures diseases due to morbid *vata*, *pitta* and *kapha*, diabetes, eye diseases, ulcers, oedema, anaemia, anorexia, leprosy and scrofula. It purifies blood by destroying the pathogenic organisms. A paste of turmeric alone, or combined with a paste of neem (*Azadirachta indica*) leaves, is used to cure ringworm, obstinate itching, eczema and other parasitic skin diseases and in chicken pox and small pox. The drug is also useful in cold, cough, bronchitis, conjunctivitis and liver affections (Nadkarni, 1954; Kurup *et al*,1979; Kolammal, 1979). The rhizome is the officinal part and is an important ingredient of formulations like *Nalpamaradi taila, Jatyadi taila, Narayana gula,* etc. (Sivarajan *et al*, 1994).

Turmeric paste mixed with a little limejuice and saltpetre and applied hot is a popular application to sprains and bruises. In smallpox and chickenpox, a coating of turmeric is applied to facilitate the process of scabbing. The smoke produced by sprinkling powdered turmeric over burnt charcoal will relieve scorpion sting when the part affected is exposed to the smoke for a few minutes. Turmeric and alum powder in the proportion of 1:20 is blown into the ear in chronic otorrhoea (Nadkarni, 1998). "*Haridra Khand*", a compound containing powdered turmeric, sugar and many other ingredients is a well-known preparation for cold, cough and flu, and for skin diseases. In Unani system, roasted turmeric is an ingredient of "*Hab Narkachur*", used as antidysenteric for children (Thakur *et al*, 1989).

Essential oil contains ar-turmerone, and ar-curcumene as major constituents. Some of the other compounds are α-and β-pinene, sabinene, myrcene, α-terpinene, limonene, p-cymene, perillyl alcohol, turmerone, eugenol, iso-eugenol, eugenol methyl ether and iso-eugenol methyl ether. Curcumin and related compounds have also been reported as major constituents of the rhizomes. Recently a number of sesquiterpenes have been reported from *C. longa*, viz., the sesquiterpenoids of germacrane, bisabolane and guainane skeletons (Husain *et al*, 1992). The study of sesquiterpenes has revealed a new compound curlone (Kisoy *et al*, 1983). The crystalline colouring matter curcumin (0. 6%) is diferuloyl methane (Mathews *et al*, 1980). Stigmasterol, cholestrol, β-sitosterol and fatty acids, mainly straight chain dienoic acids are reported (Moon *et al*, 1977). Curcumin, the colouring agent and major constituent of *C. longa*, is said to possess local as well as systemic antiinflammatory property which has been found to compare favourably with phenylbutazone (Srimal and Dhawan, 1973). An extract of the crude drug 'akon' containing the rhizomes exhibited intensive preventive activity against carbon tetrachloride induced liver injury *invivo* and *invitro*. The liver protecting effects of some analogs of ferulic acid and p-coumaric acid, probable metabolites of the curcuminoids have been also evaluated (Kiso *et al*, 1983). Curcumin is antiinflammatory. Rhizome is antiprotozoal, spasmolytic, CNS active, antiparasitic, antispasmodic, antibacterial, antiarthritic, anthelmintic, carminative, antiperiodic, emollient, anodyne, laxative, diruretic, expectorant, alterative, alexertive, febrifuge, opthalmic and tonic.

4. *C. zedoaria* (Berg.) Rosc. syn. *C. zerumbet* Roxb; *Amomum zedoaria* Christm.

Eng: Round zedoary; San: Kachura, Shati; Hin: Kakhur; Ben: Sati; Kan: Kachora
Mal: Manjakoova, Adavi-kacholam; Tam: Kichilikizhangu, Nirvisham; Tel: Kacheramu

The round zedoary or Zerumbet is mostly found in India and S. E. Asia. The plant has 4-6 leaves with 20-60cm long lamina. The leaf lamina is oblong-lanceolate, finely acuminate and glabrous on both the surfaces. Flower stalk is 20-25cm long, emerging before the leaves. Flowers are yellow, while the flowering bract is green tinged with red. Calyx is 8mm long, corolla tube is twice as long as the calyx. Capsule is ovoid, trigonous, thin smooth and bursting irregularly. Tubers are palmately branched and camphoraceous (Thakur *et al*, 1989). The identity of the plant sources of the drug *Karcura* is a matter of debate. There is difference of opinion among men of Ayurveda, as to whether *Sati* and *Karcura* are the same drug or different. Many authors consider them different and equate *Sati* with *Hedychium spicatum* Smith. and *Karcura* with *C. zedoaria*, both belonging to Zingiberaceae (Kurup *et al*,1979; Chunekar 1982; Sharma, 1983). Some others treat them to be the same and equate it with *C. zedoaria* (Kirtikar and Basu, 1918; Vaidya, 1936; Nadkarni, 1954; Kapoor and Mitra, 1979). However, the source of *Karcura* in Kerala in the recent times has been *Kaempferia galanga* of the same family. The rhizome of *C. zedoaria is* used as appetiser and tonic, particularly prescribed to ladies after childbirth. In case of cold, a decoction of long pepper (*Piper longum*), cinnamon (*Cinnamomum verum)*, zedoary and honey is given. In Ayurveda it is an ingredient of *"Braticityadi kwatha"*, used in high fever (Thakur *et al*, 1989). Root is useful in flatulence and dyspepsia, and as a corrector of purgatives. Fresh root checks leucorrhoeal and gonorrhoeal discharges. Root powder is a good substitute for many foreign foods for infants. For worms, the juice from the tubers is given to children. Juice of the leaves is given in dropsy (Nadkarni, 1982). It is an odoriferous ingredient of the cosmetics used for the cure of chronic skin diseases caused by impure or deranged blood (Nadkarni, 1998).

Essential oil from rhizomes contains α-pinene, d-camphene, cineole, d-camphor, sesquiterpenes and sesquiterpene alcohols (Husain *et al*, 1992). The novel sesquiterpenoids which have been isolated and characterised are cuzerenone, epi-cuzerenone, iso-furanogermerene, curcumadiol, curcumol, curcumenol, iso-curcumenol, procurcumenol, dehydrocurdione (Hikino *et al*, 1968, 1971, 1972), germacrone-4, 5-epoxide, germacrone, germacrone furanodienone, curcumenol, iso-curcumenol, curcumanolides A and B and curcumenone (Shiobara *et al*, 1985). The starch left after the extraction is purified and sold as a commodity of cottage industry in West-Bengal under the name '*Shoti'* (Rao *et al*, 1928). Ethyl-p methoxy-cinnamate has been isolated from the alcoholic extract of the plant (Gupta *et al*, 1976). Rhizome is stomachic, diuretic, and carminative and gastrointestinal stimulant.

Other important species of *Curcuma* genus are

C. angustifolia Roxb. (Vellakoova)
C. caesia Roxb. (Black ginger)
C. leucorhiza Roxb.
C. pseudomontana Grah.
C. rubescens Roxb.

Agrotechnology

Curcuma species are tropical herbs and can be grown on different types of soils both under irrigated and rainfed conditions. Rich loamy soils having good drainage are ideal for the crop. The plant is propagated by whole or split mother rhizomes. Well developed, healthy and disease free rhizomes are to be selected. Rhizomes are to be treated with copper oxychloride fungicides and stored in cool, dry place or earthen pits plastered with mud and cowdung. The best season of planting is during April with the receipt of pre-monsoon showers. The land is to be prepared to a fine tilth during February-March. On receipt of pre-monsoon showers in April, beds of size 3x1.2m with a spacing of 40cm between beds are to be prepared. Small pits are to be taken in the beds in rows with a spacing of 25-40cm.

Finger rhizomes are to be planted flat with buds facing upwards and covered with soil or dry powdered cattle manure. The crop is to be mulched immediately after planting and 50 days after first mulching. Cattle manure or compost is to be applied as basal dose at 20-40t/ha at the time of land preparation or by spreading over the beds after planting. Application of NPK fertilizers is beneficial and found to increase the yield considerably. Weeding is to be done twice at 60 and 120 days after planting, depending upon weed intensity. Earthing up is to be done after 60 days. No major incidence of pest or disease is noticed in this crop. Leaf blotch and leaf spot can be controlled by spraying Bordeaux mixture or 0.2% Mancozeb. Shoot borers can be controlled by spraying 0.05% Dimethoate or 0.025% Quinalphos. Time of harvest usually extends from January-March. Harvesting is generally done at about 7-10 months after planting depending upon the species and variety. Harvested rhizomes are to be cleaned of mud and other materials adhering to them. Good fingers separated are to be used for curing (KAU, 1996).

INDIAN SARASAPARILLA Hemidesmus indicus Asclepiadaceae

San: Anantamulah, Sariba; Hin: Anantamul, Magrabu; Ben: Anantamul; Mal: Nannari, Naruninti, Narunanti; Tam: Nannari, Saribam; Tel: Sugandipala; Kan: Namadaballi

Importance

Indian Sarasaparilla or Country Sarasaparilla is a climbing slender plant with twining woody stems and a rust-coloured bark. The roots are useful in vitiated conditions of *pitta*, burning sensation, leucoderma, leprosy, skin diseases, pruritus, asthma, bronchitis, hyperdipsia, opthalmopathy, hemicrania, epileptic fits, dyspepsia, helminthiasis, diarrhoea, dysentery, haemorrhoids, strangury, leucorrhoea, syphilis, abcess, arthralgia, fever and general debility. The leaves are useful in vomiting, wounds and leucoderma. The stems are bitter, diaphoretic and laxative and are useful in inflammations, cerebropathy, hepatopathy, nephropathy, syphilis, metropathy, leucoderma, odontalgia, cough and asthma. The latex is good for conjunctivitis (Warrier *et al*, 1995). The important formulations using the drug are *Saribadyasava, Pindataila, Vidaryadi lehya, Draksadi kasaya, Jatyadi ghrita*, etc. (Sivarajan *et al*, 1994). The *Hemidesmus* root powdered and mixed with cow's milk is given with much benefit in the case of strangury. In the form of syrup, it has demulcent and diuretic proportions. The root, roasted in plantain leaves, then beaten into a mass with cumin and sugar and mixed with *ghee* is a household remedy in genito-urinary diseases. The hot infusion of the root-bark with milk and sugar is a good alterative tonic especially for children in cases of chronic cough and diarrhoea (Nadkarni, 1998). It has been successfully used in the cure of venereal diseases where American Sarasaparilla (*Aralia nudicaulis* Linn.) has failed. Native doctors utilize it in nephritic complaints and for sore mouths of children (Grieve and Leyel, 1992).

Distribution

Hemidesmus is distributed throughout India, the Moluccas and Sri Lanka.

Botany

Hemidesmus indicus (Linn.) R. Br. syn. *Periploca indica* Linn. belongs to the family *Asclepiadaceae*. It is a perennial, slender, laticiferous, twining or prostrate, wiry shrub with woody rootstock and numerous slender, terete stems having thickened nodes. Leaves are simple, opposite, very variable from elliptic-oblong to linear-lanceolate, variegated with white above and silvery white and pubescent beneath. Flowers are greenish purple crowded in sub-sessile cymes in the opposite leaf-axils. Fruits are slender follicles, cylindrical, 10cm long, tapering to a point at the apex. Seeds are flattened, black, ovate-oblong and coma silvery white. The tuberous root is dark-brown, coma silvery white, tortuous with transversely cracked and longitudinally fissured bark. It has a strong central vasculature and a pleasant smell and taste (Warrier *et al*, 1995).

The Ayurvedic texts mention two varieties, viz. a krsna or black variety and a sveta or white variety (Aiyer, 1951) which together constitute the pair, *Saribadvayam*. The drug is known as *Sariba*. *Svetasariba* is *H. indicus*. Two plants, namely, *Ichnocarpus fructescens* (Apocynaceae) known as *pal-valli* in vernacular and *Cryptolepis buchanani* (Asclepidaceae) known as *Katupalvalli* (Rheeds, 1689) are equated with black variety or *Krsnasariba* (Chunekar, 1982; Sharma, 1983).

Agrotechnology

Hemidesmus is propagated through root cuttings. The root cuttings of length 3-5cm can be planted in polybags or in the field. They can be planted in flat beds or on ridges. Planting is done usually at a spacing of 50x20cm. Heavy application of organic manure is essential for good growth and root yield. Inorganic fertilizers are not usually applied. Frequent weeding and earthing up are required, as the plant is only slow growing. Provision of standards for twining will further improve the growth and yield of the plant.

Properties and Activity

The twigs of the plant give a pregnane ester diglycoside named desinine. Roots give β-sitosterol, 2-hydroxy-4-methoxy benzaldehyde, α-amyrin, β-amyrin and its acetate, hexatriacontane, lupeol octacosonate, lupeol and its acetate. Leaves, stem and root cultures give cholesterol, campesterol, β-sitosterol and 16-dehydro-pregnenolone. Leaves and flowers also give flavonoid glycosides rutin, hyperoside and iso-quercitin (Husain *et al*,1992). "*Hemidesmine*"- a crystallizible principle is found in the volatile oil extracted from roots. Some suggest that it is only a stearoptene. It also contains some starch, saponin and in the suberous layer, tannic acid (Grieve and Leyel, 1992). The root is alterative, febrifuge, antileucorrhoeic, antisyphilitic, demulcent, diaphoretic, diuretic, tonic, galactogenic, antidote for scorpion-sting and snake-bite, antidiarrhoeal, blood purifier, antirheumatic and aperitive. Essential oil from root is anti-bacterial and the plant is antiviral (Husain *et al*, 1992).

INDIAN SENNA *Cassia senna*

Caesalpiniaceae

San: Svarnapatri; Hin: Sanay, Sana Ka Patt; Ben: Sonamukhi; Mal: Sunnamukki, Chonnamukki, Nilavaka; Tam: Nilavirai, Nilavakai; Tel: Netatangedu

Importance

Indian Senna or **Tinnevelly senna** is a shrub very highly esteemed in India for its medicinal value. The leaves are useful in constipation, abdominal disorders, leprosy, skin diseases, leucoderma, splenomegaly, hepatopathy, jaundice, helminthiasis, dyspepsia, cough, bronchitis, typhoid fever, anaemia, tumours and vitiated conditions of *pitta* and *vata* (Warrier *et al*,1994). It is used in Ayurvedic preparations; "*Pancha Sakara Churna*", "*Shat Sakara Churna*" and "*Madhu Yastyadi Churna*" used for constipation. Its use is widespread in Unani system and some of the important products of this system containing senna are "*Itrifal Mulayyin*", "*Jawarish Ood Mulayyin*", "*Hab Shabyar*", "*Sufuf Mulliyin*", "*Sharbat Ahmad Shahi*", etc. used as a mild laxative (Thakur *et al*, 1989).

Distribution

The plant is of Mediterranean origin. It is found in Somalia, Saudi Arabia, parts of Pakistan and Kutch area of Gujarat. It is largely cultivated in Tirunelveli, Ramanathapuram, Madurai and Salem districts of Tamil Nadu.

Botany

The genus *Cassia*, belonging to the family *Caesalpiniaceae*, comprises of a number of species, namely,

C. senna Linn. syn. *C. angustifolia* Vahl.
C. absus Linn.
C. alata Linn.
C. auriculata Linn.
C. burmanni Wight. syn. *C. obovata* (Linn.) Collad.
C. glauca Lam.
C. javanica Linn.
C. mimosoides Linn.
C. obtusifolia Linn. syn. *C. tora* Linn.
C. occidentalis Linn.
C. pumila Lam.
C. slamea Lam.
C. acutifolia Delile.
C. sophera Linn.

C. senna is a shrub or undershrub, 60-75cm in height with pale subterete or obtusely angled erect or spreading branches. Leaves are paripinnate. Leaflets are 5-8 in number, ovate-lanceolate and glabrous. Flowers are yellowish, many and arranged in axillary racemes. Fruits are flat legumes, greenish brown to dark brown and nearly smooth (Chopra *et al*,1980, Warrier *et al*,1994).

In commerce, the leaves and pods obtained from *C. senna* are known as " *Tinnevelly Senna*" and those from *C. acutifolia* Delile. as *"Alexandrian Senna*". The leaves of *C. acutifolia* are narrower than *C. senna*, otherwise both resemble to a large extent (Thakur *et al*, 1989). All the true Sennas have the portions of their leaves unequally divided. In some kinds the lower part of one side is reduced to little more than a line in breadth, while the other is from a quarter to half an inch in breadth. The drug known under the name of East Indian Senna is nearly free from adulteration; and as its properties appear identical with those of the Alexandrian and the price being less, it probably will supersede it in general practice. Its size and shape readily identify it (Graves, 1996).

Agrotechnology

The plant requires a mild subtropical climate with warm winters which are free from frost for its growth. Semiarid areas with adequate irrigation facilities are ideal for

cultivation. Areas having high rainfall, humidity and poor drainage are not suitable. Light or medium loamy soils with adequate drainage and pH varying from 7.0-8.2 are preferable. In South India both summer and winter crops are possible. The plant is propagated by seeds. The seed rate required is 15-20kg/ha. Seeds are sown in October-November (winter rainfed crop) or in February-March (irrigated crop). Higher seed rate is required for unirrigated crop. Seeds are sown in lines 30cm apart. Application of 5-10t of FYM/ha before planting or raising a green manure crop is beneficial. About 40kg N and 25-50kg P_2O_5/ha applied as basal dressing and 40kg N/ha applied in 2 split dozes as top dressing gave better yield. While the rainfed crop is grown without irrigation, the irrigated crop requires 5-8 light irrigations during the entire growing season. The crop requires 2-3 weedings and hoeings in order to keep it free from weeds. *Alternaria alternata* causes leaf spot and dieback but the disease is not serious. In North India, the plant is attacked by the larvae of butterfly *Catopsilia pyranthe* which can be controlled by planting the crop in March-April instead of June-July. Under irrigated conditions, the first crop is obtained after 90 days of planting. The leaves are stripped by hand when they are fully green, thick and bluish-green in colour. The second crop is taken 4 weeks after the first harvest and the third 4-6 weeks after the second one. The last harvest of leaves is done when the entire crop is harvested along with the pods. Yield under irrigated conditions is nearly1.4t of leaves and 150kg pods/ha and under unirrigated conditions is 500-600kg leaves and 80-100kg pods/ha. The leaves are dried in thin layers under shade so as to retain the green colour and the pods are hung for 10-12 days to get dried. The leaves and pods are cleaned, graded and marketed (Husain *et al*, 1993).

Properties and Activity

Leaves contain glucose, fructose, sucrose and pinnitol. Mucilage consists of galactose, arabinose, rhamnose and galacturonic acid. Leaves also contain sennoside-C(8,8'-diglucoside of rhein-aloe-emodin-dianthrone). Pods contain sennosides A and B, glycoside of anthraquinones rhein and chrysophanic acid. Seeds contain β-sitosterol (Husain *et al*, 1992). Leaves and pods also contain 0.33% β-sterol and flavonols-kaempferol, kaempferin, and iso-rhamnetin. Sennoside content of *C. acutifolia* is higher ranging from 2.5% to 4.5% as compared to *C. angustifolia* ranging from 1.5 % to 2.5%.

The purgative activity of Senna is attributed to its sennosides. The pods cause lesser griping than the leaves. Leaf and pod is laxative. The leaves are astringent, bitter, sweet, acrid, thermogenic, cathartic, depurative, liver tonic, anthelmintic, cholagogue, expectorant and febrifuge.

NAGADANTI Baliospermum montanum Euphorbiaceae

San: Danti; Hin: Danti; Mal: Danti, Nagadanti; Tam: Nakatanti; Tel: Nelajidi

Importance

Danti or *Nagadanti* is a stout undershrub with numerous flowers. Root, which is the officinal part, is used in abdominal pain, constipation, calculus, general anasarca, piles, helminthic manifestations, scabies, skin disorders, suppurative ulcers and diseases caused by the morbidity of *kapha* and *pitta*. Root paste is applied to painful swellings and piles. Leaves cure asthma and seeds are used in snakebite (Kurup *et al*, 1979; Sharma, 1983). The drug forms an important constituent of preparations like *Dantyarishta, Dantiharitakileham, Kaisoraguggulu gulika*, etc.(Sivarajan *et al*, 1994).

Distribution

The plant is found throughout the sub-Himalayan tracts from Kashmir to Khasi Hills. It is common in West Bengal, Bihar and Central and Peninsular India.

Botany

Baliospermum montanum (Willd.) Muell-Arg. syn. *B. axillare* Bl., *B. polyandrum* Wt. belongs to the family *Euphrobiaceae*. It is a stout under-shrub 0.9-1.8m in height with herbaceous branches from the roots. Leaves are simple, sinuate-toothed, upper ones small, lower ones large and sometimes palmately 3-5 lobed. Flowers are numerous, arranged in axillary racemes with male flowers above and a few females below. Fruits are capsules, 8-13mm long and obovoid. Seeds are ellipsoid smooth and mottled (Warrier *et al*,1993).

Agrotechnology

The tropical plant is suited to almost all soils. It can be cultivated either as pure crop or intercrop. It is propagated vegetatively by cuttings. About 15-20cm long rooted cuttings are used for planting. Pits of size 50cm cube are to be taken at 3m spacing and filled with dried cowdung, sand and top soil and formed into a mound. On these mounds, rooted cuttings are to be planted at 2 cuttings/mound. Cuttings establish within one month. Weeding is to be carried out at this time. Application of organic manure after every 6 months is beneficial. Irrigation during summer months is preferable. The plant is not attacked by any serious pests or diseases. Roots can be collected at the end of second year. The roots are to be cut and dried in sun before marketing. The yield is about one tonne root/ha (Prasad *et al*,1997).

Properties and Activity

Roots contain diterpenes, baliospermin, montanin, phorbol-12-deoxy-13-O-palmitate, phorbol-12-deoxy-16-hydroxy-13-O-palmitate and phorbol-12-deoxy-5β-hydroxy-13 – myristate (Ogura *et al*, 1978). Alcoholic extract of plant showed hypotensive activity in experimental animals (Bhakuni *et al*, 1971). Antilukaemic and cytotoxic activities have been demonstrated in the esters of both 12-deoxyphorbol and 12-deoxy-16-hydroxyphorbol, isolated from B. montanum (King-horn, 1979). The roots are acrid, thermogenic, purgative, antiinflammatory, anodyne, digestive, anthelmintic, diuretic, diaphoretic, rubefacient, febrifuge and tonic. Seed is purgative, stimulant, rubefacient and antidote for snakebite. Seed oil is antirheumatic. Leaf is antiasthmatic and wound healing. Root and seed oil is cathartic and antidropsical. Stem is anti-dontalgic.

ALSTONIA *Alstonia venenata*

Apocynaceae

San: Visaghni, Anadana; Mal: Analivegam; Tam: Sinnappalai; Kan: Addasarpa

Importance

Alstonia is a large shrub with straight bole and growing upto about 6m height. The roots are useful in skin diseases, erysipelas, leprosy, cobra bite and other venomous bites, epilepsy, fatigue, fever and otalgia. The fruits are useful in syphilis, insanity and epilepsy. The plant is believed to repel snakes.

Distribution

The plant is distributed throughout India in deciduous forests in areas up to 1800m elevation.

Botany

Alstonia venenata R.Br., belonging to the family *Apocynaceae,* is a large shrub to small tree up to 6m in height with greyish brown bark and bright yellow hard and woody root. Leaves are simple, arranged in whorls of 3-6, membranous, lanceolate, margins wavy, finely acuminate, main nerves numerous, close, parallel and united by inter marginal nerve. Flowers are white, arranged in terminal sub umbellate cymes or in racemes. Fruits are fusiform with stalked and beaked follicles, tapering at both ends. Seeds are many flattened with a tuft of hair at each end (Warrier *et al*, 1993). Other important species belonging to the genus *Alstonia* are the following.

1. *A. scholaris* R. Br.

This tree is common throughout India. The bark is valuable in debility and after effects of fever, chronic diarrhoea, dysentery and catarrhal fever. The milky juice is applied to ulcers and rheumatic pains, mixed with oil and dropped into ear to relieve earache. Ditanin is the active principle of the bark, possessing powerful febrifuge properties. The bark is astringent, tonic and febrifuge (Nadkarni, 1998).

2. *A. spectabilis* R. Br.

It is a large evergreen tree seen in tropical forests of Andamans. The bark contains alkaloids such as alstonamine, ditamine, echitamine and echitenine (Chopra *et al*,1980)

Agrotechnology

The plant is propagated mainly by seeds. Seeds are to be sown on seedbeds and germinated ones are to be transferred to polybags. About three months old seedlings are used for transplanting. If seeds are not available, thin stem cuttings can be planted in polybags and rooted cuttings used. Pits of size 60cm cube are to be taken at 3m spacing, filled with dried cowdung, sand and topsoil and made into a mound. To this mounds seedlings from polybags are to be transplanted. Irrigation is essential during early stages of growth. Application of organic manure every year is beneficial. Regular weeding is to be done. The plant is not attacked by any serious pests or diseases. Flowers are formed in the first year itself. It can be used for medicinal purposes after seven years of growth. Fruits and roots are the economical parts (Prasad *et al*,1997).

Properties and Activity

The plant is a rich source of indole alkaloids. Alkaloids are present in various parts. Stem bark and root contain venenatine, alstovenine, 3-dehydroalstovenine and reserpine. Stem bark contains venoxidine (venenatine N_b-oxide), anhydroalstonatine, kopsinine, venalstonine, venalstonidine(venalstonine-6,7-epoxide), echitovenine and veneserpine. Fruits contain echitovenidine, (+)minovincinine, echitoserpidine, echitoserpine, echitoveniline, 11-methoxy echitovonidine, 11-methoxy (-) minovinicinine, echitoserpiline, (-)vincadifformine, 11-methoxy(-)vincadifformine and venoterpine. Leaves contain echitovenaldine, echitoveniline, alstolenine, deacetylakuammiline, polynuridine, dihydropolynuridine and raucaffrininoline. The yellow tint in bark is because of the presence of Δ^3-alstovenine. A number of indole alkaloids have been further isolated from the plant. In addition to alkaloids fruits contain β-amyrin acetate and lupeol ester of β-hydroxy acid (Husain *et al*,1992).

The root is bitter, astringent, thermogenic, depurative, antitoxic, febrifuge and anodyne. The alkaloid alstovenine in lower doses exhibited monoamine oxidase inhibitor activity, while in higher doses it showed marked central stimulant effect. Veninatine exhibited reserpine like activity. Alcoholic extract of the fruits showed initial activation effect on acetylcholine esterase, followed alternately by inhibition and activation of the enzyme.

PURGING CROTON *Croton tiglium* *Euphorbiaceae*

San: Jepalah, Dantibijah Hin: Jamalgota Ben: Jaypal Mal: Nirvalam
Tam: Nervalam, Sevalamkottai Tel: Nepala

Importance

Purging croton or **croton oil plant**, a small evergreen tree with separate male and female flowers, is one among the seven poisons described in Ayurveda. The drug is well known for its drastic purgative property. The drug is found to be useful in ascites, anasarca, cold, cough, asthma, constipation, calculus, dropsy, fever and enlargement of the abdominal viscera. The seed paste is a good application for skin diseases, painful swellings and alopacia. The seed-oil is useful in chronic bronchitis, laryngeal affections, arthritis and lock jaw. Misraka-sneham is an important preparation using the drug (Nadkarni, 1954; Dey, 1980; Sharma, 1983).

Distribution

It is distributed throughout North India. It is cultivated in Assam, West Bengal and South India.

Botany

Croton tiglium Linn. belongs to the family *Euphorbiaceae*. It is a small evergreen tree, 4.5-6.0m in height with ash coloured smooth bark and young shoots sprinkled with stellate hairs. Leaves are oblong to ovate-lanceolate, obtuse or rounded at the 2-glanded box, acuminate, membraneous, yellowish green and minutely toothed. Flowers are small, unisexual, males on slender pedicels, females larger and on short thick pedicels. Fruits are ovoid or oblong trigonous capsules. Seeds are smooth, testa black and enclosing reddish brown oily endosperm (Warrier *et al*,1994). Other species belonging to the genus *Croton* are as follows:

C. aromaticus Linn.
C. caudatus Geisel
C. jouera Roxb.
C. malabaricus Bedd.
C. oblongifolius Roxb.
C. polyandrus Roxb. syn. *Baliospermum montanum* Muell-Arg.
C. reticulatus(Chopra *et al*, 1980)

Agrotechnology

The plant is propagated by seeds. Seeds are to be sown on seedbeds and about 2 months old seedlings are used for transplanting. Pits of size 50cm cube are to be taken at 3m spacing and filled with dried cowdung, sand and topsoil and formed into a mound. The seedlings are to be planted on these mounds. Irrigation during summer months is beneficial. Application of organic manure after every 6 months is desirable. Weeding is to be carried out one month after transplanting. The plant is not attacked by any serious pests or diseases. Fruits are formed at the end of first year. Fruits when ripen and start to crack are to be collected, dried in sun, then the outer shell is removed and again dried for one day before marketing (Prasad *et al*,1997).

Properties and activity

Oil contains phorbol myristate acetate (Husain *et al*, 1992). Seeds contain upto 20% protein and 30-50% lipids. Iso-guanine-D-ribose (crotoniside) and saccharose were isolated from the seeds. In fractionation of croton oil, liquid-liquid distribution procedures proved to be the separation tools of choice. The per hydrogenated parent hydrocarbon of phorbol is a perhydrocyclopropabenzulene called tigliane and phorbol is 1, 1aα, 1bβ, 4, 4a, 7aα, 7b, 8, 9, 9a-decahydro-4aβ, 7α, 9β, 9aα-tetrahydroxy-3-(hydroxymethyl)-1, 1, 6, 8α tetramethyl-5-H-cyclopropa[3,4] benz [1.2-e]azulen-5-one. Phorbol, a tetracylic diterpene with a 5, 7, 6 and 3- membered ring has 6 oxygen functions. Phorbol accounts for 3.4% and 4- deoxy- 4α- phorbol for 0.29% of the weight of croton oil. Twenty-five phorbol-12, 13-diesters have been detected (Hecker *et al*, 1974). A toxin croton 1, mol. wt 72,000 has been isolated from the seeds (Lin *et al*, 1978).

Phorbol myristate acetate activates nitroblue tetrazolium reduction in human polymorphs. Seed and oil is purgative, rubefacient and anti-dote for snakebite. The seeds and oil are acrid, bitter, thermogenic, emollient, drastic purgative, digestive, carminative, anthelmintic, antiinflammatory, vermifuge, deterent, diaphoretic, expectorant, vesicant, irritant and rubefacient.

ASHOKA *Saraca asoca*

Caesalpiniaceae

San:Asoka, Gatasokah; Hin:Asok, Asoka; Ben:Ashok; Mal:Asokam; Tam: Asogam; Kan:Asokada, Aksunkara; Tel: Asokamu, Vanjalamu

Importance

Ashoka, the sacred tree of Hindus and Buddhists, possesses varied medicinal uses. The bark is useful in dyspepsia, fever, dipsia, burning sensation, visceromegaly, colic, ulcers, menorrhagia, metropathy, leucorrhoea and pimples. The leaf juice mixed with cumin seeds is used for treating stomachalagia. The floweres are considered to be uterine tonic and are used in vitiated conditions of *pitta*, syphilis, cervical adinitis, hyperdipsia, burning sensation, haemorrhoids, dysentery, scabies in children and inflammation. The well-known Ayurvedic preparations are "*Ashokarishta*" and "*Ashokaghrita*". *Ashokarishta* is prescribed in leucorrhoea, haematuria, menorrhagia and other diseases of genitourinary system of females.

Distribution

Ashoka is found almost throughout India, except North-Western India, upto 750m. It is also found in the Andaman Islands.

Botany

Saraca asoca (Roxb.) de Wilde. syn. *S. indica* auct. non Linn. is a medium sized evergreen tree growing upto 9m height with numerous spreading and drooping glabrous branches. Leaves are pinnate, 30-60cm long having 2-3 pairs of lanceolate leaflets. Flowers are orange or orange yellow, arranged in dense corymbs and very fragrant. Fruits are flat black pods, leathery and compressed with 4-8 seeds/pod. Seeds are ellipsoid oblong and compressed. The bark is dark brown to grey or black with a warty surface. The thickness varies from 5mm to 10mm. The entire cut surface turns reddish on exposure to air. *Polyalthia longifolia* (*Annonaceae*) is equated with the name *Asoka* by some (Kapoor & Mitra, 1979; Chunekar, 1982) and is often used as an adulterant of the genuine *Asoka* bark or as a substitute (Warrier *et al*,1996).

Agrotechnology

Asoka grows well in areas with well distributed rainfall and in slightly shady areas. *Asoka* requires soil rich in organic mater and moisture. The best season of planting is June-July. It is also grown in summer, if irrigation facilities are available. The plant is seed propagated. Seeds are formed usually during February-April. Seeds are collected when they are ripen and fall down and are sown after soaking in water for 12 hours on the prepared beds. Seeds germinate within 20 days. The seeds are then planted in polybags. 2-month-old seedlings from the polybags are used for transplanting. Square shaped pits of 60cm depth are taken at 3m spacing and filled with topsoil, sand and dried cowdung. On this the seedlings are planted. Application of FYM at 10kg/tree/year is highly beneficial. Chemical fertilisers are not usually applied. Irrigation during summer months is essential. No serious pests or diseases are generally noted in this crop. If properly cultivated, *Asoka* can be cut after 20 years and the bark collected. It is cut at a height of 15cm from the soil level. If given irrigation and fertilisers, the cut wood will sprout again and harvested again after 5 years. This can be continued. When it is difficult to cut the tree, the bark can be peeled off from one side first. When the bark grows and cover that part, the other side can be peeled off. This is also continued (Prasad *et al*, 1997; Karshakasree, 1998).

Properties and Activity

Flowers give β-sitosterol, flavonoids and flavone glycosides-quercetin, kaempferol-3-O-β-D-glucoside, quercetin-3-O-β-D-glucoside. The anthocyanins present are pelargonidin-3, 5-diglucoside and cyanadin-3, 5-diglucoside. Bark yields catechol and sterols-(24ζ)-24-methyl cholest-5-en-3β-ol, (22E, 24ζ)-24-ethylcholesta-5, 22-dien-3 β-ol and (24ζ)-24-ethyl cholest-5-en-3β-ol, a wax containing n-alkanes, esters and free primary alcohols. Alcoholic extract and glycoside P_2 from stem bark is oxytoxic. Aerial part is CNS active, hypothermic, CNS depressant and diuretic. Stem bark is anticancerous, has spasmodic action on rabbit intestine and cardiotonic action in frog and dog. Seed is antifungal. Stem bark is astringent, antileucorrhoeic, antibilious and uterine sedative. Flower is uterine tonic, antidiabetic and antisyphilitic. Stem bark and flower is antibilious (Husain *et al*, 1992).

GREEN CHIRETTA *Andrographis paniculata* *Acanthaceae*

San: Bhunimbah, Kiratatiktah Hin: Kakamegh, Kalpanath Ben: Kalmegh
Mal: Nilaveppu, Kiriyattu Tam: Nilavempu Kan: Kreata

Importance

Kalmegh, the Great or **Green Chiretta** is a branched annual herb. It is useful in hyperdipsia, burning sensation, wounds, ulcers, chronic fever, malarial and intermittent fevers, inflammations, cough, bronchitis, skin diseases, leprosy, pruritis, intestinal worms, dyspepsia, flatulence, colic, diarrhoea, dysentery, haemorrhoids and vitiated conditions of *pitta* (Warrier *et al*, 1993). It is used to overcome *sannipata* type of fever, difficulty in breathing, hemopathy due to the morbidity of *kapha* and *pitta*, burning sensation, cough, oedema, thirst, skin diseases, fever, ulcer and worms. It is also useful in acidity and liver complaints (Aiyer and Kolammal, 1962). The important preparations using the drug are *Tiktakagheta, Gorocandi gulika, Candanasava, Panchatiktam kasaya*, etc. (Sivarajan *et al*, 1994). A preparation called "*Alui*" is prepared by mixing powdered cumin (*Cuminium cyminum*) and large cardamom (*Amomum subulatum*) in the juice of this plant and administered for the treatment of malaria (Thakur *et al*, 1989). It is also a rich source of minerals.

Distribution

The plant is distributed throughout the tropics. It is found in the plains of India from U.P to Assam, M.P., A.P, Tamil Nadu and Kerala, also cultivated in gardens.

Botany

Andrographis paniculata (Burm.f.) Wall ex. Nees belongs to the family *Acanthaceae*. It is an erect branched annual herb, 0.3-0.9m in height with quadrangular branches. Leaves are simple, lanceolate, acute at both ends, glabrous, with 4-6 pairs of main nerves. Flowers are small, pale but blotched and spotted with brown and purple distant in lax spreading axillary and terminal racemes or panicles. Calyx-lobes are glandular pubescent with anthers bearded at the base. Fruits are linear capsules and acute at both ends. Seeds are numerous, yellowish brown and sub-quadrate (Warrier *et al*,1993).

Another species of Andrographis is *A. echioides* (Linn.) Nees. It is found in the warmer parts of India. The plant is a febrifuge and diuretic. It contains flavone-echiodinin and its glucoside-echioidin (Husain *et al*, 1992).

Agrotechnology

The best season of planting Andrographis is May-June. The field is to be ploughed well, mixed with compost or dried cowdung and seedbeds of length 3m, breadth 1/2m and 15cm height are to be taken at a distance of 3m. The plant is seed propagated. Seeds are to be soaked in water for 6 hours before sowing. Sowing is to be done at a spacing of 20cm. Seeds may germinate within 15-20 days. Two weedings, first at one month after planting and the second at 2 month after planting are to be carried out. Irrigation during summer months is beneficial. The plant is not attacked by any serious pests or diseases. Flowering commences from third month onwards. At this stage, plant are to be collected, tied into small bundles and sun-dried for 4-5 days. Whole plant is the economic part and the yield is about 1.25t dried plants/ha (Prasad *et al*, 1997).

Properties and Activity

Leaves contain two bitter substances lactone "andrographolid" and "kalmeghin". The ash contains sodium chloride and potassium salts. Plant is very rich in chlorophyte. Kalmeghin is the active principle that contains 0.6% alkaloid of the crude plant. The plant contains diterpenoids, andrographolide, 14-deoxy-11-oxo-andrographolide, 14-deoxy-11,12-dihydroandrographolide, 14-deoxy andrographolide and neoandrographolide (Allison *et al*, 1968). The roots give flavones-apigenin-7,4-dio-O-methyl ether, 5-hydroxy-7,8,2',3'-tetramethoxyflavone, andrographin and panicolin and α-sitosterol (Ali *et al*, 1972;

Govindachari *et al*, 1969). Leaves contain homoandrographolide, andrographosterol and andrographone.

The plant is vulnerary, antipyretic, antiperiodic, anti-inflammatory, expectorant, depurative, sudorific, anthelmintic, digestive, stomachic, tonic, febrifuge and cholagogue. The plant is antifungal, antityphoid, hepatoprotective, antidiabetic and cholinergic. Shoot is antibacterial and leaf is hypotensive(Garcia *et al*, 1980). This is used for the inflammation of the respiratory tract. In China, researchers have isolated the andrographolide from which soluble derivative such as 14-deoxy-11, 12-dehydro-andrographolide which forms the subject of current pharmacological and clinical studies. Apigenin 7,4'-O-dimethyl ether isolated from *A. paniculata* exhibits dose dependent, antiulcer activity in shay rat, histamine induced ulcer in guinea pigs and aspirin induced ulcers in rats. A crude substance isolated from methanolic extract of leaves has shown hypotensive activity. Pre-treatment of rats with leaf (500mg/kg) or andrographolide (5mg/kg) orally prevented the carbon tetrachloride induced increase of blood serum levels of glutamate-oxaloacetate transaminase in liver and prevented hepatocellular membrane.

GARDEN RUE *Ruta chalepensis*

Rutaceae

San: Gucchapatra; Hin: Pismaram, Sadab, Satari; Ben: Ermul; Mal: Aruta, Nagatali; Tam: Aruvadam, Arvada; Kan: Sadabu, Nagadali; soppu, Simesdanu; Tel: Sadapa, Aruda

Importance

Common rue or **Garden rue** also known as **Herb of Grace** due to its service in the Roman Catholic Church for sprinkling the holy water among the congregation, is an aromatic perennial herb. The plant is useful in vitiated conditions of *kapha* and *vata*, strangury, fever, flatulence, colic, amenorrhoea, epilepsy and hysteria. The oil acts as a stimulant for uterine and nervous systems. The fresh leaves are used for rheumatalgia. The juice obtained from the leaves is given to children for helminthic infections and is good for odontalgia and otalgia (Warrier *et al*, 1996). The dried leaves, powdered and combined with aromatics, are given as a remedy for dyspepsia and with the fresh leaves a tincture is made which is used as an external remedy in the first stages of paralysis (Nadkarni, 1998).

Distribution

The plant is a native of South Europe and it is found in subtropical countries. It is commonly cultivated in Indian gardens.

Botany

Ruta chalepensis Linn.syn. *R. graveolens* Linn. var. *angustifolia* Sensu Hook. f. belongs to the family *Rutaceae*. It is an aromatic perennial herb growing upto 75cm height. Leaves are compound, shortly petiolate with ultimate segments oblong or obovate-oblong. Flowers are yellow. Fruits are capsules and shortly pedicelled (Warrier *et al*, 1996).

Agrotechnology

The plant is suited to areas which are about 1000m above mean sea level and with moderate rainfall and sunlight. The plant can be propagated either by seeds or stem cuttings. Seeds are to be sown in seedbeds. Stem cuttings of length 20-25cm are to be planted in polybags for rooting. About 3-4 months old seedlings can be transplanted to pots and harvested when plants attain 6-8 months age. In highlands land is to be ploughed to a fine tilth, mixed with organic manure and seedlings are to be transplanted at a spacing of 45cm between plants. Irrigation is essential during summer months. Regular weeding is to be done. The plant is not attacked by any serious pests and diseases. Harvesting commences from sixth month onwards. The economic part is the whole plant and the oil extracted from it (Prasad *et al*, 1997).

Properties and Activity

Roots contain coumarins-xanthyletin and (-)-byakangelicin. The alkaloids are rutacridone-epoxide, gravacridonol and its monomethyl ether, gravacridonchlorine, furacridone, 1-hydroxy-3-methoxy-N-methylacridone, iso-gravacridonechlorine, dictamine, r-fragarine and skimmianine. Skimmianine is also present in leaves and stem. Leaves and stem also contain graveolinine (1-methyl-2(3',4'-methylenedioxyphenol)-4-methoxy-quinoline). Aerial parts give coumarins bergapten, xanthotoxin and psoralen. Coumarin-imperatin has also been reported from the plant. Herb contains alkaloids such as kokusagenine, rutamine(methylgraveoline) and graveoline(1-methyl-2(3',4'-methylenedioxyphenyl)-4-quinoline). Tissue culture of the plant gives furacridone alkaloids-1-hydroxyrutacridone-epoxide, rutagravin and gravacridonol. Gravacridondiol and its glucoside have been obtained from the root tissue culture. The essential oil from leaves, stem and root yielded aliphatic ketones including 2-nonanone (10-35%), undecyl-2-acetate (0.5-15%), 2-nonyl acetate (trace-10%), nonylacetate, nonanol, 2-nonylpropionate, 2-nonylpropionate, 2-undecanol and its esters. The oil from roots gave pregeijerene also.

The plant is spasmolytic which is due to the presence of bergapten, xanthotoxin, the essential oil and a coumarin. It is also antispasmodic, emmenagogue, irritant, abortifacient and anti-bacterial. Leaf is analgesic, antirheumatic, antihysteric and anthelmintic (Husain *et al*, 1992).

WORM KILLER Aristolochia bracteolata Aristolochiaceae

San: Kitamari Hin: Kiramar, Kitamar Mal: Attuthottappala, Atuthinnappala Tam: Atutinnappalai

Importance

The **bracteated birthwort** or **worm killer** is a perennial prostrate herb. As the name suggests it is a killer of intestinal worms especially roundworms. It is also used in vitiated conditions of *kapha* and *vata*, constipation, inflammations, amenorrhoea, dysmenorrhoea, foul ulcers, boils, syphilis, gonorrhoea, dyspepsia, colic, skin diseases, eczema, artheralgia and intermittent fevers. The plant is an insect repellent due to the presence of aristolochic acid, which is poisonous to man and livestock. Plant is also used against scorpion sting. Seeds ground in water to form a lotion and used for softening hair. Powdered root is used in fertility control.

Distribution

The plant is found in Sri Lanka, Arabian countries and tropical Africa. In India, the plant is grown in Deccan and Carnatic Plateau.

Botany

Aristolochia bracteolata Lam. syn. *A. bracteata* Retz. belongs to the family *Aristolochiaceae*. It is a perennial prostrate herb with weak, glabrous stems. Leaves are simple, alternate, reniform or broadly ovate, cordate at the base with a wide sinus upto 7.5cm in diameter, reticulately veined. Flowers are solitary with a large sessile orbicular bract at the base. Perianth tube is cylindric with dark purple tip having revolute margins. Fruits are oblong-ellipsoid 12-ribbed glabrous capsules. Seeds are deltoid with slightly cordate base (Warrier *et al*, 1993)

Another important species belonging to the genus *Aristolochia* is *A. indica* Linn. The plant grows wild throughout the low hills and plains of India from Nepal to West Bengal and South India. It is a valuable anti-dote to snake bite and to bites of poisonous insects as scorpion, etc. It is given in cases of cholera and diarrhoea after macerating with black pepper corns. The juice of the leaves has stimulant, tonic and antiperiodic properties.

Agrotechnology

Shady areas and well-drained soils are most suited to *Aristolochia*. The plant can be seed propagated. 3-month-old seedlings raised in polybags are required for transplanting. Pits of size 50cm cube are to be taken at a distance of 3m and filled with sand, topsoil and dried cowdung. To these pits, the seedlings are to be transplanted. Regular irrigation and organic manure application is beneficial. The plant is to be trailed on iron wires tied to poles. The plant is not attacked by any serious pests or diseases. Plant attains good spread within one year. Leaves can be collected for the next 10 years. Roots and leaves constitute the economic parts (Prasad *et al*, 1997).

Properties and Activity

Leaves and fruits yield ceryl alcohol, β-sitosterol and aristolochic acid. Root contains aristolochic acid. Seeds give an alkaloid magnoflorine, aristolochic acid, fatty oil comprising palmitic, stearic, lignoseric and oleic acids and β-sitosterol.

The plant is anthelmintic, cathartic, antiperiodic and emmenagogue. Leaf is antigonorrhoeic, larvicidal and used in eczema on children's leg and ulcers. The plant is oxytocic (Husain *et al*,1992).

FICUS *Ficus spp.*

Moraceae

The genus *Ficus* constitutes an important group of trees with immense medicinal value. It is a sacred tree of Hindus and Buddhists. Among the varied number of species, the most important ones are the four trees that constitute the group "*Nalpamaram*", namely, *F .racemosa, F. microcarpa, F. benghalensis and F. religiosa* (*Athi, Ithi, Peral and Arayal* respectively).

1. *Ficus racemosa* Linn. syn. *F. glomerata* Roxb.

Eng: Cluster fig, Country fig San: Udumbarah, Sadaphalah Hin: Gular, Umar Ben: Jagya dumur Mal, Tam, Kan: Athi Tel: Udambaramu, Paidi

Gular fig, Cluster fig or Country fig, which is considered sacred, has golden coloured exudate and black bark. It is distributed all over India. Its roots are useful in treating dysentery. The bark is useful as a wash for wounds, highly efficacious in threatened abortions and recommended in uropathy. Powdered leaves mixed with honey are given in vitiated condition of *pitta*. A decoction of the leaves is a good wash for wounds and ulcers. Tender fruits (figs) are used in vitiated conditions of *pitta*, diarrhoea, dyspepsia and haemorrhages. The latex is administered in haemorrhoids and diarrhoea (Warrier *et al*, 1995). The ripe fruits are sweet, cooling and are used in haemoptysis, thirst and vomiting (Nadkarni, 1954; Aiyer *et al*, 1957; Moos, 1976). *Nalpamaradi coconut oil, Candanasava, Valiya Arimedastaila, Dinesavalyadi Kuzhambu, Abhrabhasma, Valiya candanaditaila*, etc. are some important preparations using the drug (Sivarajan *et al*, 1994).

It is a moderate to large-sized spreading laticiferous, deciduous tree without many prominent aerial roots. Leaves are dark green and ovate or elliptic. Fruit receptacles are 2-5cm in diameter, sub-globose or pyriform arranged in large clusters on short leafless branches arising from main trunk or large branches. Figs are smooth or rarely covered with minute soft hairs. When ripe, they are orange, dull reddish or dark crimson. They have a pleasant smell resembling that of cedar apples. The bark is rusty brown with a fairly smooth and soft surface, the thickness varying from 0.5-2cm according to the age of the trunk or bark. Surface is with minute separating flakes of white tissue. Texture is homogeneously leathery (Warrier *et al*, 1995).

Stem-bark gives gluanol acetate, β-sitosterol, leucocyanidin-3-O-β-D-glucopyrancoside, leucopelargonidin-3-O-β-D-glucopyranoside, leucopelargonidin -3-O-α-L-rhamnopyranoside, lupeol, ceryl behenate, lupeol acetate and α-amyrin acetate. Stem- bark is hypoglycaemic and anti-protozoal. Gall is CVS active. Bark is tonic and used in rinder pest diseases of cattle. Root is antidysenteric and antidiabetic. Leaf is antibilious. Latex is antidiarrhoeal and used in piles. Bark and syconium is astringent and used in menorrhagia (Husain *et al*, 1992).

2. *Ficus microcarpa* Linn. f. syn. *F. retusa* auct. Non. Linn.

San: Plaksah; Hin, Ben: Kamarup; Mal: Ithi, Ithiyal; Tam: Kallicci, Icci; Kan: Itti; Tel: Plaksa

Plaksah is the Ficus species with few branches and many adventitious roots growing downward. It is widely distributed throughout India and in Sri Lanka, S. China, Ryuku Isles and Britain. *Plakasah* is one of the five ingredients of the group *panchvalkala i.e*, five barks, the decoction of which is extensively used to clear ulcers and a douche in leucorrhoea in children. This decoction is administered externally and internally with satisfactory results. *Plaksah* is acclaimed as cooling, astringent, and curative of *raktapitta doshas*, ulcers, skin diseases, burning sensation, inflammation and oedema. It is found to have good healing property and is used in preparation of oils and ointments for external application in the treatment of ulcers (Aiyer and Kolammal, 1957). The stem-bark is used to prepare *Usirasava, Gandhataila, Nalpamaradi taila, Valiya marmagulika*, etc. (Sivarajan et al, 1994). The bark and leaves are used in wounds, ulcers, bruises, flatulent colic, hepatopathy, diarrhoea, dysentery, diabetes, hyperdipsia, burning sensation, haemaorrhages, erysipelas, dropsy, ulcerative stomatitis, haemoptysis, psychopathy, leucorrhoea and coporrhagia (Warrier *et al*,1995)

F. microcarpa is a large glabrous evergreen tree with few aerial roots. Leaves are short-petioled, 5-10cm long, 2-6cm wide and apex shortly and bluntly apiculate or slightly emarginate. Main lateral nerves are not very prominent and stipules are lanceolate. Fruit receptacles are sessile and globose occurring in axillary pairs. It is yellowish when ripe without any characteristic smell. Bark is dark grey or brown with a smooth surface except for the lenticels. Outer bark is corky and crustaceous thin and firmly adherent to inner tissue. Inner bark is light and flesh coloured with firbrous texture (Warrier et al, 1995). It is also equated with many other species of the genus. *viz. F.*

infectoria Roxb., *F. arnottiana* Miq, *F. lacor* Buch-Ham and *F. talboti* King (cf. Nadkarni, 1954, Singh and Chunekar, 1972; Kapoor and Mitra, 1979; Sharma, 1983).

The bark contains tannin, wax and saponin. Bark is antibilious. Powdered leaves and bark is found very good in rheumatic headache. The bark and leaves are astringent, refrigerant, acrid and stomachic.

3. *Ficus benghalensis* Linn.

Eng: Banyan tree; San: Nyagrodhah, Vatah; Hin: Bat, Bargad; Ben: Bar, Bot; Mar: Vada; Mal: Peral, Vatavriksham; Tam: Alamaram, Peral; Kan: Ala; Tel: Peddamarri; Guj: Vad

Banyan tree is a laticiferous tree with reddish fruits, which is wound round by aerial adventitious roots that look like many legs. It is found in the Sub-Himalayan tract and Peninsular India. It is also grawn throughout India. It is widely used in treatment of skin diseases with pitta and rakta predominance. Stem-bark, root -bark, aerial roots, leaves, vegetative buds and milky exudate are used in medicine. It improves complexion, cures erysepelas, burning sensation and vaginal disorders, while an infusion of the bark cures dysentery, diarrhoea, leucorrhoea, menorrhagia, nervous disorders and reduces blood sugar in diabetes. A decoction of the vegetative buds in milk is beneficial in haemorrhages. A paste of the leaves is applied externally to abcesses and wounds to promote suppuration, while that of young aerial roots cure pimples. Young twigs when used as a tooth brush strengthen gum and teeth (Nadkarni, 1954; Aiyer and Kolammal, 1957; Mooss,1976). The drug forms an important constituent of formulations like *Nalpamaradi Coconut oil, Saribadyasava, Kumkumadi taila, Khadira gulika, Valiyacandanadi taila, Candanasava, etc*. (Sivarajan et al, 1994). The aerial roots are useful in obstinate vomiting and leucorrhoea and are used in osteomalacia of the limbs. The buds are useful in diarrhoea and dysentery. The latex is useful in neuralgia, rheumatism, lumbago, bruises, nasitis, ulorrhagia, ulitis, odontopathy, haemorrhoids, gonorrhoea, inflammations, cracks of the sole and skin diseases (Warrier *et al*, 1995).

It is a very large tree up to 30m in height with widely spreading branches bearing many aerial roots functioning as prop roots. Bark is greenish white. Leaves are simple, alternate, arranged often in clusters at the ends of branches. They are stipulate, 10-20cm long and 5-12.5cm broad, broadly elliptic to ovate, entire, coriaceous, strongly 3-7 ribbed from the base. The fruit receptacles are axillary, sessile, seen in pairs globose, brick red when ripe and enclosing male, female and gall flowers. Fruits are small, crustaceous, achenes, enclosed in the common fleshy receptacles. The young bark is somewhat smooth with longitudinal and transverse row of lenticels. In older bark, the lenticels are numerous and closely spaced; outer bark easily flakes off. The fresh cut surface is pink or flesh coloured and exudes plenty of latex. The inner most part of the bark adjoining the wood is nearly white and fibrous (Warrier *et al*, 1995).

The bark yields flavanoid compounds A, B and C; A and C are identified as different forms of a leucoanthocyanidin and compound B a leucoanthocyanin. All the 3 were effective as hypoglycaemic agents. Leaves give friedelin, β-sitosterol, flavonoids- quercetin-3-galactoside and rutin. Heart wood give tiglic acid ester of ψ taraxasterol. Bark is hypoglycemic, tonic, astringent, antidiarrhoeal and antidiabetic. Latex is antirheumatic. Seed is tonic. Leaf is diaphoretic. Root fibre is antigonorrhoeic. Aerial root is used in debility and anaemic dysentery (Husain *et al*, 1992).

.4. *Ficus religiosa* Linn.

Eng:Peepal tree, Sacred fig; San:Pippalah, Asvatthah; Hin:Pippal, Pipli, Pipar; Mal:Arayal Ben: Asvatha; Tam: Arasu, Asvattam; Kan: Aswatha; Tel: Ravi; Mar: Ashvata, Pimpala

Peepal tree or **Sacred fig** is a large deciduous tree with few or no aerial roots. It is common throughout India, often planted in the vicinity of the temples. An aqueous extract of the bark has an antibacterial activity against *Staphylococcus aureus* and *Escherichia coli*. It is used in the treatment of gonorrhoea, diarrhoea, dysentery, haemorrhoids and gastrohelcosis. A paste of the powdered bark is a good absorbent for inflammatory swellings. It is also good for burns. Leaves and tender shoots have purgative properties and are also recommended for wounds and skin diseases. Fruits are laxative and digestive. The dried fruit pulverized and taken in water cures asthma. Seeds are refrigerant and laxative. The latex is good for neuralgia, inflammations and haemorrhages (Warrier *et al*, 1995). Decoction of the bark if taken in honey subdues *vatarakta* (Nadkarni, 1954; Aiyer and Kolammal, 1957; Mooss, 1976; Kurup *et al*, 1979). The important preparations using the drug are *Nalpamaradi taila, Saribadyasava, Candanasava, Karnasulantaka, Valiyamarma gulika etc* (Sivarajan *et al*, 1994).

It is a large deciduous tree with few or no aerial roots. It is often epiphytic with the drooping branches bearing long petioled, ovate, cordate shiny leaves. Leaves are bright green, the apex produced into a linear-lanceolate tail about half as long as the main portion of the blade. The receptacles occurring in pairs and are axillary, depressed globose, smooth and purplish when ripe. The bark is grey or ash coloured with thin or membranous flakes and is often covered with crustose lichen patches. The outer bark is not of uniform thickness, the middle bark in sections appear as brownish or light reddish brown. The inner part consists of layers of light yellowish or orange brown granular tissue (Warrier *et al*, 1995).

Bark gives β-sitosterol and its glucoside. Bark is hypoglycaemic. Stem bark is antiprotozoal, anthelmintic and antiviral. Bark is astringent, antigonorrheic, febrifuge, aphrodisiac and antidysenteric. Syconium, leaf and young shoot is purgative (Husain *et al*, 1992).

Agrotechnology

Ficus species can be cultivated in rocky areas, unused lands, or other wastelands of the farmyard. The plant is vegetatively propagated by stem cuttings. A few species are also seed propagated. Stem cuttings of pencil thickness taken from the branches are to be kept for rooting. Rooted cuttings are to be transplanted to prepared pits. No regular manuring is required. Irrigation is not a must as a plant is hardy. The plant is not attacked by any serious pests or diseases. Bark can be collected after 15 years. *Ficus* species generally has an economic life span of more than hundred years. Hence bark can be regularly collected from the tree. Root, bark, leaves, fruits and latex form the economic parts (Prasad *et al*,1995).

WEST INDIAN MEDLAR *Mimusops elengi* *Sapotaceae*

San: Bakulah Hin: Bakul, Maulsiri Ben: Bakul Mal: Ilanji, Elanji **Tam: Magilam, Ilanci Tel: Pogada Kan: Pagademara Guj: Barsoli, Bolsari**

Importance

Spanish cherry, West Indian Medlar or **Bullet wood tree** is an evergreen tree with sweet-scented flowers having ancient glamour. Garlands made of its flowers are ever in good demand due to its long lasting scent. Its bark is used as a gargle for odontopathy, ulitis and ulemorrhagia. Tender stems are used as tooth brushes. It is also useful in urethrorrhoea, cystorrhoea, diarrhoea and dysentery. Flowers are used for preparing a lotion for wounds and ulcers. Powder of dried flowers is a brain tonic and is useful as a snuff to relieve cephalgia. Unripe fruit is used as a masticatory and will help to fix loose teeth. Seeds are used for preparing suppositories in cases of constipation especially in children (Warrier *et al*,1995). The bark and seed coat are used for strengthening the gum and enter into the composition of various herbal tooth powders, under the name of "*Vajradanti*", where they may be used along with tannin-containing substances like catechu (*Acacia catechu*), pomegranate (*Punica granatum*) bark, etc. The bark is used as snuff for high fever accompanied by pains in various parts of the body. The flowers are considered expectorant and smoked in asthma. A lotion prepared from unripe fruits and flowers is used for smearing on sores and wounds. In Ayurveda, the important preparation of *Mimusops* is "*Bakuladya Taila*", applied on gum and teeth for strengthening them, whereas in Unani system, the bark is used for the diseases of genitourinary system of males (Thakur *et al*, 1989).

Distribution

It is cultivated in North and Peninsular India and Andaman Islands. It is grown as an avenue tree in many parts of India.

Botany

Mimusops elengi Linn. belongs to the family *Sapotaceae*. It is an evergreen tree with dark grey fissured bark and densely spreading crown. Leaves are oblong, glabrous and leathery with wavy margins. Flowers are white, fragrant, axillary, solitary or fascicled. Fruits are ovoid or ellipsoid berries. Seeds are 1-2 per fruit, ovoid, compressed, greyish brown and shiny (Warrier *et al*, 1995). Other important species belonging to the genus *Mimusops* are *M. hexandra* Roxb. and *M. kauki* Linn. syn. *Manilkara kauki* Dub.(Chopra *et al*, 1980).

Agrotechnology

Mimusops prefers moist soil rich in organic matter for good growth. The plant is propagated by seeds. Fruits are formed in October-November. Seeds are to be collected and dried. Seeds are to be soaked in water for 12 hours without much delay and sown on seedbeds. Viability of seeds is less. After germination they are to be transferred to polybags. Pits of size 45cm cube are to be taken and filled with 5kg dried cowdung and top soil. To these pits, about 4 months old seedlings from the polybags are to be transplanted with the onset of monsoon. Addition of 10kg FYM every year is beneficial. Any serious pests or diseases do not attack the plant. Flowering commences from fourth year onwards. Bark, flowers, fruit and seeds are the economic parts.

Properties and Activity

β-sitosterol and its glucoside, α-spina-sterol, quercitol, taraxerol and lupeol and its acetate are present in the aerial parts as well as the roots and seeds. The aerial parts in addition gave quercetin, dihydroquercetin, myricetin, glycosides, hederagenin, ursolic acid, hentriacontane and β-carotene. The bark contained an alkaloid consisting largely of a tiglate ester of a base with a mass spectrum identical to those of laburinine and iso-retronecanol and a saponin also which on hydrolysis gave β-amyrin and brassic acid. Seed oil was comprised of capric, lauric, myristic, palmitic, stearic, arachidic, oleic and linoleic acids.

Saponins from seed are spermicidal and spasmolytic. The aerial part is diuretic. Extract of flower (1mg/kg body weight) showed positive diuretic action in dogs. Bark is tonic and febrifuge. Leaf is an antidote for snakebite. Pulp of ripe fruit is antidysenteric. Seed is purgative. Bark and pulp of ripe fruit is astringent (Husain *et al*, 1992).

HOLOSTEMMA *Holostemma ada-kodien* *Asclepiadaceae*

San: Jivanti; Hin: Chirvel, Charivel; Mal: Atapathiyan, Atapotiyan, Atakotiyan; Tam: Palaikkirai; Tel: Palagurugu; Mar: Dudurli, Shidodi; Guj: Kharner, Khiravel

Importance

Holostemma is a twining shrub with large flowers. The roots of Holostemma are useful in ophthalmopathy, orchitis, cough, burning sensation, stomachalgia, constipation, fever and *tridoshas*. The leaves, flowers and fruits are eaten as vegetable. The root is also used in spermatorrhoea. It is used in preparations of *Vidaryadiganam, Dhanwandharam thaila, Manasamithravatakam, Balarishta* and *Anuthaila*. It is also useful in eye diseases and it imparts resistance to diseases.

Distribution

The plant occurs in tropical countries. In India, it is found in Himalayas, Dehradun, Konkan, Bombay, Deccan, Karnataka, Kerala and Tamilnadu. It grows over hedges and in open forests especially on the lower slopes of the hills. It is also distributed in Sri Lanka, Burma and W. China.

Botany

Holostemma ada-kodien Schult. syn. *Holostemma annulare* (Roxb.) K. Schum., *Holostemma rheedii* Wall. belongs to the family *Asclepiadaceae*. It is a laticiferous twining shrub with large conspicuous flowers. Leaves are simple, opposite and cordate. Flowers are purple, arranged in axillary umbellate cymes. Fruits are thick follicles, 9 cm long, cylindrical and bluntly pointed. The roots are long upto 1 m or more, irregularly twisted, thick and cylindrical. When dry it is yellowish brown to brown black in colour with nearly smooth surface bearing white scars and small depressions. A mature root is about 1-2 cm thick when extracted for use (Warrier *et al*, 1995).

Agrotechnology

Holostemma prefers a tropical climate. The plant is propagated vegetatively by stem cuttings, but mainly by seeds. The seeds are collected from the plant in November-December before being dispersed. Seeds are cleaned, dried and stored for sowing. The stored seeds after soaking in water for 4-5 hours are sown in the seedbeds. About one month old seedlings are then planted in polybags of size 14x10cm which are filled with soil, sand and dried cowdung in 1:1:1 ratio, respectively. Polybags should be kept in shade and irrigated. About 1-1.5 month old seedlings are ready for transplanting. Pits of 30cm cube size are taken at 1-1.2m distance and filled with 10kg dried cowdung and sand. This is covered with surface soil and formed into a mound. Seedlings are transplanted on to the mounds from the polybags carefully. Regular irrigation is to be given till flowering. To aid in trailing, staking is given one month after planting. Flowering and fruiting occurs in November-December. Harvesting can be done at the end of second year when the vines start drying up. Harvesting is done by digging up the tubers. The tubers are cut into pieces of 10cm length and dried in sun before sale (Prasad *et al*, 1997).

Properties and activity

Holostemma tubers give α-amyrin, lupeol and β-sitosterol. Alanine, aspartic acid, glycine, serine, threonine and valine were detected chromatographically (Hussain *et al*, 1992). The root is antidiabetic, antigonorrhoeic, bechic, alterative, tonic, lactative, ophthalmic, emollient, stimulant, aphrodisiac, expectorant and galactagogue.

BLACH MUSALE Curculigo orchioides Amaryllidaceae

San: Musali; Hin: Kalimusali, Mushali; Ben: Talamuli; Mal: Nilappana; Guj: Musalikand Tam: Nilapanai; Tel: Nelatadi Kelangu; Kan: Neladali

Importance

Musali is a small, geophilous herb, the tuberous rootstock of which is used as a rejuvenating and aphrodisiac drug. It cures morbid *vata* and *pitta*, improves complexion and is useful in general debility, deafness, cough, asthma, piles, skin diseases, impotence, jaundice, urinary disorders, leucorrhoea and menorrhagia (Nadkarni, 1954; Aiyer and Kolammal, 1963; Mooss, 1978). Rootstock is the officinal part and it enters into the Ayurvedic formulations like *Vidaryadighrta, Vidaryadi lehya, Marmagulika, Musalyadi churna etc.* The Pharmacognosy of C. *orchioides* has been discussed by Aiyer, Kolammal (1963), Raghunathan, and Mitra (1982). A bibliographical study on *C. orchioides* has been done by Pandey *et al* (1983).

Distribution

The plant is found in all districts of India from near sea level to 2300m altitude, especially in rock crevices and laterite soil. It has been recorded to occur in the sub tropical Himalayas from Kumaon eastwards ascending to 1800m, the Khasia hills, Bengal, Asssam, Konkan, Kanara, the western peninsula and Madras extending south as far as a Cape Comerin. It is also distributed in Sri Lanka, Japan, Malaysia and Australia.

Botany

Curculigo orchioides Gaertn. syn. *C. malabarica* Wight, *C. brevifolia* Dryand, *Hypoxis dulcis* Stand belongs to the family Amaryllidaceae. *Musali* is a small herbaceous plant with cylindrical rootstock. Leaves are simple, sessile, crowded on the short stem with sheathing leaf bases. Flowers are bright yellow. Seeds are black, deeply grooved in wavy lines.

A detailed description of the plant is as follows (Victoria, 1998). Rootstock is straight, cylindrical, tuberous, 5-22cm long, 0.5-0.8 cm thick, brownish surfaces marked with closely spaced prominent transverse wrinkles in the upper or basal half. It bears a few stout lateral roots of 5 or more cm long. Lateral roots are dull white in colour and spongy externally. The fresh cut surfaces of the rootstock has a starch white colour and mucilaginous. A few fibrous roots also occur. Leaves are sessile or short petiolate with sheathing bases, 15-45x1.2-2.5 cm size, linear or linear lanceolate, membranous, glabrouus or sparsely sofly hairy and plicate in bud. The leaf tips when contacts the soil, develops roots and produce adventitious buds. Inflorescence is axillary, scapose racemose, the scape very short and hidden among the bases of leaves underground, clavte, flattened with the pedicels, bracts and the ovary concealed in the leaf sheaths. The lower big flowers on the scape are mostly bisexual and the upper small ones staminate. Flowers are epigynous bright yellow, bisexual or unisxual with lanceolate, membranous bract.. Perianth gamophyllous, rotate & six lobed, locate at the top of a slender sterile long extension of the ovary by means of which the perianth is exposed above the ground. Perianth lobes similar, elliptic oblong 1.2-1.6 cm long, 0.2-0.3 cm broad, outer lobes hairy on the back, inner ones sparsely hairy along nerves. Stamens 6 in number, filamentous filiform, short 2mm long, adnate to the base of the perianth lobes, Anthers linear or linear lanceolate, basifixed and sagittate,.Ovary inferior, hidden among the leaves usually below the ground, tricarpellary syncarpous, lanceolate and trilocular with a fairly long slender beak or extension -the stipe. Ovules many in each cell attached by a distinct long funicle. Style short columnar, 2mm with a 3 lobed stigma. Lobes elongate, erect and appressed. Fruit is a capsule about 1.5-2cm long, 8mm broad, oblong, glabrescent with a slender beak and spongy septa. Seeds 1-many, oblong, black, shiny with crustaceous testa grooved deeply in wavy lines.

Properties and Activity

Rao and Beri (1951) have identified glucose, mannose, xylose and glucuronic acid from the rootstock of *C. orchioides*. The rootstock is also reported to contain glycoside, polysaccharides (hemicellulose and other polysaccharides), starch, resin, tannin, mucilage, fat and calcium oxalate. The hexane extract contains an alkaloid-lycorine, sterols including β-sitosterols and sapogenin identified as yuccagenin (Rao *et al*, 1978). The flavone glycoside from the rootstock has been identified as 5,7- dimethoxy glucopyranoside (Yadav *et al*, 1974; Sharma *et al* 1975). Mehta *et al* (1980) have isolated a number of fatty acids from *C. orchioides* root oil by GLC techniques. They are palmitic, oleic, linolenic linoleic, arachidic and behenic acid. Kubo *et al* (1983) isolated a new phenolic glycoside namely, curculigoside from the rhizomes and its structure has been elucidated as 5-hydroxy-2-0-β-d-glucopyranosyl benzl 1,2,6-dimethoxy benzoate. Yamasaki *et al* (1994) developed HPLC method for estimating the curculigoside content in curculigo rhizome.

Two new aliphatic hydroxy ketone 27-hydroxy tricontan-6-one (M. P. 84-85^{o}C) and 23-hydroxy tricontan-2-one (M. P. 109-110 ^{o}C) were isolated from the rhizome by Misra *et al* (1984). They also isolated 21-hydroxy tetracontan-20-one and 4-methyl heptade canoic acid from the root stock. Porwal *et al* (1988) have isolated and identified three new compounds from the rhizome as N-acetyl-N-hydroxy-2-carbamic acid methyl ester, 3-acetyl-5-carbomethoxy-2H-3,4,5,6-tetrahydro-1,2,3,5,6-oxatetrazine and N, N, N', N'-tetra methyl succinamide. The rhizomes of *C. orchioides* yielded a new phenolic glycoside corchioside a, characterised as orcinol-3-β-D-xylopyranosyl- (1→6)-β-D-glucopyranoside and hentriacontanol (Garg *et al*, 1989).

A new aliphatic compound has been isolated from the rhizomes and characterised as 25-dihydroxy-33-methyl pentatricontan-one (Mehta *et al*, 1990). Misra *et al* (1990) isolated a new natural triterpene alcohol-Curculigol charactrised as 24-methy cycloart-7-en-3-beta-20-diol. A novel pentacyclic triterpene has been isolated from the rhizomes of *C.orchioides* and characterised as 31-methyl-3-oxo-20-ursen-28-oic acid (Metha and Gawarikar,1991). Xu and Xu (1992) and Xu *et al* (1992 a, b) have isolated 13 cycloartane type. Triterpene glycosides from *C. orchioides* rhizome and characterised them as curculigo saponin A-M.

The root stock are mucilaginous, sweet, cooling, bitter, emollient, diuretic, aphrodisiac, depurative, alternative, appetiser, carminative, viriligenic, antipyretic and tonic (Sivarajan and Indira, 1994; Warrier *et al*, 1994).

The uterine stimulant activity of the flavone glycoside extracted from *C. orchioides* has been studied by Dhawan and Saxena (1958), Sharma *et al* (1975) and Dhar *et al* (1979).

The plant extract of *C. orchioides* showed hypoglycaemic, spasmolytic and anticancer properties (Dhar *et al*,1968). Phagocytic activity (Kubo *et al*, 1983) and immunoadjuvant activity (Oru *et al*, 1982) of phenolic glycosides, curculigoside isolated from the rhizome of the plant have been reported. Porwal and Mehta (1985) discussed the medicinal importance of the plant and its use in indigenous system of medicine as a tonic. Sharma *et al* (1991) reported the influence of MAK an ayurvedic food supplement constituting *C. orchioides* against Dimethyl benz anthracene induced mammary tumours in rats. Samanta (1992) reported the modulation of male infertility by Ayurvedic drug, which constitutes *C. orchioides*. Immunostimulant activity of *C. orchioides* has been demonstrated by Saxena (1992). Immunological activites of curculigo saponin G were assayed in mice and the results showed that it promoted proliferation of spleen lymphocyctes very significantly and increased the weight of the thymus *in vivo* in mice (Xu *et al*,1992).

Pharmacological studies in China, on the alcoholic extract obtained from the plant showed several active effects such as adaptogenic, anti-inflammatory, anticonvulsant, sedative, androgenic and immunopromoting activities (Xu *et al*, 1992).

Curculigo orchioides is distributed widely throughout the country. The demand of the raw materials and derivatives of the plant for the indigenous drug industries are satisfied mainly from the wild source, depleting the natural population and thus the species have become extinct or endangered. Ansari (1993) have reported *C. orchioides* as a threatened plant from *Madhulia* forest of Garakhpur. Augustin and Souza (1995) also considered the plant as an endangered species. As the information on the cultivation of C.orchioides is scanty, it is very necessary to develop suitable agrotechniques for the domestication and large-scale cultivation of the plant.

STRYCHNINE TREE Strychnos nux-vomica Loganiaceae

San: Karaskara; Hin: Kajra, Kuchila; Mal: Kanjiram; ; Tam: Itti, Kagodi, Kanjirai Mar:Jharkhatchura; Kan: Hemmushti, Ittangi; Tel: Mushti, Mushidi; Ori: Kora, Kachila

Importance

It is a large deciduous tree, with simple leaves and white fragrant flowers. *Strychnos* is highly toxic to man and animals producing stiffness of muscles and convulsions, ultimately leading to death. However, in small doses it can also serve as efficacious cure forms of paralysis and other nervous disorders. The seeds are used as a remedy in intermittent fever, dyspepsia, chronic dysentery, paralytic and neuralgic affections, worms, epilepsy, chronic rheumatism, insomnia and colic. It is also useful in impotence, neuralgia of face, heart disease, spermatorrhoea, skin diseases, toxins, wounds, emaciation, cough and cholera. Leaves are applied as poultice in the treatment of chronic wounds and ulcers and the leaf decoction is useful in paralytic complaints. Root and root bark used in fever and dysentery (Nadkarni, 1982; Kurup *et al*, 1979).

Distribution

The plant is distributed throughout India in deciduous forests up to 1200m. It is also found in Sri Lanka, Siam, Indochina and Malaysia.

Botany

Strychnos nux-vomica Linn. is a large tree belonging to the family Loganiaceae. Leaves are simple, opposite, orbicular to ovate, 6-11.5x6-9.5cm, coriaceous, glabrous, 5 nerved, apex obtuse, acute or apiculate, transverse nerves irregular and inconspicuous. Inflorescence is many flowered terminal cymes, 2.5-5cm across. Bracts (5mm) and bracteoles (1.5mm) small. Flowers are white or greenish white and fragrant. Calyx 5 lobed, pubescent and small (2mm). Corolla salver shaped, tube cylindrical slightly hairy near the base within and greenish white, tube much elongate than the lobes. Tube 7mm and lobes 2.5mm long. Lobes 5 and valvate. Stamens 5, filaments short, 0.1mm long. Anthers 1.5mm subexerted, linear oblong. Ovary 1.5 mm, pubescent, 2 celled, ovules one to many. Style 9mm, stigma capitate. Fruit is a berry, 5-6cm diameter, globose, indehiscent, thick shelled, orange red when ripe with fleshy pulp enclosing the seeds. Seeds 1-many, discoid, compressed, coin like, concave on one side and convex on the other, covered with fine grey silky hairs.

The leaf fall is during December (do not shed all the leaves at a time) and new foliage appears in February. Flowering is during March - April and fruiting during May - December. Fruits take about 8-9 months to mature.

Properties and Activity

Strychnine and brucine are the most important and toxic alkaloids present in the plant. They occur not only in the seeds but also in roots, wood, bark, fruit pulp and hard fruit shells. The minor alkaloids present in the plant are vomicine, α-colubrine, β-colubrine, pseudostrychnine and N-methyl-sec-pseudobrucine (novacine). Loganin a glycoside is also present (Warnat, 1932; Martin *et al*, 1953; Guggisberg *et al*, 1966; Bisset and Chaudhary, 1974). Chatterji and Basa (1967) reported vomicine as the major constituent alkaloid along with unidentified alkaloid in leaves and identified another alkaloid kajine (N-methyl pseudostrychnine) from the leaves of very young plants.

Root bark of *S. nux-vomica* yeilded 4-hydroxy-3-methoxy strychnine, 4 hydroxy strychine, nor-macusine, a new alkaloid 12β, 13α dihydro-12α-hydroxy isostrychnine named protostrychnine (Baser *et al*, 1979) methoxy strychnine, and mavacurine (Guggisberg *et al*, 1966). Leaves and root bark also yeilded 11 new alkaloids. 10-hydroxy strychnine, 3-12-dihydroxystrychnine, 12-hydroxy–11- methoxy strychnine, 3-12-dihydroxy-

11-methoxy strychnine,12-hydroxy strychnine-N- oxide 12-hydroxy-11-methoxy strychnine-N-oxide-19,20–dihydro isostrychnine, 16α, 17β dihydro-17α-hydroxy isostrychnine, O-methyl-macusine B, 16-epi-o-methyl–macusine B and normelinone B (Baser and Bisset, 1982).

De and Datta (1988) isolated 5 tertiary indole alkaloids viz. strychnine, brucine, vomicine, icajine and novacine from *S.nux-vomica* flowers. Bisset *et al* (1989) isolated and identified two phenolic glycosides salidroside and cuchiloside – a compound consisting of salidroside and an attached xylose unit, from the fruit of *S.nux-vomica*.

Rodriguez *et al* (1979) isolated an indole alkaloid from the seeds of *S. nux-vomica* and identified as a 3-methoxy icajine. A new alkaloid 15-hydroxy strychnine has been isolated from the seeds and the structure of the alkaloid established by spectroscopic data (Galeffi *et al*, 1979). Cai *et al* (1990a) isolated 4 new alkaloids isobrucine, isobrucine N-oxide, isostrychnine N-oxide and 2 hydroxy–3-methoxy strychnine from the heat treated seeds of *S. nuxvomica* and the structure of the alkaloids were determined by 13 CNMR (Cai *et al*, 1994). Cai *et al* (1990 b) studied the changes in the alkaloid composition of the seeds during drug processing. Saily *et al* (1994) determined the mineral elements in *Strychnos nux-vomica*. Corsaro *et al* (1995) reported polysaccharides from the seeds of *Strychnos* species.

Seeger and Neumann (1986) reviewed the physico-chemical characteristics, occurrence, identification, utilisation, poisoning, toxicity, kinetics, differential diagnosis and therapeutic uses of strychnine and brucine. *Aspergillus niger*, *A. flavus* and *Pencillium citrinum* showed regular association with *Strychnos* seeds and effectively deteriorated the alkaloid content of the seeds (Dutta, 1988; Dutta and Roy, 1992). Nicholson (1993) described the history, structure and synthesis of strychnine which occur in the seeds of *S. nux-vomica*. Rawal and Michoud (1991) developed a general solution for the synthesis of 2-azabicyclo (3.3.1) nonane substructure of *Strychnos* alkaloids.

Villar *et al* (1984) and Hayakawa *et al* (1984) developed HPLC method for the analysis of strychnine and brucine. Graf and Wittliner (1985), Kostennikova (1986) and Gaitonde and Joshi (1986) suggested different methods for the assay of strychnine and brucine. Biala *et al*, (1996) developed new method for the assay of alkaloids in *S. nux-vomica.*

The seeds are bitter, acrid, alexeteric, aphrodisiac, appetiser, antiperiodic, anthelmintic, digestive, febrifuge, emmenagogue, purgative, spinal, respiratory and cardiac stimulant and stomachic. The bark is bitter, and tonic and febrifuge (Nadkarni, 1954; Kurup *et al*, 1979; Warrier *et al*, 1996).

The quarternery alkaloid from the root bark of the Sri Lankan plant exhibited muscle-relaxant activity (Baser and Bisset, 1982). Antimicrobial activity of indole alkaloid isolated from the *Strychnos nux-vomica* was studied by Verpoorte *et al*, 1983. Shukla *et al* (1985) evaluated the efficacy of *Rasnadigugglu* compound consisting of *S. nux-vomica*, on rheumatoid arthritis and found to be effective in reducing inflammatory oedoma and rheumatoid arthritis. It also exhibited analgesic activity. A compound Unani formulation containing *S. nux-vomica* significantly attenuated withdrawal intensity in morphine dependent rats (Zatar *et al*, 1991). Shahana *et al* (1994) studied the effect of Unani drug combination (UDC) having *Strychnos nux-vomica* on the abstinence syndrome in moderately and severely morphine dependent rats. The UDC strikingly suppressed the abstinence syndrome was seen to possess central depressant and analgesic action.

Melone *et al* (1992) reported brucine-lethality in mice. Panda and Panda (1993) and Satyanarayanan *et al* (1994) reported antigastric ulcer activity of nux vomica in Shay rats. Banerjee and Pal (1994) reported the medicinal plants used by the tribals of plain land in India for hair and scalp preparation and *S. nux-vomica* being used to cure alopecia (baldness) by the tribals. Tripathi and Chaurasia (1996) studied the effect of *S. nux-vomica* alcohol extract on lipid peroxidation in rat liver.

IX. ABBREVIATIONS USED IN THE TEXT

%	Per cent
°C	Degree Celsius
α	Alpha
β	Beta
γ	Gamma
@	At the rate of
a.i.	Active ingredient
Ass	Assamese
Ben	Bengali
Ca	Calcium
CNS	Central nervous system
CVS	Central venal system
D	Dextro-rotatory
eg	Example
et al	and others
FYM	Farm yard manure
g	gram
GLC	Gas liquid chromatography
Guj	Gujarathi
ha	hectare
Hin	Hindi
HPLC	High pressure (performance) liquid chromatography
hr	hour
ie	that is
k	kilo
K	Potassium
Kan	Kannada
Kas	Kashmiri
l	litre
L	Levo-rotatory
m	metre, milli
M&AP	Medicinal and aromatic plants
Mal	Malayalam
Mar	Marathi
Mg	Magnesium
N	Nitrogen
O	Oxygen
O	Oxygen
P	Phosphorus
p	page
pp	pages
Pun	Punjabi
Raj	Rajasthani
S	Sulphur
San	Sanskrit
sp, spp	species
t	tonne
Tam	Tamil
Tel	Telugu
TLC	Thin layer chromatography
var	variety
viz	namely
vol	volume
yr	year

X. NAMES OF BOTANISTS

Alef.	
Alst	Alston, Arthur Hugh Grafit
Arg	
Backer	Backer, Cornelis Andries
Bal	Balansa, Benedict
Bartl.	F.G. Bartling
Batsch	A.J.G.K. Batsch
Bedd	Beddome, Richard Henry
Boj	Bojer, Wenceslas
Borss	Borssum Waalkes
Braun Blanquet	
Burkill	Burkill, Issac Henry
Cav	Cavanilles, Antonio Jose
Christm	Christmann, Gottlieb, Friedrich
Clark	
Colebr	Colebrooke, Henry Thomas
Collet.	
Corr	
Coss	
Cramer	Louis H. Cramer
Crepin.	
Czern.	
De Wilde	De Wildeman, Emile August(e) Joseph
Desv	Desvaux, Auguste Nicaise
Diels	Diels, Friedrich Lugurig Emil
Don	Don, George
Druce	Druce, George Claridge
Dunal	Dunal, Michel Felix
Eberm	
Ehrh	J.F. Ehrhart
Ener,	
Forsk	Forsskal, Pehr
Friis	Friis, Ib
G. Don	Don, George
Gaenep	
Gagnep	Gagne pain, Francois
Gandich	
Gaud	Gaudichaud - Beaupre, Charles
Gilib.	J.E. Gilibert
Guerke	Gurke (Guerke), Robert Louis August Maximilian
Haw	Haworth, Adrian
Haworth	
Herrm.	
Heyne	Heyne, Benjamin
Hout	
Houtt	Houttuyn, Martin
Hunter	W. Hunter
J. Burm	
Jacq	Jacquin, Nicolaus
Jowitt	
Juss	Jussieu, Adrien Henri Laurent de
Juss	Jussieu, Antoine Laurent de
Ker-Gawler	Ker Gawler, John Bellenden
Koch	Koch, Grungberg Christian Theodar
Koenig	Koenig, Johann Gerhard
Kosterm	Kostermans, Andre Joseph Gulliaume Henri
Kunth	Kunth, Karl Sigismund
Kuntze	Kuntze, Carl Ernst
Kurz	Kurz, W. Sulpiz
L. Herit	L’Heritier, Charles Louis

Labill	Labillardiere, Jacques Julien Houtton de
Less	Lessing, Christian Friedrich
Link	Link, Johann Heinrich Friedrich
Lippold	Lippold, Hans
Lour	Loureiro, Joao de
M. R.	
Maire	Maire, Rene Charles Joseph Ernest
Maton	Maton, William George
Medicus	Medikus, Friedrich Casimir
Mich	
Miers	Miers, John
Millsp	Millspaugh, Charles Frederick
Miq	Miquel, Friedrich Anton Wilhelm
Moon	Moon, Alexander
Murray	Murray, Johan Andreas
Nash	Nash, George Valentine
Nees	Nees von Esenbeck, Christian Gottfried Daniel
Oken	Oken, Lorenz
Ortega	Ortega, Casimiro Gomez
Osb	Osbeck, Pehr
Parker	
Pellet	
Pennell	Pennell, Francis Whittier
Perr.	T.A. Perry floreat
Pers	Persoon, Christiaan Hendrik
Pierre	Pierre, Jean Baptiste Louis
Poiret	Poiret, Jean Louis Marie
Poisson	
Prain	Prain David
Radlk	Radlkofer, Ludwig Adolph Timotheus
Raeush	Rauschel, Ernst Adolph
Rafin	Rafinesque - Schmaltz, Constantine Samuel
Rehd.	Rehder, Alfred
Rendle	Rendle, Alfred Barton
Retz	Retzius, Anders Jahan
Robs	Robson, Norman K.B.
Rosc	Roscoe, William
Roth	Roth, Albrecht Wilhelm
S. M. Almeida	
S. Manso	Silva Manso Antonio Luiz Patricio da
Sargent	C.S. Sargent
Schott	Schott, Heinrich Wilhelm
Schrank	Schrank, Franz Paulavon
Schult	Schultes, Josef August
Sims	Sims, John
Skeels	Skeels, Homer collar
Sonner	Sonnerat, Pierre
Sprague	Sprague, Thomas Archibald
Spreng	Sprengel, Curt Polycarp Joachim
Stapf	Stapf, Otto
Steud	Steudel, Ernst Gottlieb von
Stocks	
Suresh	
Sw	Swartz, Olof Peter
Swartz	O. Swartz
Swingle	Swingle, Walter Tennyson
Taub	Taubert, Paul Hermann Wilhelm
Thonn	Thonning, H.
Thumb	Thunberg, Carl Peter
Thw	Thwaites, George Henry Kendrick
Urban	Urban, Ignatz

Vahl	Vahl, Jens Lorenz Moestue
Vent	Ventenat, Etienne Pierre
Voigt	Voigt, Johann Otto
Voigt	
Watt	
Wills	

GLOSSARY

Abortifacient	An agent that induces abortion
Abscess	A localised collection of pus caused by suppuration in a tissue
Absorbent	Any agent which attracts and sucks up gases or secretions from a wound.
Acne	An inflammatory disease occurring in or around the sebaceous glands
Acrid	Biting, pungent
Agalactia	Absence or failure of secretion of milk
Ague	Malaria
Albuminuria	The presence of serum albumin and serum globulin in the urine
Alexipharmic	Antidote to poison
Alexiteric	Protective to infectious diseases
Alopecia	Loss of hair-a malady in which the hair falls from one or more circumscribed round or oval areas, leaving the skin smooth and white.
Alterative	Causing a favorable change in the disordered functions of the body or metabolism
Amenorrhoea	Failure of menstruation
Amentia	An arrest of the development of the mind from birth to early age.
Anaemia	Lack of enough blood in the body causing paleness
Analeptic	Having a restorative or stimulating effect, as on the central nervous system
Analgesic	Relieving pain
Anaphrodisiac	Having the power to lessen or inhibit sexual feeling
Anasarca	Diffused dropsy in the skin and subcutaneous tissue
Anaesthetic	Inducing loss of feeling or consciousness
Anodyne	A medicine that allays pain
Anorectic	Lacking appetite
Anorexia	A condition of having lost the appetite for food
Anthelmintic	Destroying or expelling worms
Antiasthmatic	Relieving asthma
Antibiotic	Killing disease causing microorganisms
Anticoagulant	Inhibiting the clotting of blood
Antidiarrheal	Preventing or controlling diarrhea
Antidote	An agent which neutralizes or opposes the action of a poison
Antidote	Substance that counteracts the effects of a poison
Antidyspeptic	Relieving dyspepsia or indigestion
Antiemetic	Stopping emesis or vomiting
Antihemorrhagic	Controlling bleeding
Antihypertensive	Reducing high blood pressure
Antiinflammatory	Controlling inflammation
Antilithich	An agent which prevents the formation of calculi or promotes their dilution
Antiperiodic	Preventing the regular recurrence of a disease
Antiphlogistic	Acting against heat or inflammation
Antipruritic	Preventing or relieving itching
Antipyretic	Counteracting fever
Antirachitic	Preventing or curing rickets
Antirheumatic	A condition that causes inflammation and pain in the joints and muscles
Antiscorbutic	Acting against scurvy
antiscrofulous	Treating scrofula or tubercular swellings of the lymph glands
Antiseptic	A chemical sterilising substance to kill or control pathogenic microbes
Antispsmodic	Opposing spasms or convulsions
Antitussive	Controlling or preventing cough
Antiuric	Counteracting excessive acidity in the urine
Anuria	Complete cessation of the secretion and excretion of urine
Aperient	A laxative or mild cathartic
Aphrodisiac	A drug which stimulates sexual desire
Aphthae	Ulcer on the surface of a mucous membrane
Apoplexy	A sudden loss of consciousness
Arthralgia	Pain in joint
Arthritis	Inflammation of a joint
Ascites	Abnormal accumulation of fluid in the peritoneal cavity
Asphyxia	Inability to breath
Astringent	Causing soft tissues or drawing together

Atrophy	Wasting of a tissue or organ
Balanitis	A condition of inflammation of the penis or of the clitoris
Bechic	Anything which relieves or cures cough
Beriberi	A deficiency disease caused by imbalance of carbohydrate and vitamin B
Blennorrhagia	Free discharge of mucus
Brachycardiac	Making the heart beat slower
Bronchopathy	Any disease of the bronchi
Bubo	An inflammatory swelling of a lymph gland
Cachexia	Depressed habit of mind
Calculus	A concretion formed in any part of the body usually compounds of salts of organic or inorganic acids
Calefacient	A remedy which gives rise to a sensation of warmth
Calibration	Demonstrating that a measuring device produces results within the specified limits of those produce by a reference standard device over an appropriate rang of measurements
Calmative	Sedative
Carbuncle	An infection of the skin and subcutaneous tissue by *Staphylococcus aureus*
Carcinogenic	Causing cancer
Carcinoma	A malignant epithelial tumour eventually becoming fatal
Cardiac	Relating to the heart
Cardiac depressant	Slowing the action of the heart
Cardiodynia	Pain in the region of the heart
Cardiokinetic	Regulating or strengthening the heartbeat
Cardiopalmus	Palpitation of the heart
Cardiopathy	A morbid condition of the heart
Cardiotonic	Keeping the heart functioning normally
Carminative	Drug causing the release of stomach or intestinal gas
Cataplexy	A condition marked by abrupt attacks of muscular weakness
Cataract	Opacity in the crystalline lens of the eye which may be partial or complete
Catarrh	A condition in which the mucous membranes of the nose and breathing passages are inflamed, often chronically
Cathartic	Having the power of cleaning the bowels-purgative
Cephalalgia	Headache
Cephalic	A remedy for disorders of the head
Cephalopathy	Any disease of the head
Cerebropathy	Any disorder of the brain
Cholagogue	A drug which causes increased flow of bile into the intestine
Cholera	A severe infectious epidemic disease due to *Vibrio cholerae*
Cicatrizing	Promoting the growth
Cirrhosis	Progressive fibrous tissue overgrowth in an organ
Colic	A severe spasmodic griping pain
Colitis	Inflammation of the colon
Collyrium	An eye-salve or eye-wash
Colonalgia	Pain in the colon
Colonitis	Inflammation of the colon
Colonorrhagia	Hemorrhage from the colon
Colpitis	Inflammation of the vagina
Colpoptosis	Prolapse of the vagina
Colporrhagia	Hemorrhage from the vagina
Coma	The state of complete loss of consciousness
Conjunctivitis	Inflammation of the conjunctiva
Consumption	Pulmonary tuberculosis
Contraceptive	Any agent or device used to prevent conception
Contusion	An injury to tissue that does not break the skin
Convulsion	A violent involuntary contraction of the skeletal musculature
Corn	A small circumscribed painful horny growth
Counterirritant	An agent that causes local inflammation of an area
Coxalgia	Pain in the hip
Coxitis	Inflammation of the hip joint
Croup	Any condition caused by respiratory obstruction
Cystalgia	Pain in the urinary bladder

Cystitis	Inflammation of a bladder, especially the urinary bladder
Cystodynia	Pain in the urinary bladder
Cystorrhea	Mucous discharge from the bladder
Dandruff	Dead scarf-skin separating in small flakes
Decongestant	Relieving congestion, as of the mucous membrane
Demulcent	Soothing
Dental caries	Decay of teeth
Dentalgia	Toothache
Dentifrice	Any liquid, paste or powder used for cleansing the teeth.
Deobstruent	Relieving or removing obstruction
Deodorant	Removing the odour
Depurative	An agent that purifies blood
Dermatitis	Irritation or inflammation of the skin
Dermatopathy	Any skin disorder
Dermatophytosis	A superficial infection of the skin caused by a fungus
Desiccating	Depriving of moisture
Diaphoresis	Sweating
Diaphoretic	A drug which induces perspiration
Digestive	Improving digestion
Diphtheria	A specific infectious disease caused by virulent strains of a *Bacillus*
Discutient	Removing tumours
Disinfectant	Having a lethal effect upon germs
Diuretic	Promoting the flow of urine
Dizziness	Sensation of imbalance of a stable relationship with the immediate environment
Dropsy	An excessive accumulation of clear or watery fluid in any of the tissues or cavities of the body
Drug	An agent that is used therapeutically to treat diseases. It may also be defined as any chemical agent and/or biological product or natural product that affects living processes
Drug product	A finished dosage form, for eg., a tablet, capsule or solution that contains a drug substance
Drug substance	An active ingredient that is intended to furnish pharmacological activity or other direct effect in diagnosis, cure, mitigation, treatment or prevention of diseases or to effect the structure or any function of the human body
Dysmenorrhoea	Difficult or painful menstruation
Dysopia	Defective vision
Dyspepsia	Indigestion
Dysphonia	Difficulty or pain in speaking
Dyspnoea	Difficulty in breathing
Dystocia	Difficult parturition
Dysuria	Difficulty or pain while passing urine
Ecbolic	Tending to increase contractions of the uterus and thus facilitate childbirth
Eclampsia	An attack of convulsion associated with hypertension in pregnancy
Eczema	A noncontagious inflammatory disease of the skin with much itching and burning
Edema	Fluid retention by the body causing swelling and discomfort
Elephantiasis	Gross lymphatic edema of the limbs leading to hypertrophy
Elixir	A drug capable of prolonging life indefinitely
Embrocate	To moisten and rub
Emetic	Causing vomiting
Emmenagogue	Medicine intended to restore the mensus
Emollient	Softening
Emphysema	A pathologic accumulation of air in tissues or organs
Empyema	Accumulation of pus in a body cavity
Encephalitis	Inflammation of the brain and spinal cord due to infection
Encephalopathy	Any degenerative brain disease
Enuresis	Involuntary voiding of urine
Epilepsy	An affection of the nervous system resulting from excessive or disordered discharge of cerebral neurons
Epistaxis	Bleeding from the nose
Errhine	An agent causing increased nasal discharge
Erysipelas	An inflammatory disease generally affecting the face marked by a bright redness

	of the skin
Escharotic	A caustic substance that creates a mass of dead cells or scab
Euphoriant	Producing a sense of bodily comfort and well-being and the absence of pain or distress
Expectorant	Aiding the secretion of the mucous membrane of the air passages and the removal of fluid by spitting
Extract	A concentrate of dried, less volatile aromatic plant part obtained by solvent extraction with a polar solvent
Febrifuge	Anything which reduces fever
Felon	A deep infection around the nails of toes or fingers
Filariasis	Infection with filarial nematode worms
Fistula	An open channel from the anus or rectum to the skin near the anus
Flatulence	Presence of excessive gas in the stomach or intestine
Frenzy	Violent temporary mental derangement
Galactogenic	Promoting the flow of milk
Galactogogue	Medicine that promotes secretion of milk
Galactorrhea	Excessive or spontaneous flow of milk
Gangrene	Necrosis and putrefaction of tissue due to lack of blood supply
Gastralgia	Pain in the stomach
Gastrodynia	Pain in the stomach
Gastroenteritis	Inflammation of the mucous coat of the stomach and intestine due to bacterial infection
Gastrohelcosis	Ulceration of the stomach
Gastromegaly	Enlargement of the stomach
Gastropathy	Any disease of the stomach
Germicidal	Causing destruction of micro-organisms
Gingivitis	Inflammation of the gingival margins around the teeth accompanied by swelling and bleeding
Glaucoma	Increased intraocular pressure and its consequences
Gleet	Chronic discharge of thin mucous from the vagina
Glycosuria	Excretion of sugar in the urine
Goitre	Enlargement of the thyroid gland
Gonorrhoea	An inflammatory disease of the genitourinary passages characterized by pain and discharge
Gout	A disease of purine metabolism characterized by attacks of arthritis with an associated raised level of serum uric acid
Gripe	A sharp pain in the stomach
Haematemesis	Vomiting of blood
Haematuria	The presence of blood in the urine
Haemoptysis	Spitting of blood
Haemorrhoid	A bleeding pile
Haemostatic	Having the power to arrest bleeding
Halitosis	Offensive odour of the breath
Hallucinogenic	Producing hallucinations
Heart palpitations	Abnormally rapid and irregular beating of the heart
Helminthiasis	Morbid state due to infestation with worms
Hemagogue	An agent that promotes the flow of blood
Hematinic	Stimulating the formation of blood cells and hemoglobin
Hematorrhea	Copious hemorrhage
Hemicrania	Headache confined to one side
Hemiplegia	Paralysis of one side of the body
Hemolytic	Destructive to red blood cells
Hepatalgia	Pain in the liver
Hepatic	Having to do with the liver
Hepatitis	Inflammation of the liver; jaundice
Hepatodynia	Pain in the liver
Hepatomegaly	Enlargement of the liver
Hepatopathy	Any disease of the liver
Hepatosis	Downward displacement of the liver
Hernia	The protrusion of an internal organ through a defect in the wall of the anatomical cavity in which it lies.

Herpes	Inflammation of the skin or mucous membrane with clusters of deep seated vesicles
Herpetic	Treating skin eruptions
Hydragogue	Promoting expulsion of water or serum
Hydrocele	A circumscribed collection of fluid in the tunica vaginalis testis
Hydrophobia	Exaggerated fear of water as in rabies
Hyperdenosis	Proliferation of glandular tissue
Hyperdipsia	Intense thirst of relatively brief duration
Hyperdiuresis	Excessive secretion of urine
Hyperemesis	Excessive vomiting
Hyperhydrosis	Excessive perspiration
Hyperorexia	Excessive appetite
Hyperpraxia	Abnormal activity; restlessness
Hypertension	High arterial blood pressure
Hypertensive	Tending to rise the blood pressure
Hyperthermia	A very high body temperature
Hypnotic	Inducing sleep or a state resembling sleep
Hypochonodriasis	A state of mind in which the sufferer is much preoccupied with his health
Hypoglycement	Lowering the level of blood sugar in the body
Hypotension	A fall in blood pressure below the normal level
Hypotensive	Tending to lower blood pressure
Hypothermia	Greatly decreased temperature
Hysteria	A neurotic disorder with varying symptoms
Impetigo	An inflammation of the skin associated with discrete vesicles due to streptococcal infection
Impotence	Inability to perform the sexual act due to failure of the reflex mechanism
Infusion	A hot extract of either a plant part or its exudate with either water or an organic solvent.
Insanity	Mental disease of a grave kind
Insecticide	Any agent which kills or destroys insects
Insomnia	The condition of being unable to sleep
Installation-qualification	Documented verification that all key aspects of the installation adhere to the appropriate codes and approved design intentions and that manufacturers recommendations are duly considered
Intermittent fever	A regularly recurring fever
Intoxication	General condition which results following the absorption and diffusion in the body of a soluble poison
Irritant	An agent that causes inflammation
Jaundice	Yellowing of the skin and other tissues caused by the presence of bile pigments
Kidney stone	Small, hard stone that may form in the kidneys and cause intense pain
Lactation	The secretion of milk by mammals
Lactifuge	Retarding or causing cessation of the secretion of milk
Laryngitis	Inflammation of the larynx
Laxative	Having the action of loosening the bowel
Lentigo	A brownish or yellowish spot found on the skin, generally on the hands, arms or face often caused by exposure to sunlight
Lesion	A wound
Leucoderma	Any white area on the skin
Leucorrhoea	An abnormal mucous discharge from the vagina
Leukaemia	Blood cancer
Liniment	A liquid or thin paste applied to the skin to work as a pain reliever
Linthontriptic	An agent that effects the dissolution of a calculus
Lithiasis	The formation of calculus of any kind
Lumbago	Pain in mid or lower back
Malignant	Threatening life or tending to cause death
Mammillitis	Inflammation of the nipple
Masticatory	A substance that is chewed to increase the flow of saliva
Melalgia	Pain in the limbs
Melancholia	A mental illness in which the predominant symptom is melancholy, depression of spirits, unhappiness and misery
Menolipsis	Temporary cessation of menstruation

Menorrhagia	Excessive or prolonged menstruation
Menostasis	Failure of menstruation
Metropathy	Any uterine disease
Metroptosis	Prolapse of the uterus
Metrorrhagia	Uterine, bleeding, usually of normal amount occurring at completely irregular intervals, the period of flow sometimes being prolonged
Metrorrhea	Abnormal uterine discharge
Micturition	The act of passing urine
Migraine	A periodic condition with localised headaches, frequently associated with vomiting and sensory disturbances
Morbid	Relating to disease
Mumps	Epidemic parotitis, an acute infectious disease caused by a virus
Myalgia	Muscular pain
Mydriasis	Dilation of the pupil
Mydriatic	A drug that dilates the pupil
Myringitis	Inflation of the tympanic membrane
Narcotic	A drug that induces sleep
Nasitis	Inflation of the nose
Nauseant	An agent that causes nausea
Nepholithiasis	Presence of renal calculi
Nephralgia	Pain in the kidney
Nephritis	Inflation of the kidneys
Nephropathy	Disease of the kidneys
Neuralgia	A painful affection of the nerves due to functional disturbances or neuritis
Neurasthenia	Nervous debility
Notalgia	Pain in the back
Nyctalopia	Night blindness
Obesity	An excessive accumulation of fat in the body
Odontalgia	Toothache
Odontopathy	Any disease of the teeth
Oleaginous	Oily, greasy
Opacity	An opaque or non-transparent area
Operation-qualification	documented verification that the system or sub system performs as intended throughout all anticipated operating ranges
Ophthalmia	Referring to conjunctivitis
Ophthalmodynia	Pain in the eye
Ophthalmopathy	Any disease of the eye
Opthalmitis	Inflation of the eye ball
Orchialgia	Pain in the testis
Orchiopathy	Any disorder of the testis
Orchitis	Inflammation of the testis characterised by hypertrophy and pain
Ostalgia	Pain in the bones
Osteomalacia	Softening of the bones, resulting from vitamin D deficiency
Otalgia	Pain in the ear
Otopathy	Any disease of the ear
Otopyorrhea	Purulent discharge from the ear
Pancreatitis	Inflammation of the pancreas
Paraplegia	Stroke affecting one side
Parkinsonism	Parkinson's disease characterised by rigidity of muscles and tremor of the hands
partiurient	Inducing the contractions of labour at childbirth
Pectoral	Effective in diseases of the chest
Pectoralgia	Pain in the chest
Performance-qualification	Documented verification of the appropriateness of critical process parameters, operating ranges and system reproducibility over an appropriate time period
Pertussis	Whooping cough
Pharyngitis	Inflammation of the mucous membrane and underlying part of the pharynx
Pharyngodynia	Pain in the pharynx
Pharyngopathy	Any disease of the pharynx
Phythisis	Any wasting disease in which the whole body or part of the body is involved
Pneumonia	Inflammation of lung tissue
Pneumonopathy	Any disease of the lungs

Pneumonosis	Any lung disorder
Pneumorrhagia	A severe haemoptysis
Poliomyelitis	An acute inflammation of the anterior horn cells of the spinal cord due to an enterovirus infection
Poultice	A soft mush prepared by various substances with oily or watery fluids
Procreant	The drug which begets
Proctalgia	Pain in the rectum
Proctoptosis	Prolapse of the rectum
Prophylactic	Pertaining to the prevention of the development of a disease
Prurigo	An eruption of the skin causing severe itching
Pruritus	Itching
Psoriasis	A condition characterised by the eruption of circumscribed discrete and confluent reddish, silvery scaled lesions
Psoriasis plantaris	Psoriasis of the sole
Psychopathy	Any disease of the mind
Ptyalism	Excessive secretion of saliva
Purgative	Strong laxative
Pyorrhoea	A discharge of pus
Pyrexia	A condition characterised by the presence of pus
Rachialgia	Pain in the vertebral column
Radiculalgia	Neuralgia of the nerve roots
Radiculitis	Inflammation of spinal nerve roots
Ramitis	Inflammation of a nerve root
Rectalgia	Pain in the rectum
Rectitis	Inflammation of the rectum
Refrigerant	Cooling
Renal	Relating to the kidneys
Renal calculi	Calculi relating to kidney
Renopathy	Any disease of the kidney
Resolvent	Causing resolution of a tumour or swelling
Resorptive	Aiding reabsorption of blood from bruises
Restorative	Having the power to restore or renew health
Resuscitative	The act of restoring to life
Retinitis	Inflammation of the retina
Revulsive	Causing revulsion in drawing away of blood from a pathological area to another area
Rheumarthritis	Rheumatoid arthritis
Rheumatalgia	Rheumatic pain
Rhinalgia	Pain in the nose
Rhinitis	Inflammation of the nasal mucous membrane
Rhinodynia	Pain in the nose
Rhinopathy	Any disease of the nose
Rickets	A disturbance of the calcium/phosphorus metabolism which occurs in the growing child as a result of vitamin D deficiency
Roborant	A strengthening agent
Rubefacient	Having the action of counter irritant
Sarcocele	Fleshy swelling or tumour of the testis
Scabies	Sarcoptic infestation of the human skin particularly a contagious skin disease caused by invasion of the epidermis
Scald	The lesion caused by contact with a hot liquid or vapour
Scalding of urine	Severe burning sensation during micturition
Scleritis	Inflammation of the sclera
Scrofula	Tuberculous cervical adenitis with or without ulceration
Scurvy	A deficiency disease due to lack of Vitamin C
Sedative	Acting on the central nervous system to produce sleep
Sialogogue	An agent that increases the flow of saliva
Sinovitis	Inflammation of the synovial membrane of a joint
Sinusitis	Inflammation affecting the mucal epithelium of a sinus
Somatalgia	Body pain
Somnifacient	Causing sleep
Somnolence	Sleepiness

Soporific	Inducing sleep
Spanomenorrhea	Scanty menstruation
Spasmolytic	Helping to relieve cramps and other muscle contractions
Splenalgia	Pain in the spleen
Splenitis	Inflammation of the spleen
splenohepatomegaly	Enlargement of spleen and liver
Splenomegaly	Enlargement of the spleen
Splenopathy	Any disease of the spleen
Stimulant	Making a body organ active
Stomachalgia	Pain in the stomach
Stomachic	Aiding the stomach and digestion
Stomatalgia	Pain in the mouth
Stomatitis	Generalised inflammation of the oral mucosa
Stomatopathy	Any disorder of the mouth
Stomatorrhagia	Hemorrhage from the mouth
Stupefacient	Inducing stupor
Styptic	Having the power to arrest bleeding
Sudorific	Acting to increase perspiration
Suppurative	Pus forming
Syphilis	A contagious venereal disease
Syrup	A water and sugar solution to which are added flavouring, medicinal, or some other desired ingredients
Taeiniacide	An agent that kills tapeworms
Tetanus	An infective disease due to the toxins of *Clostridium tetani*
Thermoplegia	Sun stroke
Thrombosis	A blood clot that may partially or wholly block the flow of blood through a blood vessel
Tincture	A medication that has its medicinal agent dissolved in alcohol
Tonic	An agent that is used to give strength to the system
Tonsilitis	Inflammation of the tonsil
Toxaemia	The condition of general poisoning caused by the entrance of soluble bacterial toxins into the blood
Tranquilizer	Drug employed to calm or sedate people or animals
Trauma	A pathological alteration of the supporting tissues of a tooth due to abnormal occlusion
Trichogenous	Stimulating the growth of hair
Ulemorrhagia	Bleeding from the gums
Ulitis	Inflammation of the gums
Ulocace	Ulceration of the gums
Ulorrhagia	Hemorrhage from the gums
Ulorrhea	Bleeding from the gums
Unguent	Ointment
Urelcosis	Ulceration of the urinary tract
Ureteralgia	Pain in the ureter
Ureteritis	Inflammation of the ureter
Urethritis	Inflammation of the urethra
Urethrorrhagia	Flow of blood from the urethra
Urethrorrhea	Abnormal discharge from the urethra
Urocyst	The urinary bladder
Urocystitis	Inflammation of the urinary bladder
Urodynia	Pain on urination
Urolithiasis	Urinary calculi
Uro-edema	Edema due to infiltration of urine
Uropathy	Any disease of the urinary tract
Urorrhagia	Excessive secretion of urine
Urorrhea	Involuntary flow of urine
Uroschesis	Retention of urine
Urticaria	Itching, inflamed skin caused by an allergic reaction to a drug, food, or substance in the environment; also called hives
Uteralgia	Pain in the uterus
Uterine sedative	An agent that relaxes the muscles of the uterus

Uteritis	Inflammation of the uterus
Vaginitis	Inflammation of the vagina
Vaginodynia	Pain in the vagina
Vaginopathy	Any disease of the vagina
Validation	Establishing documented evidence which provides a high degree of assurance that a specific process will consistently produce a product meeting its pre-determinant specifications and quality attributes
Vasoconstrictor	An agent that narrows blood vessel openings, restricting the flow of blood through them
Vasodilator	An agent that expands blood vessels, allowing more blood to flow through them
Vermifuge	A drug that expels worms
Verminosis	Morbid state due to infestation with worms
Vertigo	Dizziness
Vesical	Referring to the urinary bladder
Vesicant	A counter irritant strong enough in some cases to cause blistering
Visceromegaly	Abnormal enlargement of the viscera
Vulnerary	Soothing or healing wounds and sores
Wart	A circumscribed cutaneous excrescence
Wash	Liquid medicinal preparation for external use

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VIII. Database on tropical medicinal plants

Scientific Name	Family	Distribution	Habit	Propagation	Part used	Activity/Properties
Abelmoschus moschatus (Linn.) Medicus	Malvaceae	India	Shrub	Seed	Seed	Diuretic, demulcent,antiseptic, carminative
Abrus precatorius Linn.	Papilionaceae	Plains and hills of India	climber	seed	Roots, leaves, seeds	Cytotoxic, antifertility, abortifacient
Abutilon indicum (Linn.) Sweet	Malvaceae	India, Sri Lanka	herb	Seed	Seed, root, bark, leaves	Hypothermic, CNS active, analgesic, aphrodisiac
Acacia catechu Willd.	Mimosaceae	India	tree	seed	Bark, heart wood	Anthelmintic, anti-inflammatory, hypotensive
Acalypha fruticosa Forsk.	Euphorbiaceae	India	Shrub			
Acalypha indica Linn.	Euphorbiaceae	India	herb		Leaves, roots, stalks, flower	Anthelmintic, expectorant, emetic, anodyne
Achyranthes aspera Linn.	Amaranthaceae	India herb	herb	seed	Whole plant	Cardiac, stimulant, diuretic, astringent,
Acorus calamus Linn.	Araceae	India	herb	rhizome	rhizome	Stomachic, tonic, anti-flatulent, tranquilizer
Adhatoda beddomei C. B. Clarke	Acanthaceae	Hills of Kerala	shrub	Seed and vegetatively	Whole plant mainly root	Astringent, diuretic
Adhatoda zeylanica Medicus	Acanthaceae	Lower Himalayan ranges	shrub	Seed, vegetatively	Leaves, root, bark, flowers	Expectorant, diuretic, alterative
Aegle marmelos (Linn.) Corr.	Rutaceae	Forest of himalayan tracts, central and S. India	Small tree	Seed, root	Root, stem, leaves, fruits	Hypoglycaemic, antifungal, CVS active
Aerva lanata (Linn.) Juss.	Amaranthaceae	Tropics and sub-tropics, Africa, Asia	Under shrub			Anthelmintic, diuretic, anti-inflammatory,anti-bacteria
Ageratum conyzoides Linn.	Asteraceae		herb		Antilithic	
Ailanthus excelsa Roxb.	Simarubaceae	India	tree		Bark, leaf	Antispasmodic, anti-asthamatic
Alangium salviifolium (Linn. f.) Wang.	Alangiaceae	S. India	Small tree		Roots, fruits	Antiprotozoal, hypoglycaemic
Albizia lebbeck (Linn.) Benth.	Mimosaceae	India, Burma, Sri Lanka, Africa, Australia	Tree	seed	Bark, flower, seeds, leaves, roots	Immunomodulator, hypoglycaemic, anticancer
Allium cepa Linn.	Liliaceae	India	herb	Bulb	Bulb, seed	Stimulant, diuretic, expectorant, emmenagogue
Allium cepa var. *aggregatum*	Liliaceae	India	herb	Bulb	Bulb, seed	Stimulant, diuretic, expectorant, emmenagogue
Allium sativum Linn.	Liliaceae	All over India	herb	Cloves, bulblets	bulbs	Anti-inflammatory, hypotensive
Aloe barbadensis Mill.	Liliaceae	India, Florida, W.Indies, Asia	herb	vegetative	Leaf juice, Elio (dried gum)	Anthelmintic, purgative, oxytocic
Alpinia allughas Rosc.	Zingiberaceae	W.ghats, Sri Lanka, Malaya, China, India	herb	rhizome	rhizome	CVS & CNS active, diuretic, hypothermic, antiulcerative
Alpinia calcarata Rosc.	Zingiberaceae	W.ghats, Sri Lanka, Malaya, China, India	herb	rhizome	rhizome	CVS & CNS active, diuretic, hypothermic, antiulcerative
Alpinia galanga Sw.	Zingiberaceae	Himalaya, Assam, Bihar, W. ghats	herb	rhizome	rhizome	CVS & CNS active, diuretic, hypothermic, antiulcerative
Alstonia scholaris (Linn.) R. Br.	Apocynaceae	India especially W. Ghats	tree	seed	Bark, leaves, milky exudate	Antimalarial, hypotensive, anthelmintic
Alstonia venenata R. Br.	Apocynaceae	India	shrub	seed, vegetative	Roots, fruits	Depurative, febrifuge
Amaranthus spinosus Linn.	Amaranthaceae	India, native of America	herb	seed	Root, leaf	Galactogenic, emollient

Amomum subulatum Roxb.	Zingiberaceae	E. Himalaya, Bengal, Sikkim, Assam	herb	Seed, rhizome	Seed, oil	Stimulant, stomachic alexipharmic, astringent
Amorphophalus companulatus (Roxb.) Bl.	Araceae	India	herb	Corm	Corm, seed	Antiasthmatic, antiemetic
Anacardium occidentale Linn.	Anacardiaceae	Tropics	tree	seed	Bark, leaf, fruit	Anthelmintic, anti-asthmatic
Anacyclus pyrethrum DC	Asteraceae	Bengal, Arabia	herb		root	Cardiac stimulant, sialogogue
Andrographis paniculata Nees	Acanthaceae	India, Sri Lanka	herb		Whole plant	Antipyretic, alterative, febrifuge
Anisochilus carnosus Wall.	Lamiaceae	N. Circars, Mysore, Malabar	herb		Leaves, oil	Stimulant, diaphoretic, expectorant
Anisomeles malabarica R. Br.	Lamiaceae	S.India, Sri Lanka	herb		Leaves, essential oil	Stimulant, diaphoretic, astringent
Annona squamosa Linn.	Annonaceae	India	tree	seed	Whole plant	Purgative, suppurative
Antiaris toxicaria (Pers.) Lesch.	Moraceae	Java, Sri Lanka, Malaya, Burma	tree	seed	seeds	febrifuge
Aphanamixis polystachya (Wall.) Parker	Meliaceae	Tropics	tree	seed	Bark, seed	Anthelmintic, astringent, anticancer
Areca catechu Linn.	Arecaceae	Tropical India, E. Archipelago	palm	Seed	Seed or kernal, root, tender leaves, catechu	
Argemone mexicana Linn.	Papaveraceae	Native of Mexico, India	Annual	seed	Milky juice, seed, fresh root	Astringent, anthelmintic, aperient
Argyreia speciosa Sweet	Convolvulaceae	india	Climbing shrub		Leaves, root	antipholgistic
Aristolochia bracteolata Ham.	Aristolochiaceae	India	twiner	Seed, veg.,	Roots, leaves, fruits	Digestive, diuretic, anthelmintic
Aristolochia indica Linn.	Aristolochiaceae	India	twiner	Root, rhizome	Stimulant, emmenagogue, alexiteric	Antidote, leprosy, dropsy
Artemisia pallens	Asteraceae	Poona, Alndi, Jejuri	Sub shrub		Whole plant	Antipyretic, anthelmintic
Artemisia vulgaris Linn.	Asteraceae		tree	Seed	Leaves, flowering tops	Anthelmintic, antiseptic, expectorant
Artocarpus heterophyllus Lam.	Moraceae	India	tree	Seed	Roots, leaves, fruits. Seeds, wood, latex	Antidiarrhoeal. Astringent, carminative, tonic
Artocarpus hirsutus Lam.	Moraceae		Tree	Seed	Bark, leaves. fruits	Astringent, anaphrodisiac
Asparagus racemosus Willd.	Liliaceae	India, Andaman and Nicobar islands	climber	Seed, root	Tuberous roots	Spasmolytic, anticancer
Averrhoa bilimbi Linn.	Oxalidaceae	India, Burma	Ever green tree	Seed	fruit	Astringent, stomachic, refrigerant, cooling
Averrhoa carambola Linn.	Oxalidaceae		Ever green tree	Seed	Leaves, root, fruit	Laxative, refrigerant,
Azadirachta indica A. Juss.	Meliaceae	India, Africa	Tree	Seed	Bark, leaves, flower, seeds, oil	Antiviral, anthelmintic, insectcide, antiseptic
Azima tetracantha Lam.	Salvadoraceae	Decan, Sri Lanka, Coromandal coast			Leaves, roots	diuretic
Bacopa monnieri (Linn.) Pennell	Scrophulariaceae	Throughout India in wet places	herb	Seeds, vegetative	Whole plant	Barbiturate, hyponosis potentiation effect
Baliospermum solanifolium (J. Burm.) Suresh	Euphorbiaceae	Sub Himalayan tracts, W.Bengal, Bihar	Under shrub	vegetativel	Roots, leaves, seeds	CVS active, hypotensive, diuretic
Bambusa bambos Druce	Poaceae	India, Lower Himalaya	Thorny bambo	Seed, tiller	Interior stalks, young shoots, leaves	Emmenagogue, anthelmintic, astringent, stimulant
Barleria mysorensis	Acanthaceae	Malabar, Travancore	shrub			
Bauhinia purpurea Linn.	Caesalpiniaceae	S.Asia, India			Bark, flower, root	Astringent, carminative, laxative
Bauhinia racemosa Lam.	Caesalpiniaceae				Leaf, bark	Astringent, anthelmintic, cephalalgic

Bauhinia tomentosa	Caesalpiniaceae					
Bauhinia variegata Linn.	Caesalpiniaceae	Sub-Himalayan tracts, Dry forests	Tree	seed	Root, bark	Hypothermic, CNS active, anti-bacterial
Biophytum sensitivum (Linn.) DC.	Oxalidaceae	Throughout India	herb	seed	Whole plant	Astringent, anti-pyretic, anti-septic
Blepharis boerhaavifolia	Acanthaceae		Under shrub			
Blepharistemma corymbosa	Rhizophoraceae					
Boerhaavia diffusa Linn.	Nyctaginaceae	India	Creeping herb	vegetative	Herb and root	Laxative, diuretic, expectorant, emetic, purgative, anthelmintic, febrifuge
Bombax ceiba Linn.	Bombacaceae	India	Tree	seed	Gum, seed, leaves, fruit, bark, flower	Astringent, demulcent, diuretic, aphrodisiac, emetic
Brassica campestris Linn.	Brassiccaceae	India	herb	seed	Stem, root, leaves, seeds	Aperient, diuretic, rubefacient
Brassica juncea (Linn.) Czern. & Coss.	Brassicaceae	India	herb	seed	Seed, oil	Asperient, stimulant, emmengogue
Brassica oleracea Linn. var. *botrytis* Linn.	Brassicaceae	India	herb	seed		
Breynia patens Benth.	Euphorbiaceae		Shrub			
Bridelia crenulata Roxb.	Euphorbiaceae		Tree			
Bridelia scandens (Roxb.) Willd.	Euphorbiaceae		Climbing shrub			
Bryonia sp.	Cucurbitaceae	India, Tropical Himalya, Sri Lanka, South East Asia, Malaysia				
Butea monosperma (Lam.) Taub.	Papilionaceae	India	Deciduous tree	seed	Gum, seeds, flower, bark, leaves	Anthelmintic, astringent, aperient
Caesalpinia bonduc (Linn.) Roxb.	Caesalpiniaceae	S.India, W.Bengal	Climbing herb	seed	Seeds, nuts, root, bark, leaves	Antiperiodic, antispasmodic, anthelmintic, febrifuge
Caesalpinia sappan Linn.	Caesalpiniaceae		Tree	seed	Heart wood	Anti-cancer, anti-inflammatory, semen coagulating
Cajanus cajan (Linn.) Millsp.	Papilionaceae		shrub	seed	Seeds, beans, leaves	
Calamus travancoricus Bedd. ex Hook. f.	Arecaceae				Tender leaves	
Callicarpa tomentosa (Linn.) Murray	Verbenaceae		shrub		Root, bark	febrifuge
Calotropis gigantea (Linn.) R. Br.	Asclepiadaceae	India	Milky shrub	seed	Whole plant	Depurative, anthelmintic, expectorant
Calycopteris floribunda Lam.	Combretaceae	India	Woody shrub		Leaves, fruits, root	Stimulant, anthelmintic, laxative
Cananga odorata Hook. f. & Thom.	Annonaceae		tree	seed	Oil from flowers	Anti-rheumatism, anti-malarial, anti-diarrhoeal
Capparis sepiaria Linn.	Capparidaceae	S.India	shrub			
Capparis zeylanica Linn.	Capparidaceae		Climbig shrub			
Capsicum annum	Solanaceae	India	Annual shrub		fruit	Thermogenic, digestive, carminative, cardio tonic
Cardiospermum halicacabum Linn.	Sapindaceae	Throughtout India	Herb		Roots, leaves, seeds	Antibacterial, hypotensive, antirheumatism
Careya arborea Roxb.	Lecythidaceae		Deciduous tree	seed	Bark, leaves, flower, fruits	Astringent, thermogenic, expectorant
Carica papaya Linn.	Caricaceae	India	Soft wood tree	Seed, mount layering	Fruits, latex	Anti-fertility, anti-coagulant, anthelmintic
Carum bulbocastanum Koch	Apiaceae		Herb			
Carum carvi Linn.	Apiaceae				Oil	Stomachic, carminative

Caryota urens Linn.	Arecaceae		Tree	seed	Juice, spirit, nuts	
Cascabela thevetia (Linn.) Lippold	Apocynaceae		Shrub			
Cassia fistula Linn.	Caesalpiniaceae	Throughout India	Tree	Seed	Whole plant	Anti-viral, anti-cacer, hypoglycaemic
Cassia occidentalis Linn.	Caesalpiniaceae	Throughout india	Under shrub	seed	Whole plant	Diuretic, antibacterial
Cassia sophera Linn.	Caesalpiniaceae	Throughout tropical India	Under shrub	seed	leaves	Spasmolytic, anthelmintic, antiseptic
Casuarina equisetifolia Linn.	Casuarinaceae		Tree	seed	Wood, bark, leaves	Astringent
Catharanthus roseus (Linn.) G. Don	Apocynaceae	India	herb	seed	Whole plant	Hypotensive, sciative, stomachic
Catunaregam nutans (DC.) Tiruv.	Rubiaceae		Deciduous shrub			
Cayratia pedata (Lam.) Juss. ex Gagnep.	Vitaceae		Climbing shrub		Berry	Astringent, refrigerant
Ceiba pentata (Linn.) Gaertn.	Bombacaceae		Tree		Gum, root, young leaf	Alterative, laxative, antidiabetic
Centella asiatica (Linn.) Urban	Apiaceae	India	herb	vegetative	Whole plant	Nerve tonic, brain tonic
Chenopodium ambrosioides Linn.	Chenopodiaceae		herb		Seed, seed oil	Amoebicidal, analgesic, diuretic
Chukrasia tabularis A. Juss.	Meliaceae				Bark	Astringent, spasmolytic, diuretic
Cicca acida (Linn.) Merr.	Euphorbiaceae		Tree	seed		
Cinnamomum camphora Nees & Eberm.	Lauraceae		Evergreen tree	vegetative	oil	Stimulant, carminative
Cinnamomum verum Presl	Lauraceae		Ever green aromatic tree	seed	Bark, oil	Stimulant, diuretic, expectorant, febrifuge
Cissampelos pareira Linn.	Menispermaceae		Climbing plant		Root, bark, leaves	Stomachic, diuretic, anthelmintic
Cissus quadrangularis Linn.	Vitaceae		Tendril climber		Whole palnt	Aphrodisiac, carminative
Citrus aurantifolia (Christm.) Swingle	Rutaceae		Thorny tree	seed	Fruit juice, rind of fruit	Stomachic, antiscorbutic, anthelmintic
Citrus limon (Linn.) Burm. f.	Rutaceae		Thorny shrub	seed	Rind of fruit, fruit juice	Stomachic, carminative, antiscorbutic
Citrus maxima (Burm.) Merr.	Rutaceae			seed		
Cleistanthus collinus (Roxb.) Benth. & Hook. f.	Euphorbiaceae		tree		Whole plant	Poison, anticancer,astringent
Clematis triloba Heyne ex Roth	Ranunculaceae				leaves	Alterative, sedative
Cleome gynandra Linn.	Capparidaceae		Herb	seed		
Cleome viscosa Linn.	Capparidaceae	India	herb	seed	Whole plant	antifungal, anthelmintic, carminative
Clerodendrum phlomidis Linn. f.	Verbenaceae	Drier parts of India	shrub	seed	bark	Anthelmintic, Hypoglycaemic
Clerodendrum serratum (Linn.) Moon	Verbenaceae	india	Woody shrub	seed	Roots, leaves	Antispasmolytic, expectorant, carminative
Clerodendrum viscosum Vent.	Verbenaceae	india	shrub	seed	leaves	Antiinflammatory, demulcent, vermifuge
Clitoria ternatea Linn.	Papilionaceae	India	climber	seed	Seeds, roots, leaves	Purgative, diuretic, laxative
Coccinia grandis (Linn.) Voigt.	Cucurbitaceae	India	climber	Vegetatively by stem cuttings	Roots, leaves, fruits	Hypoglycaemic, antiprotozoal
Cocculus hirsutus (Linn.) Diels.	Menispermaceae	Tropical& subtropical India	shrub		Roots, leaves	Cardio tonic, anticonvalasant
Cochlospermum religiosum (Linn.) Alst.	Cochlospermaceae	India	Deciduous tree	seed	Leaves, flowers, gum	stimulant
Cocos nucifera Linn.`	Arecaceae	S. India, Sri Lanka, Archipelago	Tree	seed	Flowers, roots, fruit, oil, ash	Purgative, refrigerant, antacid
Coffea arabica Linn.	Rubiaceae	S.India, Sri lanka	Large shrub	seed	Seeds, leaves	Dietetic, nervous stimulant

Coffea robusta	Rubiaceae			seed		
Coix lacryma-jobi Linn.	Poaceae	India	Perennial grass	seed	Roots,seeds	Diuretic, cathartic,depurative
Coldenia procumbens Linn.	Boraginaceae		herb		Leaves	Antirheumatic
Coleus amboinicus Lour.	Lamiaceae	India	herb	Stem cutting	leaves	appetising, digestive
Coleus zeylanicus (Benth.) Cramer	Lamiaceae			Stem cutting	leaves	
Colocasia esculenta (Linn.) Schott	Araceae	India	Perennial herb	corm	Leaves, corms	Styptic,stimulant, rubefacient
Commiphora caudata (Wt. & Arn.) Engl.	Burseraceae		Tree	seed	Roots, leaves	Astringent, aphrodisiac, diuretic
Commiphora mukul (Hook. ex Stocks) Stocks	Burseraceae	Africa, Asia, Rajasthan, A.P, Assam, M.P	Small tree	Seed, vegetative cuttings, grafts	Roots, leaves	Nypolipaemic, hypocholesteraemic, aphrodisiac
Connarus monocarpus Linn.	Connaraceae		Shrub	seed	Fruit, root	
Coriandrum sativum Linn.	Apiaceae	India	Herb	seed	fruit	Aromatic, stimulant, carminative, antibilious
Coscinium fenestratum (Gaertn.) Colebr.	Menispermaceae	W.ghats of T.N and Kerala	Climbing shrub	Stem cutting	stem	Thermogenic, anodyne, opthalmic
Costus speciosus (Koen.) Sm.	Zingiberaceae	India	Herb	rhizome	rhizome	Hypotensive, antifertility
Crataeva religiosa Hook. f. & Thom.	Capparidaceae		Small tree		Bark, stem	Laxative, rubefacient
Cressa cretica Linn.	Convolvulaceae	India	Shrub		Whole plant	Expectorant, digestive, haematinic
Crossandra infundibuliformis	Acanthaceae		Shrub			
Crotalaria juncea Linn.	Papilionaceae			seed	Leaves, roots, seeds	Astringent, expectorant
Croton tiglium Linn.	Euphorbiaceae	N.India	Tree	seeds	seeds	Digestive, carminative, antiinflammatory
Cryptolepis buchanani Roem. & Schult.	Asclepiadaceae		Climber		Whole plant	
Curculigo orchioides Gaertn.	Amaryllidaceae	Sub tropical Himalaya, W.Ghats			Root	Hypoglycaemic, spasmolytic, anticancer
Curcuma amada Roxb.	Zingiberaceae	India	Rhizomatous aromatic herb	rhizome	rhizomes	Appetiser, carminative, digestive, demulcent
Curcuma angustifolia Roxb.	Zingiberaceae		Herb	rhizome	rhizome	Demulcent, anthelmintic
Curcuma aromatica Salisb.	Zingiberaceae	Wild throughtout india	Herb	rhizome	rhizome	Spasmolytic, carminative, stimulant
Curcuma longa Linn.	Zingiberaceae	India	Herb	rhizome	rhizome	Anti-inflammatory, emollient, depurative
Cyathula prostrata (Linn.) Bl.	Amaranthaceae	India	India		roots	Emetic, alexipharmic
Cyclea peltata (Lam.) Hook. f. & Thom.	Menispermaceae	India	Twining herb		Roots, leaves	Thermogenic, carminative, depuratve
Cymbopogon citratus (DC.) Stapf	Poaceae	India	Perennial grass	Seed, slips	Whole plant	Anthelmintic, laxative, aphrodisiac
Cymbopogon flexuosus (Steud.) Wats.	Poaceae	Kerala	Perennial grass	seed, slips		
Cymbopogon martinii var. *motia* Roxb.	Poaceae	India	Perennial grass	seed, slips		
Cymbopogon martinii var. *sofia*	Poaceae	India	Perennial grass	seed, slips	Oil	
Cymbopogon nardus (Linn.) Rendle	Poaceae	India	Perennial grass	seed, slips	Leaf, oil	Antiseptic, carminative, rubefacient
Cymbopogon nardus var. confertiflorus x C. jawarancusa	Poaceae	India	Perennial grass	slips		
Cymbopogon pendulus Wats.	Poaceae	India	Perennial grass	seed, slips		
Cymbopogon winterianus	Poaceae	India	Perennial grass	slips		

Cynodon dactylon (Linn.) Pers.	Poaceae	India	Perennial grass	vegetative	Whole plant	Haemostat, vulnerary
Cyperus rotundus Linn	Cyperaceae	Tropics	Herb	Veg. by tuber	Bulbous tuber	Antiinflammatory, antipyretic, analgesic
Dalbergia latifolia Roxb.	Papilionaceae	India		seed	Whole plant	Anthelmintic, antipyretic, analgesic
Datura metel Linn.	Solanaceae	India	Sub-shrub	seed	Whole plant	Emetic, narcotic, anodyne, antispasmodic
Delonix regia (Boj.) Rafin.	Caesalpiniaceae		Tree	seed		
Dendrocalamus strictus (Roxb.) Nees	Poaceae				leaf	astringent
Desmodium gangeticum DC.	Papilionaceae	Lower hills and plains of india	Under shrub	seed	Roots	Antiinflammatory., aphrodisiac, analgesic
Desmodium gyrans DC.	Papilionaceae	India	shrub	seed		
Desmodium pulchellum Backer	Papilionaceae			seeds	Bark, flower	Antidiarrhoeal, antihaemorrhage
Desmodium triflorum (Linn.) DC.	Papilionaceae	India	Perennial herb	seeds	Whole plant	Expectorant, galactogogue
Desmostachya bipinnata Stapf	Poaceae		Perennial grass			Astringent, diuretic
Dioscorea bulbifera Linn.	Dioscoreaceae		Climbing herb	Tuber	Tuber, leaf	Antidysenteric, antisyphilic
Dioscorea floribunda	Dioscoriaceae	Native of Central America, India, China	climber	Tuber, stem cuttings	tubers	Carbohydrale, protein metabolism
Diospyros melanoxylon Roxb.	Ebenaceae		Tree	seeds	Unripe fruit, leaf, fruit, bark	Carminative, astringent, laxative, aphrodisiac, anaemia
Dolichos biflorus Backer	Papilionaceae		twiner	seeds	seeds	Astringent, diuretic, tonic
Ecbolium viride (Forsk.) Merr.	Acanthaceae	Sri Lanka, India, Africa, Malaya	Shrub			
Eclipta prostrata (Linn.) Linn.	Asteraceae	India	herb	seed	Whole plant	Antihepatic, hematicidal, CVS active
Elephantopus scaber Linn.	Asteraceae	India	Rigid herb		Roots, leaves	Astringent, alterative, febrifuge
Elettaria cardamomum Maton	Zingiberaceae		Perennial herb	Seed, sucker	seed	Anticephalalgia, antiemetic
Embelia ribes Burm. f.	Myrsinaceae	India	Climbing shrub		Fruits, roots, leaves	Contraceptive, acaricidal, antibacterial
Emilia sonchifolia DC.	Asteraceae	India	herb		Whole plant	Sudorific, vulnerary
Ensete superbum	Musaceae					
Entada pursaetha DC.	Mimosaceae	Tropics			seeds	irritant
Erythrina variegata Linn.	Papilionaceae	India, Sri lanka, Thailand, Laos	Tree	Seed, stem cutting	Bark, leaves	Galactogogue, anthelmintic
Eucalyptus citriodora Hook.	Myrtaceae	Australia, India	Tree	seed	Dried leaves, gum, oil	
Eucalyptus globulus Labill.	Myrtaceae	Australia, India	Tree	seed		Febrifuge, carminative, antiseptic
Eupatorium triplinerve Vahl	Asteraceae	Brazil, India	Sub shrub	seed	Dried leaves, flower tops, twigs	Diaphoretic,antiperiodic, expectorant
Euphorbia hirta Linn.	Euphorbiaceae		Straggling herb	seed	Seed, leaves	Galactogogue, diuretic, aphrodisiac
Euphorbia nivulia Buch.-Ham.	Euphorbiaceae		Tree	seed		Expectorant, digestive, stomachic, abortive
Euphorbia thymifolia Linn.	Euphorbiaceae	India	Herb		Whole plant	Laxative, antibacterial, alexipharmic
Euphorbia tirucalli Linn.	Euphorbiaceae					
Euphorbia tirucalli Linn.	Euphorbiaceae					
Euphorbia trigona Haw.	Euphorbiaceae		Tree		Milky juice	

Evolvulus alsinoides (Linn.) Linn.	Convolvulaceae		Herb		Whole plant	Tonic, alterative, febrifuge
Excoecaria agallocha Linn.	Euphorbiaceae	India	Tree		leaves	Purgative, alterative
Ficus bengalensis Linn.	Moraceae	Sub-Himalaya, Peninsular India	Tree	seed	Aerial root, bark, leaves, buds, fruits, latex	Hypoglycaemic, astringent,
Ficus exasperata Vahl	Moraceae					
Ficus heterophylla Linn. f.	Moraceae				Root, leaves	Antiasthmatic, antidysenteric
Ficus microcarpa Linn. f.	Moraceae	India	Tree	Veg. by stem cutting	Root, bark, leaves	Astringent, acrid
Ficus racemasa Linn.	Moraceae	Sub_Himalayam tracts Ever green tree			bark	Astringent, antiseptic
Ficus religiosa Linn.	Moraceae	India	Tree	seed	Bark, leaves, tender shoots, fruits, seeds, latex	Antibacterial, hypoglycaemic, anthelmintic
Flacourtia indica Merr.	Flacourtiaceae	Small tree			Root, fruit	Depurative, diuretic
Flacourtia jangomas (Lour.) Raeusch.	Flacourtiaceae		Deciduous shrub		Bark, leaves, fruits	Astringent, refrigerant, diaphoretic
Garcinia gummi-gutta (Linn.) Robs.	Clusiaceae		Trees	seed	Leaves, dried fruits	Astringent, thermogenic, constipation
Geophila reniformis	Rubiaceae					
Girardinia diversifolia (Link) Friis	Urticaceae					
Gloriosa superba Linn.	Liliaceae	Tropical India, S. Africa	Climbing herb	Seed, rhizome, tissue culture	Roots, rhizomes	Oxytoxic, uterine, stimulant
Glycosmis pentaphylla (Retz.) DC.	Rutaceae				Whole plant	Antiinflammatory, antianaemic, antirheumatic
Glycyrrhiza glabra Linn.	Papilionaceae	Mediterranean region, S. Europe, Middle East	Under shrub	Seed, crown cutting, stolon pieces	Roots, dried stem	Antidiuretic, expectorant, emetic, diuretic
Gmelina arborea Roxb.	Verbenaceae	India	Tree		Whole plant	Hypoglycaemic, antiviral, stomachic
Gymnema sylvestre R. Br.	Asclepiadaceae	India, Afganistan, Iran	climber	vegetatively	Whole plant	Antidiabetiic
Hedyotis corymbosa (Linn.) Lam.	Rubiaceae		Suffruticose annual		Whole plant	Aperient, pectoral, refrigerant
Helicteres isora Linn.	Sterculiaceae		Large shrub		Root, bark, fruits	Demulcent, lactifuge
Heliotropium indicum Linn.	Boraginaceae		Herb		roots	Errhine
Hemidesmus indicus (Linn.) R. Br.	Asclepiadaceae	India, Sri Lanka, Moluccas	Twiner	Veg. by root	Roots, leaves, stem	Antibacterial, antiviral
Hibiscus rosa-sinensis Linn.	Malvaceae	Tropical Africa, Asia	Ever green woody shrub	Stem cutting	Roots, leaves, flower	Demulcent, febrifuge, emollient
Hibiscus sabdariffa Linn.	Malvaceae,	Tropical Africa, Asia, warmer parts of India			Seed, leaf	Aphrodisiac, antiscorbutic, antibilious
Hibiscus tiliaceus Linn.	Malvaceae	W.Bengal, Peninsular India, Andaman &Nicibar islands			Root, flower, bark	Aperient, antirheumatic, resolvent
Holarrhena pubescens (Buch.-Ham.) Don	Apocynaceae		Deciduous tree		Bark, leaves, seeds	Carminative, expectorant, anthelmintic
Holoptelea integrifolia (Roxb.) Planch.	Ulmaceae		Tree			
Holostemma ada-kodien Schult.	Asclepiadaceae	India, Sri Lanka, Burma, W.China	Twiner	seed, root cutting	roots	Antidiabetic, antiviral
Homonoia riparia Lour.	Euphorbiaceae	India	shrub		Root, fruit, stem	Diuretic, antigonorrhoea, antisyphilitic
Hugonia mystax Linn.	Linaceae	Peninsular india	Scandent shrub		Root, bark	Febrifuge, anthelmintic,

						antiinflammatory
Hybanthus enneaspermus (Linn. f.) Muell.	Violaceae	India	herb		Whole plant	
Hydnocarpus laurifolia (Dennst) Sleum.	Flacourtiaceae	W.ghats	Tree		Seed oil	Antileperotic, diuretic
Hygrophila schulli (Ham.) M. R. & S. M. Almeida	Acanthaceae	India	Shrub		Roots, leaves, seeds, ashes	Diuretic, antiinflammatory, aphrodisiac
Ichnocarpus frutescens (Linn.) R. Br.	Apocynaceae		Climbing shrub		Leaf, root, stalk	Febrifuge, antisyphilitic,
Indigofera tinctoria Linn.	Papilionaceae	India	shrub	seed	Whole plant	Antipiretic, anticephalgic
Ipomoea mauritiana Jacq.	Convolvulaceae	India	Climber		Root	Aphrodisiac, galactogenic, chologogue
Ipomoea pes-tigridis Linn.	Convolvulaceae					
Ixora coccinea Linn.	Rubiaceae		Shrub		Flower, root	Antileucoderma, antidiarrhoeal, sedative
Jasminum grandiflorum Linn.	Oleaceae		Twining ever green shrub	Stem cutting	Leaves, flower	Anthelmintic, diuretic emmenagogue
Jasminum sambac Ait.	Oleaceae	India	Climbing shrub	Stem cutting	Whole plant	Emmenagogue
Jatropha curcas Linn.	Euphorbiaceae	Tropical America, India, Andaman & Nicobar islands	Shrub		Nut, whole plant	Purgative
Jatropha glandulifera Roxb.	Euphorbiaceae	S.India, W.Bengal,Andaman & Nicobar islands	Shrub		Oil, root	Antirheumatic, antiparalytic, purgative
Jatropha gossypifolia Linn.	Euphorbiaceae	India	Shrub		Leaves, bark, seed	Emmenagogue, purgative, emetic
Justicia betonica	Acanthaceae		Shrub		Bark, leaves, root stalks	Emetic, antiperiodic, insecticide
Justicia gendarussa Linn. f.	Acanthaceae		Under shrub			
Justicia wynadensis	Acanthaceae	W. ghats	Under shrub		Root, leaves, bark, stalks	Emetic, antiperiodic
Kaempferia galanga Linn.	Zingiberaceae	India	Perennial herb	rhizome	Tuber	Stimulant, expectorant, diuretic, carminative
Kaempferia rotunda Linn.	Zingiberaceae	India	Aromatic herb	rhizome	tuber	Thermogenic, sialagogue, vulneray
Lagenaria siceraria	Cucurbitaceae	India	Climber		Pulp, leaves	Emetic, purgative
Lantana camara Linn. var. *aculeata* Moldenke	Verbenaceae	India	Ever green shrub	seed	Whole plant	Antirheumatic, antimalarial
Lawsonia inermis Linn.	Lythraceae	India	Ever green shrub		Whole plant	Antibacterial, antiinflammatory
Leea indica Merr.	Vitaceae	India	Shrub		Root, leaves	Astringent, sudorific, acrid
Leucas aspera (Willd.) Spr.	Lamiaceae	India	Annual herb	seed	Whole plant	Insecticidal, antipyretic
Limnophila indica (Linn.) Druce	Scrophulariaceae		Deccumbent herb			
Limonia acidissima Linn.	Rutaceae	S.India	Deciduous tree		Fruit, leaves oil	Antiscorbutic, antibilious, demulcent
Lippia nodiflora Mich.	Verbenaceae					
Litchi chinensis Sonner.	Sapindaceae	China, India			Fruit, leaves	
Lobelia nicotianifolia Roth ex Roem. & Schult.	Lobeliaceae	W.ghats			Leaves, root	antiseptic
Macaranga peltata (Roxb.) Muell.-Arg.	Euphorbiaceae		Tree			
Maesa indica Wall.	Myrsinaceae	w.ghats				Berry, leaves
Mangifera indica Linn.	Anacardiaceae	Tropics	Tree	seed	Anthelmintic	
Maranta arundinacea Linn.	Zingiberaceae	India	Herb	Rhizome	Rhizome	Astringent, refrigerant, aphrodisiac

Melia azedarach Linn.	Meliaceae	India, Sub Himalaya	Tree	seed	Bark, leaves flower oil	Antidiarrhoeal, deobstruent, diuretic
Mentha arvensis Linn.	Lamiaceae	Japan, J & K, UP, Punjab	Aromatic herb	sucker	oil	Carminative, expectorant, antifungal
Mesua nagassarium (Burm. f.) Kosterm.	Clusiaceae	North eastern India Andaman & Nicobar islands	Tree	Seed	Flower oil	Antiinflammatory, CNS depressant
Michelia champaca Linn.	Magnoliaceae	Eastern Himalaya, Assam, S.India	Ever green tree	seed	Bark, root, flower fruit, oil	Expectorant, abortifacient, contraceptive
Mimosa pudica Linn.	Mimosaceae	Tropical America, Tropical India	Under shrub	seed	Root, leaves, stem	Purgative, antidropsical, antiinflammatory
Mimusops elengi Linn.	Sapotaceae	North Andaman & Nicobar islands Peninsular India	Tree	Seed	Bark, flower, fruit, seed	Spermicidal, spasmolytic, diuretic
Mirabilis jalapa Linn.	Nyctaginaceae				Root, leaves, stem	Purgative, antidropsical, antiinflammatory
Mollugo oppositifolia Linn.	Aizoaceae		Herb			
Morinda umbellata Linn.	Rubiaceae	Bihar, Khari hills, India	Deciduous tree		Root, leaves,	Antidiarrhoeal
Moringa oleifera Lam.	Moringaceae	Sub-Himalayan tracts, UP, India	Tree	Seed, Vegetative	Root, bark, leaves, seed	Abortifacient, spasmolytic, antibacterial,
Mucuna pruriens (Linn.) DC.	Papilionaceae	India, Andaman & Nicobar islands	Climber	seed	Root, leaves, seed	Emmenagogue, antichorein, vermifuge
Mukia maderaspatana (Linn.) M. Roemer	Cucurbitaceae	India	Climber		Root, leaves, tender shoot	Carminative, sudorific, aperient
Murraya koenigii (Linn.) Spreng.	Rutaceae		Shrub		Bark, root, leaves	Febrifuge, tonic, stomachic
Musa paradisiaca Linn. var. *sapientum* Kuntze	Musaceae		Tall herb	sucker	Root, leaves, fruit, stem	Anthelmintic, antiscorbutic, depurative
Mussaenda frondosa Linn.	Rubiaceae	Tropical Himalaya, Dehra Dun	Scandent shrub		Whole plant	Vermifuge, diuretic, antiasthmatic, spasmolytic
Myristica fragrans Houtt.	Myristicaceae	Moluccas, T.N, Kerala, A.P, Assam	Tree	Seed	Seed, aril	Antibacterial, antidiarrhoeal, abortifacient,
Naregamia alata Wt. & Arn.	Meliaceae	W.ghats, TN, Karnataka	Under shrub		Root, leaves, stem	Cholagogue, antibilious
Nerium oleander Linn.	Apocynaceae	India	Shrub	Seed	Root, leaves, bark	Cardio tonic, CNS active, spasmolytic
Nervilia aragoana Gaud.	Orchidaceae		Terrestrial orchid		Whole plant	Galactogogue, diuretic
Nyctanthes arbor-tristis Linn.	Oleaceae	Outer Himalya, Assam, W.Bengal	Large shrub		Leaves	Antiinflammatory, febrifuge, cholagogue
Nymphaea rubra Roxb.	Nymphaeaceae	Warmer India			Root stalk, flower	Stomachic, antidiarrhoeal
Ochrocarpus longifolius	Clusiaceae		Tree			
Ocimum americanum Linn.	Lamiaceae	Lower hills of India	Branched herb	seed	Whole plant	Carminative, diaphoretic, stimulant
Ocimum basilicum Linn.	Lamiaceae	Punjab	Aromatic herb	seed	Flower, seed, root	Carminative, antidysenteric, stimulant, demulcent
Ocimum gratissimum Linn.	Lamiaceae	India		seed	Whole plant	Antiparalytic, antigonorrhoea
Ocimum gratissimum Linn. var. *clocimum*	Lamiaceae			seed		
Ocimum tenuiflorum Linn.	Lamiaceae	India	Under shrub	seed	Leaves, root, seed	Expectorant, diaphoretic, genito urinary deseases
Operculina turpethum (Linn.) S. Manso	Convolvulaceae	India	Climber		Root	Purgative, antidote, antiinflammatory
Opuntia dillenii (Ker-Gawler) Haworth	Cactaceae		Shrub	Stem cutting	Whole plant	Antigonorrhoeic, antiinflammatory, purgative,

Oroxylum indicum (Linn.) Vent.	Bignoniaceae	India	Tree		Root, bark, fruit, seed	Astringent, carminative, purgative, spasmolytic
Orthosiphon stamineus Benth.	Lamiaceae		Herb			
Ougeinia dalbergioides	Papilionaceae		Deciduous tree		Bark	Astringent, acrid, sudorific, styptic
Oxalis corniculata Linn.	Oxalidaceae		Annual or perennial herb		Whole plant	Astringent, anodyne, antiseptic
Pavetta indica Linn.	Rubiaceae	India			Root, leaves, wood	Purgative, antidropsical, anticephalalgic
Phoenix dactylifera Linn.	Arecaceae	Dry regions of Gujarat, Rajastan, Punjab	Tree		Fruit, gum, fresh sap	Antiasthmatic, expectorant, astringent, antidiarrhoeal
Phoenix pusilla Gaertn.	Arecaceae	Coromandal coast	Tree		Fruit pulp, seed, gum	Febrifuge, antidiarrhoeal, laxative
Phyllanthus amarus Schum. & Thonn.	Euphorbiaceae	Throughout warmer parts of India	Herb	Seed	Whole plant	Antihepatotoxic, antibacterial
Phyllanthus emblica Linn.	Euphorbiaceae	S.India, Kashmir	Tree	Seed	Root, bark, leaves, fruit,	Antiviral, CVS active
Physalis minima Linn.	Solanaceae	India, Himalaya	Annual herb		Leaves, fruit	Diuretic, purgative, antigonorrhoeic
Pimenta racemosa J. W. Moore	Myrtaceae	W.Indies, tropical America		seed	Fruit, leaf, oi, seed	Carminative, stomachic, antiseptic, fever
Pinus Roxb*urghii* Sargent	Pinaceae	Himalaya, Kashmir to Bhutan	Coniferous tree		Pine oil	Antiseptic, expectorant, carminative, stimulant
Piper betle Linn.		India	Perennial root climber	Stem cutting	Leaves, oil, root	Antispasmodic, carminative, stimulant
Piper chaba Hunter	Piperaceae					
Piper longum Linn.	piperaceae	W.India, Nepal, W.Ghats	Climber	Vegetative	Root, dried spikes	Antitubercular, anthelmintic, antibacterial
Piper nigrum Linn.	Piperaceae	Eastern and weatern ghats, TN, Keara	Climber	Vegetative	Fruit	Antibacterial, anthelmintic, hypertensive
Pistia stratiotes Linn.	Araceae	India			Whole plant	Antitubercular, emollient, diuretic
Plumbago indica Linn.	Plumbaginaceae	Native of Sikkim, India	Herb	Vegetative	Root	Sialogogue, vesicant, stimulant
Plumbago zeylanica Linn.	Plumbaginaceae	India	Herb	Vegetative	Leaves, root	Uterine, stimulant, abortifacient
Plumeria rubra Linn.	Apocynaceae	India	Tree		Root, bark, flower, fruit	Cathartic bechic, antidontalgic
Pogostemon patchouli Hook. f.	Lamiaceae			Stem cutting		
Polyalthia longifolia Benth. & Hook. f.	Annonaceae	Drier parts of India	Tree	seed	Bark	Febrifuge, fungitoxic
Pongamia pinnata (Linn.) Pierre	Papilionaceae	India	Tree	Seed, veg by root	Leaves, seed, root	Antibacterial, antifungal, insecticidal
Portulaca oleracea Linn.	Portulacaceae	India		Whole plant	Depurative, antiscorbutic	Liver, spleen, kidney complaints
Pothos scandens Linn.	Araceae				Root, stem	Antileptic, lactogogue
Premna integrifolia Linn.	Verbenaceae	Costal regions of India			Whole plant	Antirheumatic, stimulant, bechic, astringent
Premna latifolia Roxb.	Verbenaceae	India			Leaves, bark	Diuretic, antidropsical
Prunus amygdalus Batsch	Rosaceae	India	Tree		Kernal oil	Laxative, diuretic, lithontriptic
Prunus cerasoides D. Don	Rosaceae	Himalaya	Large tree		Kernal, tender branch	Antilithic, spasmolytic
Pseudarthria viscida (Linn.) Wt. & Arn.	Papilionaceae	India	Perennial under shrub		Root	Astringent, antibilious, antirheumatic
Psidium guajava Linn.	Myrtaceae		Small tree	seed	Root, leaves, flower, fruit	Haemostatic, antiemetic

Psoralea corylifolia Linn.	Papilionaceae	India	Annual herb		Root, leaves, seed	Antidiarrhoeal, diaphoretic febrifuge
Pterocarpus marsupium Roxb.	Papilionaceae	Tropical S.India	Tree	Seed	Leaves, stem, bark, heart wood, gum	Hypoglycaemic, CVS active
Pterocarpus santalinus Linn.	Papilionaceae	AP	Deciduous tree	seed	Heart wood	Antibilious, diaphoretic, febrifuge
Punica granatum Linn.	Punicaceae	Iran, Afghanistan, India	Shrub	Seed, air layering	Root, seed, flower, fruit	antifertility, antibacterial, hypothermic
Raphanus sativus Linn.	Brassicaceae		Herb		Root, leaves, seed	Appetising, antibacterial, anodyne
Rauvolfia serpentina (Linn.) Benth. ex Kurz.	Apocynaceae	India	Herbaceous under shrub	Seed	Root, seed	Antiarrhythmic, antihypertensive
Rhaphidophora pertusa Schott	Araceae		Stout climber		Stem	Carminative, astringent, digestive
Rhinacanthus nastus (Linn.) Kurz.	Acanthaceae		Under shrub		Whole plant	Blister producer, depurative
Ricinus communis Linn.	Euphorbiaceae	India	Tree	Seed	Root, leaves, flower, seed	Antiprotozoal, anticancer
Rotula aqautica Lour.	Boraginaceae	India			Root	Diuretic, CNS active
Rubia cordifolia Linn.	Rubiaceae	Hilly dists. Of India	Climber herb	Veg. by stem	Root	Antineoplastic, antiinflammatory
Ruta graveolens Linn.	Rutaceae	India	Herb	Veg. by seed	Whole plant, oil	Decreases capillary fragility
Saccharum arundinaceum Retz.	Poaceae		Gigantic grass	Stem cutting	Root, stem	Diuretic, demulcent
Saccharum spontaneum Linn.	Poaceae		Perennial grass	Stem cutting	Root, stem	Cooling, diuretic, galactogogue
Salacia reticulata Wt.	Celastraceae	India, Andaman & Nicobar islands	Woody climber		Root	Antidiabetic, astringent
Sansevieria Roxburghiana Schult.	Haemodoraceae	Coromandal coast	Herb		Tender shoot, rhizome	Expectorant
Santalum album Linn.	Santalaceae	Dry region of India	Tree	Seed	Heart wood	CVS active, antibacterial, antifungal
Saraca asoca (Roxb.) De Wilde	Caesalpiniaceae	India, Andaman & Nicobar islands	Tree	Seed	Bark, leaves, flower, seed	Oxytocic, CNS active
Sarcostemma acidum (Roxb.) Voigt.	Asclepiadaceae	W.Bengal	Twiner		Stem, root	Emetic, hypothermic
Saussurea lappa C. B. Clarke	Asteraceae	Kashmir, HP, UP	Sub shrub	Seed	Root	CNS depressent, antifungal
Scaevola taccada	Goodeniaceae	India	Shrub		Leaves, stem, bark, fruit	Anticephalalgia, antidiarrhoeal
Schleichera oleosa (Lour.) Oken	Sapindaceae	Sub Himalayas, Kashmir, W.Bengal	Large tree		Bark, kernal, oil, seed	Astringent, antiinflammatory
Sesbania grandiflora (Linn.) Poiret	Papilionaceae	Assam, W.Bengal	Soft wooded tree	seed	Bark, leaf juice	Astringent, anticephalalgic
Sida acuta Burm. f.	Malvaceae	Warmer parts of India			Root,	Astringent, febrifuge, stomachic
Sida cordifolia Linn.	Malvaceae	Plain of India			Root, seed	Antiparalytic, aphrodisiac
Sida rhombifolia Linn. ssp. *retusa* (Linn.) Borss.	Malvaceae	Hotter parts of India	Sub shrub		Whole plant	Anabolic, emolient
Solanum americanum Mill.	Solanaceae			seed		
Solanum khasianum C. B. Clarke	Solanaceae	Khasi, Naga hills, Assam	Shrub	seed	Berries	Spasmolytic, Synthesis of corticosteroidal hormone
Solanum melongena Linn. var. *insanum* (Linn.) Prain	Solanaceae	India	Perennial herb	seed	Seed	Stimulant, anticholesterolemic
Solanum surattense Burm. F.	Solanaceae	India	Perennial under shrub	seed	Root, berry, leaves	Antiasthmatic, antirheumatic
Solanum torvum Swartz	Solanaceae	India		seed	Fruit	Spasmolytic
Solanum violaceum Ortega	Solanaceae					

Solanum virginianum Linn.	Solanaceae					
Sphaeranthus africanus Linn.	Asteraceae				Whole plant	Diuretic, alterative, aphrodisiac
Sphaeranthus indicus Linn.	Asteraceae	India	Herb		Whole plant	Diuretic, expectorant, febrifuge, stomachic
Spilanthes calva DC.	Asteraceae	India				Antidontalgia, spasmolytic
Spondias pinnata (Linn. f.) Kurz.	Anacardiaceae	India	Tree		Bark, leaves	Antidigestive, antiscorbutic
Stereospermum suaveolens DC.	Bignoniaceae	India	Tree		Root, bark, flower	Diuretic, antiinflammatory, aphrodisiac, antibilious
Strychnos nux-vomica Linn.	Loganiaceae	India	Tree	Seed, Veg	Bark, leaves, seed	Spasmolytic, muscle relaxant
Strychnos potatorum Linn. f.	Loganiaceae	S.India, W. Bengal	Deciduous tree		Leaves, unripe fruit, seed	Diaphoretic, alexeteric, demulcent
Symplocos cochin-chinensis (Lour.) S. Moore	Symplocaceae	Himalaya, Kashmir	Tree	Seed	Bark	CNS & CVS active, hypotensive, antiinflammatory
Syzygium aromaticum (Linn.) Merr.	Myrtaceae	India	Ever green tree	seed	Dried flower, bud oil	Carminative, antispasmolytic, antiemetic, stimulant
Syzygium cumini (Linn.) Skeels	Myrtaceae	India	Large tree	seed	Bud, leaves	Astringent, carminative, diuretic, antidiabetic
Syzygium jambos (Linn.) Alst.	Myrtaceae	India	Large shrub	seed	Bark, leaves, fruit	Astringent, diuretic
Syzygium zeylanicum DC.	Myrtaceae	India		seed	Whole plant	Stimulant, vermifuge, antirheumatic
Tabernaemontana divaricata (Linn.) Roem. & Schult.	Apocynaceae	Sub-Himalaya, W.Bengal, Assam	Shrub	cutting	Latex, root, flower	Antiinflammatory, antidiarhhoeal
Tamarindus indica Linn.	Caesalpiniaceae	India	Tree	seed	Root,ashes, leaves, flower, fruit, seed	Antigonorrhoea, purgative, antiasthmatic
Tectona grandis Linn. f.	Verbenaceae	India	Tree		Root, wood, bark	Diuretic, anthelmintic, expectorant, anticephalalgia
Tephrosia purpurea Pers.	Papilionaceae	India Perennial herb			Root, leaves, seed oil	Anthelmintic, alexipharma
Terminalia arjuna Wt. & Arn.	Combretaceae	MP, Bihar	Tree	Seed	Bark	CVS & CNS active, diuretic, abortifacient
Terminalia bellirica (Gaertn.) Roxb.	Combretaceae	India	Tree	Seed	Bark, kernal, fruit	astringent, cardio tonic, stimulant, anticancer
Terminalia catappa Linn.	Combretaceae	India	Tree	Seed	Bark, oil from kernal, leaves	Diuretic, astringent, cardio tonic
Terminalia chebula Retz.	Combretaceae	India, sub Himalaya, deciduous forest	Tree	Seed	Fruit, flower, stem, bark	Antispasmodic, hypoglycaemic
Terminalia paniculata Roth	Combretaceae	Western and eastern ghats	Tree		Flower, bark	Anticholerin, diuretic, cardio tonic
Terminalia tomentosa Wt. & Arn.	Combretaceae	Drier parts of India	Tree		Bark	Cardiac stimulant
Thespesia populnea (Linn.) Sol. ex Corr.	Malvaceae		Ever green tree		Root, bark, fruit, leaves	Astringent, antibilious, antiviral
Tiliacora acuminata (Lam.) Miers	Menispermaceae	India			Root	Antidote, CVS active hypothermic
Tinospora cordifolia (Willd.) Hook. f. & Thom.	Menispermaceae	India	Climber shrub	Stem cutting	Stem, leaves, root	Antiviral, hypoglycaemic, anticancer
Tinospora malabarica (Lam.) Miers	Menispermaceae	India	Climber shrub		Stem, leaves, root	Antiviral, hypoglycaemic, anticancer
Trachyspermum Roxburghianum (DC.) Sprague	Apiaceae		Herb		Fruit	Emetic, emmenagogue, antiasthmatic
Tragia involucrata Linn.	Euphorbiaceae	Warmer region of India	Twining herb		Root, fruit	Diaphoretic, alterative

Tribulus terrestris Linn.	Zygophyllaceae	India	Annual or perennial herb		Fruit, leaves	Antileprotic, haemostatic
Trichopus zeylanicus	Dioscoreaceae	India	Herb	Seed, suckers	Leaves,	CNS active, hypothermic
Trichosanthes cucumerina Linn.	Cucurbitaceae	India	Climber	Seed	Whole plant	Cytotoxic against human carcinomal cells
Tridax procumbens Linn.	Asteraceae		Herb			
Trigonella foenum-graecum Linn.	Papilionaceae	Wild India Kashmir, Punjab, Upper Gangetic plains	Herb	Seed	Leaves, seed	Diuretic, CNS depressive, hypotensive
Tylophora indica (Burm. f.) Merr.	Asclepiadaceae		Climber		Root, leaves	Bacteriostatic, emetic, cathartic
Typha elephantina Roxb.	Typhaceae				Ripe fruit, rhizome	Astringent, antidysenteric
Typhonium flagelliforme	Araceae					
Uraria lagopoides (Linn.) Desv.	Papilionaceae					
Urginea indica Kunth	Liliaceae	India	Herb	Veg.	Bulb	Expectorant, cyanogenetic
Vanda tessellata (Roxb.) Hook. ex G. Don	Orchidaceae				Root, juice	Antipyretic,
Vanilla planifolia	Orchidaceae					
Vernonia anthelmintica Willd.	Asteraceae		Herb		Seed	Anthelmintic, stomachic, diuretic
Vernonia cinerea (Linn.) Less.	Asteraceae		Annual herb		Whole plant	Astringent, diaphoretic, antirheumatic
*Vetiveria zizanioides (*Linn*.) Nash*	Poaceae	India	Shrub	slips	Whole plant	CNS active, antimicrobial
Vitex negundo Linn.	Verbenaceae			Stem cutting		Antiinflammatory, analgesic, CNS depressant
Vitex trifolia	Verbenaceae		Aromatic shrub		Leaves, root, fruit,	Antiinflammatory, expectorant, emmenagogue
Vitis vinifera Linn.	Vitaceae		Tendril climber	Stem cutting	Ripe fruit, leaves, stem, flower	Haematinic, rejuvenating suppurative
Wedelia chinensis (Osbeck) Merr.	Asteraceae				juice of leaves	Alterative, anticephalalgic
Withania somnifera (Linn.) Dunal	Solanaceae	Drier parts of India	Under shrub	Seed	Root, leaves	Anabolic, galactogogue, CNS active
Woodfordia floribunda Salisb.	Lythraceae	India, Himalaya	Shrub	Seed	Flower	Antibiotic, abortifacient
Wrightia tinctoria (Roxb.) R. Br.	Apocynaceae	Central peninsular India	Tree		Leaves, bark, seed	Tonic, aphrodisiac, febrifuge
Zingiber officinale Rosc.	Zingiberaceae		Perennial rhizomatous herb	Rhizome	Rhizome	Antidropscidal, stimulant, stomachic
Zizyphus rugosa Lam.	Rhamnaceae				Bark	Astringent, antidiarrhoeal

IX. Scientific, English and vernacular names of tropical medicinal plants

Scientific Name	English	Sanskrit	Hindi	Bengali	Malayalam	Tamil	Kannada
Abelmoschus moschatus (Linn.) Medicus	Ladie's Finger, Okra	Lata kasturika	Guj	Mushkdana	Kasthurivenda	Varttilai-kasturi	Kasturi-bende
Abrus precatorius Linn.	Wild liquorice	Gunja	Guncai	Chimhati	Kunni	Kuntumani	Gunji
Abutilon indicum (Linn.) Sweet		Atibala	Kanghi	Potari	Ooram	Tutti	Shrimud rigida
Acacia catechu Willd.	Cutch tree, Black catechu	Khadirah	Khair, Khaira	Kuth	Karingali	Karumkali	Kaggali
Acacia intsia Willd.	Soap bark				Incha		
Acalypha fruticosa Forsk.					Balamunja	Sinni	Chinni
Acalypha indica Linn.	Indian acalypha	Haritamanjari	Kuppikhokhli	Muktajari	Kuppameni	Kuppaimeni	Kuppi
Achyranthes aspera Linn.	Prickly chaff flower plant	Apamangah	Circita	Apang	Vankadaladi	Nayuruvi	Utranigida
Acorus calamus Linn.	Sweet flag	Ugra gandha , Vaca		Buch	Vayampu	Vasampu	Bajai
Adhatoda beddomei C. B. Clarke		Vasa	Adusa	Bakas	Chittadalotakam	Adutoda	
Adhatoda zeylanica Medicus	Malabar nut	Vasaka	Arusha	Bakas	Aadalotakam	Adatodai	Adumuttada
Aegle marmelos (Linn.) Corr.	Bael tree Holy fruit tree	Bilva Sriphal	Bel	Baela	Koovalam	Vilvam	Bilvapatra
Aerva lanata (Linn.) Juss.		Bhadra	Chaya	Chaya	Cherula	Cerupulai	
Ageratum conyzoides Linn.	Goat weed	Visamustih	Visadodi	Uchunti	Appa	Pumpillu	Nayitulasi
Ailanthus excelsa Roxb.		Mahanimba	Maharukh		Perumaram, Pongiliam	Perumaram	Dodda
Alangium salviifolium (Linn. f.) Wang.	Sage leaved alangium	Ankolah	Dhera	Akar kanta	Ankolam	Alangi	Guddadagoni
Albizia chinensis (Osb.) Merr.		Sirisha	kanujera	Amluki	Vaaka	Katturinjil	Hottubange
Albizia lebbeck (Linn.) Benth.	Siris tree	Shirisha	Siris	Siris	Nenmenivaka	Vaghe	Doddabage
Allium cepa Linn.	Onion	Palanduh	Pyaj	Pyanj	Ull, Savalla	Venkayam Irulli	Nirulli
Allium cepa var. aggregatum	Small onion				Chuvannulli		
Allium sativum Linn.	Garlic	Lasunah	Lahasun	Lashan	Veluthulli	Vellaipuntu	Belluli
Allophyllus serratus Radlk.		Triputah	Tippani		Mukkannanpezhu	Amalai	Sisidale
Aloe barbadensis Mill.	Indian aloe	Ghrta kumari	Ghikumari	Ghrtkumar	Kattarvazha	Sirukattalai	Lolesara
Alpinia allughas Rosc.		Taraka	Taro		Malayinjikkuva		
Alpinia calcarata Rosc.	Lesser galangal				Chittaratha, Kolinchi		
Alpinia galanga Sw.	Greater galangal	Sugandhamul Rasna	Kulainjam	Kulanjan	Aratha, Chittaratha	Arattai	Dumbarasmi
Alstonia scholaris (Linn.) R. Br.	Devil tree	Saptaparnah	Shaitan ka jat	Chatwan	Ezhilampala	Elilappalai	Janthalla
Alstonia venenata R. Br.	Alstonia	Visaghni			Analivegam	Sinnappalai	Addasarpa
Amaranthus spinosus Linn.	Prickly amaranthus	Tanduliya	Katalichaulai	Kanta-notiya	Mullancheera	Kulluk-kirai	Malluharivesoppu
Ammannia baccifera Linn.	Blistering ammania	Agnigarva	Dadmari	Dadmari	Kalluruvi	Nirumel neruppu	
Amomum subulatum Roxb.	Greater cardomom	Ela	Bari elachi	Bari elachi	Perelam	Periya yelam	Dodda-yelakkai
Amorphophalus companulatus (Roxb.) Bl.	Elephant foot yam	Arsaghana	Zaminkand	Ol	Chena	Karnai kilangu	Suvarna gadde
Anacardium occidentale Linn.	Cashew-nut tree	Vrkkaphalah	Kaju	Hiji-badam	Kasumavu	Mundiri	Gerubija
Anacyclus pyrethrum DC	Pellitory	Akara-karava	Akara-kara	Akara-kara	Akkikaruka	Akkirakkaram	

Andrographis paniculata Nees	Green chiretta	Bhunimbah	Kakamegh	Kalmegh	Kiryath	Nilavempu	Kreata
Anisochilus carnosus Wall.			Punjiri-ka-pat		Mathilkkoorka, Karppooravalli	Karpuravalli	Doddapatri
Anisomeles malabarica R. Br.	Malabar catmint	Vaikuntah Mahadronah	Codhara		Karimthumba	Irattaipeyamaratti	Karitumbe
Annona squamosa Linn.	Custard apple	Sitaphalam	Sitaphal	Ata	Aatha, Seethappazham	Sitaphalam Atta	Sitaphala
Antiaris toxicaria (Pers.) Lesch.	Upas tree	Valakala			Maravuri, Arayanalli	Ali	Ajanapatte
Aphanamixis polystachya (Wall.) Parker	Rohituka tree	Rohitakah	Harinhara	Tikataraj	Chemmaram	Semmaram	Mullumanthala
Areca catechu Linn.	Arecanut palm Betelnut palm	Pugah	Supari	Supari	Kamuku, Adackamaram	Pakkurnamaram	Adike
Argemone mexicana Linn.	Prickly poppy Mexican poppy	Bramhadandi	Bharband	Siyalkanta	Brahmadanthi	Ponnumatai	Datturi
Argyreia speciosa Sweet	Elephant creeper Woolly morning creeper	Samudrapalaka	Samandar-ka-pat	Goguli	Samudrappacha	Samuttirapalai	Samudravalli
Aristolochia bracteolata Ham.	Worm killer Bracteated birthwort	Kitamari	Kitamar		Aaduthinnappala, Easwaramooli	Adutinnappalai	Adumuttagadi
Aristolochia indica Linn.	Indian birthwort	Isvari	Isvarmul	Isharmul	Garudakkodi, Karalakam	Isvaramuli	Gopataputtipalai
Artemisia pallens	Davana				Davana	Davanam	Davana
Artemisia vulgaris Linn.	Indian worm weed Fleabane	Damanakah	Davanah	Nagadoni	Makkippoovu	Makkippu	Manjapatre
Artocarpus heterophyllus Lam.	Jack-fruit tree	Panasah	Kathal	Kanthal	Plavu	Palavu	Halasu
Artocarpus hirsutus Lam.	Wild jack	Lakucah			Aanjili	Anjali	Hebbalasu
Asparagus racemosus Willd.	Asparagus	Satavari	Satavari	Shatamuli	Satavari	Ammaikodi	Aheuballi
Averrhoa bilimbi Linn.	Cucumber tree	Brihaddala	Kamaranga	Kamarak	Vilimbi	Tamarattai	Kamarakshi
Averrhoa carambola Linn.	Carambola, Star fruit, Chinese gooseberry	Karmarangha	Kamaranga	Kamarak	Aarampuli	Tamarattai	kamarakshi
Azadirachta indica A. Juss.	Margosa tree Indian lilac	Nimbah	Nim	Nim	Aaryaveppu	Vembu	Bervu
Azima tetracantha Lam.	Mistletoe Berrythorn	Kundali	Kantagarkimai	Trikantagati	Essanku	Ichanka Mulsanga	Bileevuppi
Bacopa monnieri (Linn.) Pennell	Thyme-leaved gratiola	Brahmi	Barami Jalnim	Boihimsak	Brahmi	Nirpirami	Nirbrahmi
Baliospermum solanifolium (J. Burm.) Suresh	Castor oil plant	Danti	Danti	Danti	Nagadandi	Nakatanti	Danti
Bambusa bambos Druce	Thorny bamboo Spiny bamboo	Vamsah	Kantabams	Kutuasi	Mula	Mungil	Bidiau
Barleria mysorensis					Chulli		
Bauhinia purpurea Linn.	Camel's foot tree	Vanaraja	Lalkachna	Rakta kanchan	Velutha mandaram	Mandari	Kempukanjivala
Bauhinia racemosa Lam.		Sveta kanchan	Kachnal	Banraj	Mandaram, Malayathi	Manthari Arikka	Vana samtige
Bauhinia tomentosa	St.Thomas tree	Aswamantaka	Kachnar	Kanchan	Kanjanam, Kattathi	Kanjani	Kadatti
Bauhinia variegata Linn.	Mountain ebony	Kancanarah	Kancanar	Rakta kanchan	Chuvanna mandaram	Sigappu mandari	Ullippe
Biophytum sensitivum (Linn.) DC.		Jhullapuspah	Lajjalu	Jhalai	Mukkutti, Nilamthengu	tintanali	
Blepharis boerhaavifolia					Murikoottipacha		
Blepharistemma corymbosa					Neerkuruntha, Arumarachedi		
Boerhaavia diffusa Linn.	Hogweed Pigweed	Punarnava	Gadahpurna	Gandhapurna	Thazhuthama	Saatarani	Sanadike komma
Bombax ceiba Linn.	Red silk cotton tree	Salmali	Semal	Rokto simul	Mullilavu	Mullilavu	Boonagadamara

Brassica campestris Linn.	Swedish turnip, White mustard	Katasarshapa	Kalisarson	Kalisarsan	Velutha kaduku		
Brassica juncea (Linn.) Czern. & Coss.	Indian mustard, Red mustard	Sarsapah Rajika	Rayi	Raisarisha	Kaduku	Katugu	Sasave
Brassica oleracea Linn. var. *botrytis* Linn.	Cauliflower				Cauliflower		
Breynia patens Benth.		Bahupraja	Kalamahoma d		Punarmuringa		
Bridelia crenulata Roxb.					Mulluvenga		
Bridelia scandens (Roxb.) Willd.					Cherupanichi		
Bryonia sp.		Bahupatra	Gargunaru	Mala	Kanjikkottam		
Butea monosperma (Lam.) Taub.	Flame of the forest	Palasah	Dhak Palas	Palas	Plasu	Parasa	Muttuga
Caesalpinia bonduc (Linn.) Roxb.	Fever nut Bonduc nut	Latakaranjah	Kantikaranja	Natakaranja	Kazhanchi	Kalicikkai	Galiga
Caesalpinia sappan Linn.	Brazil wood	Patrangah	Patamg	Bakam	Chappangam, Sappangam	Patungam	Patranga
Cajanus cajan (Linn.) Millsp.	Red gram Pigeon pea	Tuvari	Tuvari Dhal	Arhar	Thuvara	Tuvarai	Karigudu
Calamus travancoricus Bedd. ex Hook. f.					Cheruchooral, Kattuchooral		Nayibettu
Callicarpa tomentosa (Linn.) Murray			Bestra	Massandari	Kattuthekku	Vettilaippattai	Ardri
Calotropis gigantea (Linn.) R. Br.	Gigantic swallow wort	Arkah	Madar	Akanda	Erikku	Erukku	Ekka
Calycopteris floribunda Lam.		Susavi	Kokkarai		Pullanni	Minnarkoti	Kuppasa
Cananga odorata Hook. f. & Thom.	Ylang-ylang				Pachachempakam	Manoranjitham	Apoorva sakpaka
Capparis sepiaria Linn.		Kakadoni	Jal kanthari	Kaliakara	Kakkathondi	Karunjarai	Kadukattari
Capparis zeylanica Linn.			Gitoranj		Karthotti	Tondai	Mullukattari
Capsicum annum	Red chilly	Raktamarciah	Lalmirca	Lalmorich	Mulaku	Milagay	Mensinakai
Cardiospermum halicacabum Linn.	Heart's pea Balloon vine	Indravalli	Kapalphoti	Lataphatkari	Uzhinja, Valliuzhinja	Mudukkottan	Agni-balli
Careya arborea Roxb.	Wild guava Slow match tree	Katabhi	Kumbi	Kamber	Pezhu	Kumbi Ayma	Kavalu mara
Carica papaya Linn.	Papaya	Erandakarkati	Pappita		Kappa/Kappalam	Pappali	Parangimarai
Carum bulbocastanum Koch	Bulbous caraway		Kala-azim		Seema jeerakam	Shema-sheragam	
Carum carvi Linn.	Caraway		Jeera	Jira	Carum	Shimai- jeerakam	
Caryota urens Linn.	Elephant's palm Fish tail palm	Sritalah	Mari ka jat		Choondappana	Kuntalpanai	Bagani
Cascabela thevetia (Linn.) Lippold					Manja arali		
Cassia fistula Linn.	Indian laburnum Golden shower	Kitamalah	Amaltas	Sonali	Kanikkonna	Konnai	Kakkaemara
Cassia occidentalis Linn.	Negro coffee Stinking weed	Kasamardah	Kasaumdi	Kalkashunda	Ponnaveeram	Ponnavirai	Doddatagassa
Cassia sophera Linn.	Senna sophera	Kasamarda	Kasunda	Kalkashunda	Ponnanthakara	Pon-navarai	Kasamardah
Casuarina equisetifolia Linn.	Beef wood		Janglisaru	Jau	Kattadi	Savukku	Chabaku
Catharanthus roseus (Linn.) G. Don	Periwinkle	Nityakalyani	Sudabahar		Ushamalari, Savakkottappacha	Sudukattumallikai	Nityamallige
Catunaregam nutans (DC.) Tiruv.					Kara		
Cayratia pedata (Lam.) Juss. ex Gagnep.		Godhapadi	Goalilata		Tripadi	Kattupirandai	
Ceiba pentata (Linn.) Gaertn.	White silk cotton tree	Sweta salmali	Saphed simal	Shwet simul	Panjimaram, Seemappoola	Pancu Ilavum	Apurani

Centella asiatica (Linn.) Urban	Indian pennywort	Mandukaparni	Brahmamanduki	Tholkhuri	Kudangal, Kudakan, Muthil	Vallarai	Kadu
Chenopodium ambrosioides Linn.	Sweet pig weed				Kattayamodakam		Kodu- vama
Chukrasia tabularis A. Juss.	Chikrassy	Chanana		Chikrassi	Chuvanna akil	Chunda-kadalai	Dallmaris
Cicca acida (Linn.) Merr.	Country gooseberry	Lavaliphala	Harfarauri	Hariphal	Arinelli	Arinelli	Aranelli
Cinnamomum camphora Nees & Eberm.	Camphor tree	Karpurah	Kapur		Karppooram	Indu Karpooram	Karpoora
Cinnamomum verum Presl	Cinnamon	Darusita	Darucini	Dalchini	Karuva	Ilavarngam Karuwa	
Cissampelos pareira Linn.	Velvet leaf	Ambastha	Akanadi	Akanadi	Malathangi	Appatta kodi	Padavali
Cissus quadrangularis Linn.	Adament creeper	Aszthisanhara	Hadjora	Harjora	Changalam-paranda	Perandai	Manjora-valli
Citrus aurantifolia (Christm.) Swingle	Country lime		Kagzi-nimbu	Kagzi-nimbu	Vadukappuli-narakam	Elummicchchai	Nimbae
Citrus limon (Linn.) Burm. f.	Rough lemon	Maha- nimbu	Bara-nimbu	Bara-nebu	Cherunarakam	Periya elumichai	
Citrus maxima (Burm.) Merr.	Forbidden fruit	Madhukarkati	Chakotra	Mahanimbu	Bablumas	Pambalimasu	Chakotre
Cleistanthus collinus (Roxb.) Benth. & Hook. f.		Indrayava	Garari	Karlajuri	Odaku	Nilappalai	Bodadaraga
Clematis triloba Heyne ex Roth	Bowstring hemp	Laghuparnika	Murhari		Perumkurumba		Morhari
Cleome gynandra Linn.		Ajagandha	Hulhul	Ansarisha	Aadunarivelam	Nagvelai	
Cleome viscosa Linn.	Wild mustard	Varada	Hurhur	Hulhuria	Kattukaduku, Ariyavila	Naykadugu	Naadusaive
Clerodendrum phlomidis Linn. f.	Clerodendrum	Vatagni	Urani		Peruvelum	Thazhuthazhi	Taggi
Clerodendrum serratum (Linn.) Moon	Beetle killer	Angaravalli	Bharang	Bomanhati	Cheruthekku	Chirutekku	Gantubaranji
Clerodendrum viscosum Vent.	Clerodendrum	Bhantaka	Bhant	Bhant	Periyilam, Peruvelam	Perugilai	
Clitoria ternatea Linn.	Clitoria	Aparajita	Aparajit	Aparajit	Sankhupushpam	Kannikkotti	Girikarniballi
Coccinia grandis (Linn.) Voigt.	Ivy gourd	Bimbika	Kanturi	Telkucha	Koval	Kovai-kodi	Tonde-kayee
Cocculus hirsutus (Linn.) Diels.	Broom creeper Ink berry	P[atalugaruda h	Patalagarudi	Huyer	Pathalagarudakkodi	Kattukkoti	Dagadiballi
Cochlospermum religiosum (Linn.) Alst.	Yellow flowered cotton tree	Girisalmalika	Galgal		Seemappanji	Konjillam	Arasina
Cocos nucifera Linn.`	Coconut tree	Narikela	Nariyal	Narikel	Thengu	Tenkaimaram	Tengu
Coffea arabica Linn.	Arabian coffee		Kawa	Kafi	Kappi	Kaapi	Kafi
Coffea robusta	Robusta coffee		Kawa	Kafi	Kappi	Kaapi	Kafi
Coix lacryma-jobi Linn.	Job's tears	Gavendhukah	Gurusamkru	Gurgur	Kakkappalunku	Kunthumani	Kolti-baeja
Coldenia procumbens Linn.		Tripakshee	Tripungki		Cherupulladi	Seruppadai	
Coleus amboinicus Lour.	Indian borage Country borage	Karpuravalli	Pathurchur	Paterchur	Panikkoorkka	karpuravalli	Karpurahalli
Coleus zeylanicus (Benth.) Cramer					Iruveli		
Colocasia esculenta (Linn.) Schott	Taro Coco yam	Alupam	Kaccalu	Kachu	Chembu	Chaembu	Kachchi
Commiphora caudata (Wt. & Arn.) Engl.					Kilippanjimaram		
Commiphora mukul (Hook. ex Stocks) Stocks	Indian bdellium	Gugulu	Gugul	Guggul	Gulgulu	Gukkalu	Guggul
Connarus monocarpus Linn.					Kurial		
Coriandrum sativum Linn.	Coriander	Dhanyakam	Dhanigam	Dhane	Malli	Kottamalli	Kothambari

Coscinium fenestratum (Gaertn.) Colebr.	Tree turmeric	Daruharida	Jhar-l-haldi	Haldi gachch	Maramanjal	Maramancal	Maramanjali
Cosmostigma racemosa Wt.					Vattolam, Vaduvalli		Gharahuroo
Costus speciosus (Koen.) Sm.	Costus	Pushkara	Kust	Kura	Channakuva	Kostam	Changakosta
Crataeva religiosa Hook. f. & Thom.	Tree leaved caper	Varunah	Barna	Barun	Neermathalam	Narvala	Bilpatri
Cressa cretica Linn.		Rudanti	Rudravanti	Rudravanti	Azhukanni	Vuppu mari kazhantu	
Crossandra infundibuliformis					Kanakambaram, Padathikongini	Pavillakurinja	Abbolige
Crotalaria juncea Linn.	Sun hemp	Sanabu	Sanabu	Sanpat	Kilukki	Sanappu	Sanabu
Croton tiglium Linn.	Purging croton	Jepulah	Jamalgota	Jaypul	Neervalam	Nervalam	Japala
Cryptolepis buchanani Roem. & Schult.			Karnata		Kilippalvalli	Paalkodi	Adavi palchedi
Curculigo orchioides Gaertn.		Musali	Kalimusali	Talamuli	Nilappana	Nilapanai	Neladali
Curcuma amada Roxb.	Mango ginger	Amradrakam	Amahaldi	Amada	Mangainchi	Mankayinci	Ambahaldi
Curcuma angustifolia Roxb.	Wild arrow root	Tavakshira	Tikhur	Tikhur	Vellakkuva, Kattumanjal	Kua	
Curcuma aromatica Salisb.	Wild turmeric	Aranyaharidra	Jangli haldi	Ban haland	Kasthurimanjal	Kasturimanjal	Kadarasina
Curcuma longa Linn.	Turmeric	Haridra	Haldi	Haldi	Manjal	Mancal	Anasina
Cyathula prostrata (Linn.) Bl.	Small prickly chaff flower plant	Raktapamargah	Lal circita		Cherukadaladi	Cirukatalati	
Cyclea peltata (Lam.) Hook. f. & Thom.	Pata root	Patha	Path		Padakkizhangu, Padathali	Patakilanka	
Cymbopogon citratus (DC.) Stapf	West Indian lemon grass	Bhustarah	Gandhatran	Gandhabena	Injippullu	Vasanapullu	Majjigehallu
Cymbopogon flexuosus (Steud.) Wats.	East Indian Lemongrass				Injippullu		
Cymbopogon martinii var. *motia* Roxb.	Palmarosa, Rosha grass	Dhyamakah	Gandhabei		Palmarosa	Munkilppul	
Cymbopogon martinii var. *sofia*	Palmarosa, Gingergrass				Palmarosa		
Cymbopogon nardus (Linn.) *Rendle*	Ceylon citronella grass	Guchcha	Gaijini	Kamakher	Ceylon citronella	Kamachi pillu	
Cymbopogon nardus var. confertiflorus x C. jawarancusa	Jamrosa				Jamrosa		
Cymbopogon pendulus Wats.	Jammu Lemongrass				Jammu inchippullu		
Cymbopogon winterianus	Java citronella				Java citronella		
Cynodon dactylon (Linn.) Pers.	Dhub grass Barmuda grass	Niladurva	Durba	Dub	Karuka	Arukampillu	Hariali
Cyperus rotundus Linn	Nut grass	Musta	Nagarmotha	Motha	Muthanga	Koral	Tungegadde
Dalbergia latifolia Roxb.	East Indian rose wood	Shishapa	Shisham	Sitsal	Eetti, Veetti	Itti	Ibadi
Datura metel Linn.	Datura	Dhustura	Kaladhutara	Dhatura	Neela ummam	Vellum mattai	Dattura
Delonix regia (Boj.) Rafin.	Gulmohar				Gulmohar, Alasippumaram		
Dendrocalamus strictus (Roxb.) Nees	Male bamboo	Vansha	Banskaban	karael	Kallanmula	Kalmoongil	Bidiru
Desmodium gangeticum DC.	Desmodium	Salaparni	Salparni	Salapani	Orila	Pulladi	Murelehonne
Desmodium gyrans DC.					Thozhukanni, Ramanamachedi		
Desmodium pulchellum Backer			Jatsalpan	Garh tapi	Kattumuthira		Jenukkadi
Desmodium triflorum (Linn.) DC.		Tripadi	Kudaliga	Kodalia	Nilamparanda	Siruppullai	
Desmostachya bipinnata Stapf	Sacrificial grass	Darbah	Davoli	Darbha	Balidarbha	Darbhaibhul	

Dioscorea bulbifera Linn.	Potato yam		Ratalu	Banalu	Kachil, Pannikizhangu	Kodi kilangu	Heggenasaru
Dioscorea floribunda	Medicinal yam				Marunnukachil		
Diospyros melanoxylon Roxb.	Persimmon	Dirghapatraka	Abnus	Kend	Ebony	Karum dumbi	Abanasi
Dolichos biflorus Backer	Horse gram	Kulattha	Kulatti	Kirti kalai	Muthira	Kollu	Hurali
Dregea volubilis (Linn. f.) Hook. f.		Hemajivanti	Nakchikkni	Titakunga	Velipparuthi	Kodippalai	Dugdhike
Ecbolium viride (Forsk.) Merr.	Blue fox tail Nail dye		Udajati	Udajati	Odiyamadantha	Nilambari	Kappukarni
Eclipta prostrata (Linn.) Linn.	Trailing eclipta	Tekarajuah	Bhamgra	Kesraj	Kayyonni, Kayyunni	Kayyantukara	Kaddigagarugu
Elephantopus scaber Linn.	Prickly leaved elephant's foot	Hastipadi	Gobhi	Gajilata	Aanachuvadi	Anashovadi	Nayee nalige
Elettaria cardamomum Maton	Cardamom	Ela	Elaci	Chotti elaci	Elam	Elam	Yelakkai
Embelia ribes Burm. f.	Embelia	Vidangah	Vagvidang	Biranga	Wizhal	Vayu-vilamga	Vayuvilanga
Emilia sonchifolia DC.		Sasarutih	Hirankhun	Sudhimudi	Muyalcheviyan	Muyalccevi	
Ensete superbum					Kalluvazha		
Entada pursaetha DC.	Elephant creeper		Barabi chian	Gila gach	Malamanjadi, Kakkavalli	Chillu	Doddakampi
Eryngium foetidum Linn.	African coriander				Africanmalli		
Erythrina variegata Linn.	Indian coral tree	Paribhadrah	Dadap pamkara	Palitamadar	Murikku	Kalyana murukku	Harivana
Eucalyptus citriodora Hook.	Eucalyptus				Yukkali		
Eucalyptus globulus Labill.	Blue gum tree	Nilanirgasa	Yukeliptas		Yukkali	Karpoora maram	Taila
Eupatorium triplinerve Vahl	Ayapana tea	Ayaparnah	Ayaparna	Ayapani	Aiyappana, Mrithasanjeevani	Ayappani	
Euphorbia hirta Linn.	Australian asthma weed	Nagarjun	Lal-dudhi	Barokherni	Nilappala	Amampatihaiarasi	Akkigida
Euphorbia nivulia Buch.-Ham.		Patra-snuhi	Sij	Sij	Ilakkalli	Naga kalli	Katathuhar
Euphorbia thymifolia Linn.		Dugdhika	Dudhiya	Dudiya	Nilappala	Sittrapaladi	
Euphorbia tirucalli Linn.	Petroleum plant Milk bush	Trikantaka	Sehund	Lankasy	Thirukkalli		
Euphorbia tirucalli Linn.					Thirukkalli	Thirukkali	Mundukalli
Euphorbia trigona Haw.					Kallimullu		
Evolvulus alsinoides (Linn.) Linn.		Visnukrantha	Syamakranth a		Vishnukranthi	Vishnukrantamu	Vishnukranti
Excoecaria agallocha Linn.	Blinding tree	Agaru	Gangwa	Gangwa	Komatti	Kampetti	Tilla
Ficus benghalensis Linn.	Banyan tree	Nyagrodhah	Bargad	Bot	Peral	Alamaram	Ala
Ficus exasperata Vahl					Therakam		
Ficus heterophylla Linn. f.		Trayamana		Bhuii-damar	Vallitherakam	Kodi athi	Adavibende
Ficus microcarpa Linn. f.		Plaksah	Kamarup	Kamrup	Itthi	Kallicci	Itti
Ficus racemosa Linn.	Cluster fig	Udumbarah	Gular umar	Jagga dumur	Atthi	Atti	Atti
Ficus religiosa Linn.	Peepal tree Sacred fig	Pippalah Asvatam	Pippal	Asvatha	Arayal	Arasu	Aswatha
Flacourtia indica Merr.	Governor's plum	Aghori	Kancu	Binja	Aghori	Sattaikala	Nakkeharagu
Flacourtia jangomas (Lour.) Raeusch.	Puneala plum	Vikankatha	Paniyala	Paniyala	Neernelli, Thaleesapathram	Vayyinkarai	Hulumanike
Garcinia gummi-gutta (Linn.) Robs.	Gamboge	Vrksamlah	Bilatti-amli		Kudampuli, Kudappuli	Kodukappuli	Punarpuli

Geophila reniformis					Karinkudungal		
Girardinia diversifolia (Link) Friis					Aanachoriyanam		
Gloriosa superba Linn.	Glory lily	Visalya	Kalihari	Bisha	Menthonni	Akkini chilam	Nangulika
Glycosmis pentaphylla (Retz.) DC.		Asvasakothah	Girgiti	Ashshoura	Kuttippanal	Kattukonci	Kasarkana
Glycyrrhiza glabra Linn.	Liquorice	Yastimadhu	Jatimadh	Yastomadhu	Irattimadhuram	Athimadhuram	Athimadhura
Gmelina arborea Roxb.	Coomb teak	Gumbhari	Gamari	Gomari	Kumizhu, Kumbil	Uri Gumadi	Kummuda
Gymnema sylvestre R. Br.	Periploca of the woods	Madhunasini	Merasimgi	Merasingi	Chakkarakkolli	Sakkarakolli	Kadhasige
Hedyotis corymbosa (Linn.) Lam.		Parpatah	Daman pappar		Parpadakappullu	Parpatagam	Parpatahullu
Helicteres isora Linn.	East Indian screw tree	Avarttani	Marodphali	Atmora	Idampiri-valampiri	Valampiri	Kempukaveri
Heliotropium indicum Linn.	Indian turnsole	Vrscikali	Siriyari	Hatisura	Thekkada	Telkedukkai	Celubaladagidha
Hemidesmus indicus (Linn.) R. Br.	Indian sarasaparilla	Sariba Anantamul	Anantamul	Anantamul	Naruneendi, Nannari	Nannari	Namadabathi
Hibiscus rosa-sinensis Linn.	Shoe-flower plant	Ondrapuspi	Jasum	Joba	Chemparathi	Cemparutti	Dasavala
Hibiscus sabdariffa Linn.	Roselle		Patwa	Lal mista	Mathippuli	Sivappu kasmakkai	Pulicha keera
Hibiscus tiliaceus Linn.	Yellow mallow	Bala	Bopla	Bopla	Pooparuthi	Attu paruthi	
Holarrhena pubescens (Buch.-Ham.) Don	Tellichery bark	Kalinga	Kurci kuda	kurchi	Kudakappala	Kutasapalai	Kodgasana Karche
Holigarna arnottiana Hook. f.					Cheru, Charu	Karunjari	Holigar
Holoptelea integrifolia (Roxb.) Planch.	Indian elm	Cirabilvah	Cibil		Aavil, Njettavil	Avali Kanji	Tapasigida
Holostemma ada-kodien Schult.	Holostemma	Jivanti	Chirvel		Adapathian	Palaikkirai	
Homonoia riparia Lour.		Jalavetasah	Jalbent		Aattuvanchi, Kallurvanchi	Kattuarali	Sannapasanabela
Hugonia mystax Linn.	Climbing flax	Kamsamarah			Mothirakkanni	Mothirakkanni	Mrema
Hybanthus enneaspermus (Linn. f.) Muell.		Amburuha	Rattan-purus	Nun-boro	Orilathamara	Purusharatnam	
Hydnocarpus laurifolia (Dennst) Sleum.	Maroti tree	Tuvarakah	Calmogaru		Marotti	Maravattai	
Hygrophila schulli (Ham.) M. R. & S. M. Almeida					Vayalchulli		
Ichnocarpus frutescens (Linn.) R. Br.	Black creeper	Ulpalasariba	Kalidudhi	Shyamalata	Palvalli	Udarkkoti	Kappunabadaberu
Indigofera tinctoria Linn.	Indian indigo	Nilika	Nil	Nil	Neelamari, Neelichedi	Averi	Nili
Ipomoea mauritiana Jacq.	Giant potato	Kairividari	Bhilaykand	Bhumikumara	Palmuthukku	Palmudamagi	Nadakumbala
Ipomoea pes-tigridis Linn.	Tiger's foot				Pulichuvadi	Pulichovadi	
Ixora coccinea Linn.	Flame of the woods	Paranti	Rangam	Rajana	Thechi, Chethi	Cetti	Kiskara
Jasminum grandiflorum Linn.	Spanish jasmine	Jati	Jati	Jati	Pichakam, Pichi	Pichi Kotimalligae	Malligae
Jasminum sambac Ait.	Arabian jasmine	Mallika	Moghra	Moghri	Kudamulla	Kundumallige	Dundumallige
Jatropha curcas Linn.	Purging nut	Dravanti	Jungli erand	Pahari erand	Kadalavanakku, Kattavanakku	Katalamanakku	Belioudalu
Jatropha glandulifera Roxb.		Nikumbu	Undarbilyu	Lalbheranda	Kannatti	Adalai	Karithrukuharalu
Jatropha gossypifolia Linn.	Tua-tua				Chuvanna-kadalavanakku	Kattuamanaku	Hattielai karalu

Justicia betonica					Paduthamara		
Justicia gendarussa Linn. f.		Vatagni	Nilanairgundi	Jagatmadari	Vathamkolli	Vataikkoti	Karinekki
Justicia wynadensis					Kurinji		
Kaempferia galanga Linn.		Karcurah	Candramula	chandumula	Kacholam, Kachooram	Kaccolam	Kacora
Kaempferia rotunda Linn.	Indian crocus	Bhucampakah	Abhuichampa	Bhuichampa	Chengazhineer-kizhangu	Nerppicin	Nelasampige
Lagenaria siceraria	Bottle gourd	Katutumbi	Titalauki	Kodalau	Churakka	Sorakkai	Kadusore
Lantana camara Linn. var. *aculeata* Moldenke	Wild sage	Caturangi	Caturang		Arippu	Arisimalar	Kadugulabi
Lawsonia inermis Linn.	Henna	Medhini	Mehanti	Mehandi	Mylanchi	Marutani	Madurangi
Leea indica Merr.		Chatri	Kurkurjihava	Kurkurjihava	Manippiranda	Ottanali	Gadhapatri
Leucas aspera (Willd.) Spr.	Thumbe	Dronapuspi	Chota lalkusa	Chota halkusa	Thumba	Tumbai	Tumbe
Limnophila indica (Linn.) Druce		Ambuja	Kuttra	Karpur	Manganari		
Limonia acidissima Linn.	Elephant apple	Kapitthah	Katbel	Kathbel	Vilarmaram	Vilankaymaram	Bela
Lippia nodiflora Mich.		Vashira	Bhuikora		Neerthippali	Podutalaei	
Litchi chinensis Sonner.			Leechi	Leechi	Litchi	Ilichi	
Lobelia nicotianifolia Roth ex Roem. & Schult.	Wild tobacco	Devanala	Nala	Nala	Kattupukayila	Upperichedi	Kandele
Macaranga peltata (Roxb.) Muell.-Arg.						Vattakkanni	Upalige
Maesa indica Wall.				Ramjanu	Kattuvizhal	Vamari	Tanipela
Mangifera indica Linn.	Cuckoo's joy	Amrah	Amb	Am	Mavu	Mamaram	Mavu
Maranta arundinacea Linn.	Arrow root	Tavaksri	Tikhor	Ararut	Kochikuva, Kuva	Kuvai	Kavihettu
Melia azedarach Linn.	Pride of India	Mahanimbah	Mahanimb	Ghoranim	Malaveppu	Malaivempu	Turakabevu
Mentha arvensis Linn.	Mint	Pudina	Pudina	Podina	Pudina	Putina	Chetamarugu
Mesua nagassarium (Burm. f.) Kosterm.	Mesua	Nagapuspam	Nagakesar	Nagesar	Nagakesaram, Churuli	Nagappu	Nagasampige
Michelia champaca Linn.	Golden champa	Champakah	Champaka	Champaka	Chempakam, Champaka	Sempakam	Sampige
Mimosa pudica Linn.	Sensitive plant	Lajjalu	Lajjavanti	Lajak	Thottavadi	Thottalvadi	Nacikegidi
Mimusops elengi Linn.	West Indian Medlar	Bakulah	Bakul	Bakul	Elenji	Ilanci	Ragademara
Mirabilis jalapa Linn.	Four O' clock plant	Krishnakeli	Gulabbas	Krishnakeli	Anthimalari	Pattarasu	Chandra mallige
Mollugo oppositifolia Linn.	Bitter cumin	Phanija	Jima	Jima	Kaippujeerakam	Kachantari	Parpataka
Morinda umbellata Linn.		Pitadaru			Kudalchurukki	Nuna	Poppili
Moringa oleifera Lam.	Drum-stick tree	Sigruh	Mungana	Sajna	Muriga, Moringa	Murunkai	Murunga
Morus acedosa Griff.		Shalmali	Tut	Tut	Kambilimaram, Yusham	Kambali	Brahmadaru
Mucuna pruriens (Linn.) DC.	Cowhage	Atmagupta	Gonca	Alkushi	Naikurana	Punaikkali	Nasuganni
Mukia maderaspatana (Linn.) M. Roemer		Tirkoskai	Agumaki	Bilari	Mukkapperam	Musumusukkai	
Murraya koenigii (Linn.) Spreng.	Curry leaf	Kalasakh	Mithipam	Barsunga	Kariveppu	Kariveppalai	Kari baeva
Musa paradisiaca Linn. var. *sapientum* Kuntze	Adam's fig	Kadali	Kela	Kela	Vazha, kadalivazha	Kadalivalai	Balehannu
Mussaenda frondosa Linn.	White lady	Sriparnah	Bedina	Nag-balli	Vellila	Vellai-ilai	Bello-tigida
Myristica fragrans	Nutmeg tree	Jati	Jayphal	Jaiphal	Jathi	Jatimaram	Jajikal

Houtt.							
Naregamia alata Wt. & Arn.	Goanese ipecacuanh	Triparnika	Tinparni		Nilanarakam	Nilanaragam	Nelaringa
Nerium oleander Linn.	Indian oleander	Karavirah	Karavira	Karabi	Arali	Sivappu arali	Kanagilu
Nervilia aragoana Gaud.		Padmacarini	Sthalapadma		Orilathamara	Orilattamarai	
Nyctanthes arbor-tristis Linn.	Night jasmine	Parijatah	Harsinghar	Harsinghar	Pavizhamulla	Pavillamallige	Parijata
Nymphaea rubra Roxb.	Indian red water lily	Aruna kamala	Chhota kamal	Rakta kamal	Velutha ambal	Allittamarai	Bilitavarai
Ochrocarpus longifolius	Indian laurel	Punnag	Nagkesar	Nagkesar	Punna	Surabunnai	Sarungi
Ocimum americanum Linn.	Hoary basil	Aranyatulasi	Vantulasi	Kalatulasi	Katturamathulasi	Nayttulaci	Nayitulasi
Ocimum basilicum Linn.	Sweet basil	Barbari	Babauitulasi	Babauitulasi	Ramathulasi	Tirunitturu	Kamakasturi
Ocimum gratissimum Linn.	Shrubby basil	Vridha tulasi	Ram tulasi	Ram tulasi	Karpoorathulasi, Kattuthrithavu	Elumicha tulasi	Elumicha tulasi
Ocimum gratissimum Linn. var. *clocimum*	Clocimum				Clocimum		
Ocimum tenuiflorum Linn.	Sacred basil	Surasah	Poojatulasi	Tulsi	Krishnathulasi	Karuttutulasi	Karitulasi
Operculina turpethum (Linn.) S. Manso	Indian jalap	Trivirt	Tarbut	Dudhkalami	Thrikolpakkonna	Kumbham	Sigade
Opuntia dillenii (Ker-Gawler) Haworth	Prickly pear	Vidara	Nagphana	Nagphana	Palakakkalli, Nagathali	Nagadali	Dabbugalli
Oroxylum indicum (Linn.) Vent.	Indian trumphrt tree	Syonakah	Sonapatha	Sona	Palakappayyani	Palayudaycci	Tattuna
Orthosiphon stamineus Benth.	Java tea				Poochameesa		
Ougeinia dalbergioides Benth.	Chariot tree	Tinisah	Tinnas	Tinis	Thodukara	Narivengai	Karimutalae
Oxalis corniculata Linn.	Inda				Puliyaral		
Pavetta indica Linn.	Indian sorrel	Cangeri	Amrulsak	Amrul	Pavatta	Pavattai	Pavetae
Phoenix dactylifera Linn.	Date palm	Kharjurah	Khajur	Khajur	Eenthappana	Periccamkay	Kajjuri
Phoenix pusilla Gaertn.	Small wind date palm	Parusakah	Palavat		Chitteenthal	Siruintu	Indu
Phyllanthus amarus Schum. & Thonn.		Tamalaki	Jaramala	Bhui amla	Keezharnelli	Kilanelli	Kirunelli
Phyllanthus emblica Linn.	Indian gooseberry	Amlaka	Amla	Amlaki	Nelli	Neli	Amalaka
Physalis minima Linn.	Sunberry	Mrdukuncika	Bandhapariya	Bandhapariya	Njottanjodiyan	Tottakali	Guddahannu
Pimenta racemosa J. W. Moore	Bayberry				Cheenamulaku	Kattukaruva	Gandamanasu
Pinus roxburghii Sargent	Chirpine	Saralah	Sarala	saralagacah	Charalam	Caraladevadaru	Sarala
Piper betle Linn.	Betel pepper	Tambulavalli	Pan	Pan	Vettila	Ilaikkodi	Viliyadaballi
Piper chaba Hunter	Bengal pepper	Chavika	Chab	Choi	Benglathippali		Chavya
Piper longum Linn.	Long pepper	Pippali	Piplamul	Piplamul	Thippali	Thippili	Thippali
Piper nigrum Linn.	Black pepper	Maricam	Kalimirc	Kalimirch	Kurumulaku	Milagu	Olli manasu
Pistia stratiotes Linn.	Water letuce	Kumbhika	Jalkumbhi	Takapana	Kodappayal	Ayastamarai	Antharangagae
Plumbago indica Linn.	Red flowered leadwort			Lalchita	Chethikkoduveli	Cittramulam	Kempucitramala
Plumbago zeylanica Linn.	White flowered leadwort	Chitraka	Chitarak	Chitarak	Vellakkoduveli	Sittaragam	Vahini
Plumeria rubra Linn.	Pogodo tree	Ksiracampaka	Golenci		Poomaram	Kallimandarai	Kadusampige
Pogostemon patchouli Hook. f.	Patchouli		Pacholi	Pachapat	Pachila	Kadir pachai	Patchetene
Polyalthia longifolia Benth. & Hook. f.	Mast tree	Ulkatah	Debdari	Debdari	Aranamaram	Asogu	Assoti
Polygonum chinense Linn.			Ameta		Poovallikodi	Bilichinee Ganigalu	
Pongamia pinnata (Linn.) Pierre	Indian beech	Karanj	Karanja	Karanja	Ungu/ Pongu	Puggam	Hongae

Portulaca oleracea Linn.	Indian parselane	Brihalloni	Baralunia	Baraloniya	Cheriyagolicheera	Karikkirai	Dudagorai
Pothos scandens Linn.					Aanapparuva, Paruvakkodi	Anaparuga	Adkebiluballi
Premna integrifolia Linn.	Headache tree	Agnimanthah	Arni	Ganiari	Munja	Mannui	Takkila
Premna latifolia Roxb.	Dusky fire brand mark		Bakar	Gohara	Nappa	Pacha mullai	
Prunus amygdalus Batsch	Almond tree	Badama	Badam	Badam	Badham	Vadumai	Budami
Prunus cerasoides D. Don	Bird cherry	Padmakah	Patmakath	Padmak	Pathimukham	Patumugam	Padmaka
*Pseudarthria viscida (*Linn.*) Wt. & Arn.*		Salaparni			Moovila	Neermalli	
Psidium guajava Linn.	Guava tree	Perukah	Amrud	Peyara	Pera	Koyya	Keli
Psoralea corylifolia Linn.	Babchi	Vakucai	Bakuci	Bavachi	Karkolari	Karpogam	Somaraji
Pterocarpus marsupium Roxb.	Indian kino tree	Asanah	Bijasal	Pitsal	Venga	Vengai	Hannemara
Pterocarpus santalinus Linn.	Red sandal wood	Raktachandanah	Raktachandana	Raktachandana	Rakthachandanam	Sivappu chandanam	Raktachandanam
Punica granatum Linn.	Pomegranate	Dadimah	Dhalim	Dalim	Mathalam	Madalam	Dalimbe
Raphanus sativus Linn.	Radish	Mulika	Muli	Mula	Mullanki	Mullanki	Mulangi
Rauvolfia serpentina (Linn.) Benth. ex Kurz.	Serpent wood	Sarpagandha	Chandrabhaga	Chandra	Sarpagandhi, Amalpori	Chivan Amalpodi	Sutranbli
Rhaphidophora pertusa Schott		Sphotyabhujangam			Elithandan	Anaittippali	
Rhinacanthus nastus (Linn.) Kurz.	Snake jasmine	Yuthikaparni	Palakjuhi	Juipana	Nagamulla	Nagamalli	Nagamalli
Ricinus communis Linn.	Castor	Erundah	Erand	Bherenda	Aavanakku	Amanakku	Maralu
Rotula aqautica Lour.		Pasanabhedah			Kallurvanchi	Seppuniringi	
Rubia cordifolia Linn.	Indian madder	Manjistha	Mamjith	Manjistha	Manchatti	Manjitti	Manjusta
Ruta graveolens Linn.	Garden rue	Gucchapatra	Pismaram Sudab	Ermul	Arootha	Aruvadam	Sadabu
Saccharum arundinaceum Retz.	Devil sugarcane	Munjah	Ramsar	Teng	Amadarbha	Munji	Munji
Saccharum spontaneum Linn.	Thatch grass	Kasah	Kas	Kagara	Kusadarbha	Pekkarimpu	Darbhe
Salacia reticulata Wt.		Vairi			Ekanayakam	Ponkoranti	Ekanayakam
Sansevieria roxburghiana Schult.	Indian bow string hemp	Murva	Murva	Murba	Muramachi	Marul	Maruga
Santalum album Linn.	Sandal tree	Chandanah	Santal	Chandan	Chandanam	Chandanam	Bavanna
Saraca asoca (Roxb.) De Wilde	Ashoka	Asoka	Asoka	Ashoka	Asokam	Asogam	Asokada
Sarcostemma acidum (Roxb.) Voigt.	Moon plant	Somavalli	Somlata	Som-lata	Somalatha	Somam	Somlata
Saussurea lappa C. B. Clarke	Costus	Kustah	Kuth		Kottam	Kostam	Kostha
Scaevola taccada	Fan flower				Bhadraksham	Vellamuttagam	
Schleichera oleosa (Lour.) Oken	Lac tree, Ceylon oak	Mukulakah	Kasum	Kusum	Poovam	Pumarata	Sagade
Sesbania grandiflora (Linn.) Poiret	Swamp pea	Agastayah	Hathya	Bak	Agathi	Attikkirai	Agasi
Sida acuta Burm. f.	Horn bean leaved sida	Bala	Bariara	Bonmethi	Kurunthotti	Malaitangi	Vishakkadi
Sida cordifolia Linn.	Bala	Brela	Bariar	Brela	Kattooram	Nilatutti	Kadira-baeru
Sida rhombifolia Linn. ssp. *retusa* (Linn.) Borss.		Bala	Jamglimethi	Pitabala	Aanakkurunthotti	Kuruntotti	Ceruparuva
Solanum americanum Mill.					Manithakkali		

Solanum khasianum C. B. Clarke					Chunda		
Solanum melongena Linn. var. *incanum* (Linn.) Prain		Brihati	Baigan		Cheruvazhuthina		
Solanum surattense Burm. F.	Yellow berried nightshade	Kantakari	Remgani		Kantakarichunda	Kantakattiri	Nelagulli
Solanum torvum Swartz	West Indian Turkey berry		Tit-baigan	Tit-baigan	Kattuchunda	Sundai-kai	Kadu sunde
Solanum violaceum Ortega					Putharichunda		
Sphaeranthus africanus Linn.					Velutha adakkamanian		
Sphaeranthus indicus Linn.	East Indian globe thistle	Mundi	Mundi	Murmuria	Adakkamanian	Visnukkarantai	Gorakmundi
Spilanthes acmella var. *olracea* C. B. Clarke				Rashiera	Kuppamanjal		
Spilanthes calva DC.	Paracress		Pipulka		Akkikaruka		Sannavanamugli
Spondias pinnata (Linn. f.) Kurz.	Hog plum	Amratakah	Amra	Ambra	Ambazham	Ampalam	Ambatemarra
Stereospermum suaveolens DC.		Patala	Paral	Parul	Pathiri	Padiri	Hude
Strychnos nux-vomica Linn.	Strychinine tree	Karaskara	Kajra	Kuchila	Kanjiram	Itti	Ittangi
Strychnos potatorum Linn. f.	Clearing nut tree	Tiktaphala	Nirmali	Nirmali	Kadakam, Thettamparal	Akkolam	Andugu
Symplocos cochinchinensis (Lour.) S. Moore		Lodhrah	Bholiya		Pachhotti	Kamblivetti	Lodha
Syzygium aromaticum (Linn.) Merr.	Clove				Grambu		
Syzygium cumini (Linn.) Skeels	Black plum	Jambuh	Jamun	Jam	Njaval	Njaval	Jambuva
Syzygium jambos (Linn.) Alst.	Rose apple	Campeyah	Gulab jamun	Gulab jamb	Chamba, Jamba	Champai	Pannerale
Syzygium zeylanicum DC.					Njara	Marungi	Nerkal
Tabernaemontana divaricata (Linn.) Roem. & Schult.	East Indian rosebay	Nandivrksah	Chandni		Nanthiarvattam	Nantiyavattam	Nantibattu
Tamarindus indica Linn.	Tamarind tree	Tintrini	Ampli	Tentaul	Valanpuli	Puli amilam	Amli
Tectona grandis Linn. f.	Teak	Sakah	Sagaun	Segun	Thekku	Tekku	Tega
Tephrosia purpurea Pers.	Wild indigo	Sarapunkah	Sarphomka	Bannilgach	Kozhinjil	Kattukkolincai	Phanike
Terminalia arjuna Wt. & Arn.	White murdah	Arjunah	Arjun	Arjun	Neermaruthu	Atumaruttu	Arjun
Terminalia bellirica (Gaertn.) Roxb.	Belleric myrobalan	Aksha	Bulla	Bahera	Thanni	Tani	Vibhita
Terminalia catappa Linn.	Indian almond	Grahadruma	Budam	Bengla	Nattubadham	Nattuvadom	Badami
Terminalia chebula Retz.	Chebulic myrobalan	Haritaki	Harara	Haritaki	Kadukka	Amagola	Alale
Terminalia paniculata Roth	Flowering murdah	Marutu			Poomaruthu	Pei	Maruva Matti
Terminalia tomentosa Wt. & Arn.	Black murdah	Dharaphala	Ain	Asan	Karimaruthu	Karramarda	Aini
Thespesia populnea (Linn.) Sol. ex Corr.	Portia tree	Haripuccah	Paraspipal	Palaspipal	Poovarasu	Cilanti	Arasi
Tiliacora acuminata (Lam.) Miers			Bagamushada	Tilakora	Vallikkanjiram		Kuri
Tinospora cordifolia (Willd.) Hook. f. & Thom.	Tinospora	Amrita	Giloe	Giloe	Chittamrithu	Amridavalli	Amritaballi
Tinospora malabarica (Lam.) Miers		Sudarsana	Gurch	Padma gulancha	Kattamrithu	Patchiundih	
Trachyspermum roxburghianum (DC.) Sprague	Ajowan	Ajamoda	Ajmud	Randhsni	Ayamodakam	Asamatavomam	Ajamodhavoma

Tragia involucrata Linn.	Indian stinging nettle	Dusparsa	Barhantia	Bichati	Kodithoova	Kanchori	Turaci
Tribulus terrestris Linn.	Puncture vine	Goksurah	Gokharu	Gokhrru	Njerinjil	Nerinci	Negalu
Trichopus zeylanicus		Varahi			Aarogyappcha		
Trichosanthes cucumerina Linn.	Snake gourd	Cicindah	Paraval	Banchichanga	Kattupadavalam	Putaval	Kripodla
Tridax procumbens Linn.					Thelkuthi		
Trigonella foenum-graecum Linn.	Fenugreek	Methi	Methi	Methi	Uluva	Ventayam	Menlesoppu
Tylophora indica (Burm. f.) Merr.	Indian ipoecacuanh	Lataksiri	Antamul	Antamul	Vallippala	Naippalai	Nipaladaberu
Typha elephantina Roxb.	Elephant grass	Eraka	Mohitrina	Hogla	Aattudarbha	Anai korai	Jambuhallu
Typhonium flagelliforme					Karinthakara		
Uraria lagopoides (Linn.) Desv.		Prishniparni	Pithavana	Chakulia	Cheria Orila		
Urginea indica Kunth	Indian squill	Kolakanda	Janglipyaz	Janglipyaz	Kattulli	Nari vengayam	Adavi irulli
Vanda tessellata (Roxb.) Hook. ex G. Don	Vanda	Rasna	Rasna	Rasna	Maravazha		Bandanike
Vanilla planifolia	Vanilla				Vanilla		
Vernonia anthelmintica Willd.	Purple fleabane	Somraji Aranyajiraka	Baksi	Somraj	Kattujeerakam	Kattu shiragam	Kadujirage
Vernonia cinerea (Linn.) Less.	Ash-coloured fleabane	Sahadevi	Sahadeyi	Kuksim	Poovankurunthal	Poovamkurunthal	Sahadevi
Vetiveria zizanioides (Linn.) Nash	Vetiver	Usirah	Khas	Khas-khas	Ramacham	Vettiver	Vattiveru
Vitex negundo Linn.	Five leaved chaste tree	Nirgundi	Samhalu	Samalu	Karinochi	Nirkundi	Lakki-gidda
Vitex trifolia	Three leaved chaste tree	Sinduvarah	Saphed samhalu	Pani	Vellanochi	Nirnochi	Nekkinocci
Vitis vinifera Linn.	Common grapevine	Draksa	Drakh	Angur	Munthiri	Kotumuntiri	Draksah
Wedelia chinensis (Osbeck) Merr.		Pitabhringaraj ah	Pitabhamgar a	Kesraj	Manjakkayyunni	Kalsarji	Guntagalagaru
Withania somnifera (Linn.) Dunal	Indian ginseng	Ashwagandha	Asgandah	Ashvagandah	Amukkiram	Amukkiram	Viremaddinagadi
Woodfordia floribunda Salisb.	Fire-flame bush	Dhataki	Davi	Dawai	Thathiri	Dhattari	Bela
Wrightia tinctoria (Roxb.) R. Br.	Pala indigo	Svetakutajah	Dudhi	Indrajalu	Danthappala	Tantampalai	Kirikodasige
Zingiber officinale Rosc.	Ginger	Ardrakam	Adarak	Ada	Inji	Inci	Ardraka
Zizyphus rugosa Lam.			Churna		Thodali	Todari	Belahadu Kanika

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