



Agro-Techniques of Selected Medicinal Plants

Volume II



National Medicinal Plants Board

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सत्यमेव जयते



National Medicinal Plants Board

Department of AYUSH, Ministry of Health & Family Welfare,
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Photographs on Cover Page: *Glycyrrhiza glabra* (Top row)
Tribulus terrestris, Evolvulus alsinoides (L to R, Second row)
Bergenia ciliata, Clerodendrum serratum, Solanum surattense (L to R, Third row)

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सत्यमेव जयते

नीलांजन सान्याल
NILANJAN SANYAL

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FOREWORD

Access to health care has been recognized under the millennium development goals, as one of the main strategies to free people from extreme deprivation. We are confronted with a situation whereby, on the one hand we are battling against communicable diseases and malnutrition which are a direct fallout of poverty and on the other hand, we are facing a growing challenge from lifestyle related disorders which are largely perceived as being byproducts of affluence and westernization. Our existing health infrastructure is being put to great strain under this dual burden. Therefore, the world over it is being realized that given the complex nature of lifestyle related disorders, natural plants based medicines are most suited to deal with them. However, it is also a fact that in order to ensure efficacy, safety and quality of botanicals there needs to be adequate knowledge base on cultivation, harvesting, handling and processing of the raw material, namely medicinal plants.

2. Today, globally the companies and users are looking for traceability of raw materials to their origin, as it is obvious that the quality of the end product can only be as good as the quality of the components that go into the product. The best way to ensure this is to grow medicinal plants under conditions which follow recognized best practices. For this to become a reality, the importance of the knowledge of the correct agro-techniques to produce quality raw material cannot be ignored.

3. According to a study conducted by the NMPB, about 6,000 higher plants are used in the folk and documented systems of medicines in India. However, the requirement is being met largely from wild sources. Therefore, development of agro-techniques for cultivation of these plants is very important to reduce burden on natural resources.

4. In this direction, NMPB has already published agro-techniques of 50 species in Volume 1 titled "Agro-techniques of Selected Medicinal Plants". The present publication - Volume 2 - covers another 32 species. These agro-techniques have been developed through various Agriculture / Horticulture universities and R&D institutions, and will go a long way in disseminating scientific information to the farmers and all others concerned, who are keen to take up cultivation of medicinal plants as well as to researchers to further take up R&D work in this field.

5. This book will fill this critical void in the programme for the promotion and cultivation of medicinal plants.

6. The formulation and implementation of the projects on the development of agro-techniques and its outcome in the form of this book is the result of the untiring efforts of Scientists in different organizations, and the officials of the National Medicinal Plants Board; I would accordingly like to compliment them for their work.


10/03/2014
(N. Sanyal)

New Delhi
10th March, 2014

Acknowledgement

There is resurgence of use of traditional medicine across the globe. According to an estimate, the global market of traditional therapy stood at \$60 billion in 2002 and is estimated to touch US\$ 5 trillion by 2050. The Indian systems of medicines use medicinal plants as the main raw material and their accelerated growth is pushing strongly the demand for medicinal plants. It is getting difficult to meet the ever-increasing demand sustainably through wild collection. Therefore, cultivation of medicinal plants has occupied central stage for the development of the sector.

The cultivation of medicinal plants offers opportunities for crop diversification and income generation to the farmers. However, development of sound agro-techniques for the plants that have traditionally been collected from forests has been a major challenge in promoting their cultivation. It is in this background that a need was felt to develop agro-techniques for some of the important medicinal plants by involving key R&D institutions and Universities in the country. Accordingly, Department of AYUSH, Govt. of India decided to support studies for development of agro-techniques under the “Central Sector Scheme for Development of Agro-techniques and Cultivation of Medicinal Plant” specifically for those plants that are used in AYUSH systems of medicine.

Projects were, therefore, allocated to 33 scientific organizations consisting of agriculture/horticulture Universities and the R&D institutions of Council of Scientific and Industrial Research (CSIR), Indian Council of Agricultural Research (ICAR) *etc.* which have infrastructure and expertise for development of agro-techniques of 115 medicinal plants. The performance and progress of the projects was monitored by the Project Evaluation Committee (PEC) set up by the Department.

Out of the 115 plants, agro-techniques of 50 medicinal plants were published entitled as “Agro-techniques of Selected Medicinal Plants” (Volume – I) and 32 medicinal plants have now have been selected for the publication as the Volume-II. The Agro-techniques of medicinal plants selected for this publication are based on the reports received from different organizations/institutions. Development of Agro-techniques of such plants is an attempt of NMPB towards promoting medicinal plants cultivation through standardized Agro-techniques and thereby to make available to the industry the raw material of quality and standardized chemical ingredients. This would not have been possible without the efforts of Principal Investigators (PIs) and Project Staff in the respective organizations that were assigned the projects for development of Agro-techniques. The National Medicinal Plant

CEO, Shri T.U. Haqqi, Assistant Adviser (Botany), Dr. Sanjiv Kumar, Assistant Director (Ay.), Dr. N. Padma Kumar, Research Officer (Botany), Sh. Sunil Dutt, Research Officer (Medicinal Plants /Agronomy), Dr. M. S. Rawat, Research Officer (Botany), Dr. Sadia Ayub, Research Officer (Biochemistry), Sh. Shahidul Khair, ARO (Phcg), Shri Akif Alvi (Marketing Assistant), Dr. Lalit Tiwari (Senior Research Assistant), Sh. Hemant (Stenographer), Sh. Rama Krishna (Office Assistant) and all other Officers / Staff of NMPB, Department of AYUSH and to everyone who has been directly or indirectly involved in bringing out this publication.



(Jitendra Sharma)

Chief Executive Officer, NMPB

New Delhi
27th Feb., 2014

Abbreviations

ASU	Ayurvedic, Siddha and Unani
AYUSH	Ayurveda, Yoga & Naturopathy, Unani, Siddha & Homoeopathy
@	at the rate of
BA	Butyric acid
°C	Degree Celsius
CCAU	Chaudhary Charan Singh Agricultural University
CIMAP	Central Institute of Medicinal and Aromatic Plants
cm	Centimeter
DAP	di-ammonium phosphate
Dicho	Dichotomous
DP	Di-phenyl
DW	Dry Weight
EC	Emulsion Concentration
FYM	Farm Yard Manure
FW	Fresh Weight
FWB	Fresh Weight Biomass
GA ₃	Gibberellic acid
gm	Gram
ha	Hectare = 10000 m ²
IAA	Indole acetic acid
IBA	Indole butyric acid
K	Potassium
K ₂ O	Potassium Oxide
kg	Kilogram
lit	Litre
m	Metre
mg	Miligram
ml	Mililiter
mm	Milimeter
µm	Micro metre
µg	Micro gram
msl	Mean sea level
MT	Metric tones
N	Nitrogen
NAA	Naphthalene acetic acid
NMPB	National Medicinal Plants Board
NPK	Nitrogen + Phosphorous + Potassium
O	Oxygen



ABBREVIATIONS

P	Phosphorous
P ₂ O ₅	Phosphate
pH	acid/alkali value of soil (below 7 pH – acidic; above 7 pH- alkali)
PPM	Parts Per Million
Sps	Species
sqm	Square metre
TRF	Triademophon
t	Tonne
WDP	Wettable Dispersible Powder
ZnSO ₄	Zinc Sulphate

Introduction

India has 15 Agro-Climatic zones and medicinal plants are distributed across all biogeographic regions, diverse habitats and landscapes. Around 70% of India's medicinal plants are found in the tropical areas and around 30% in the temperate and alpine areas. World Health Organization (WHO) has estimated that approximately 80% of the world population still relies on traditional medicines, which are mostly plant-based drugs. About 6198 species of plants are estimated to be used for human and veterinary health care in the country, out of which about 2,700 plants species are reported to be used in the codified Indian Systems of Medicine viz. Ayurveda (1800 species), Siddha (500 species), Unani (400 species) and Amchi (300 species). In addition to their use in preparation of traditional medicines, the medicinal plants are being used in preparation of various pharmaceuticals and health products under the modern system of medicine.

The global resurgence of interest in complementary and alternative systems in general and in Indian Systems of Medicine in particular is increasing the demand of Ayurvedic, Siddha and Unani (ASU) drugs, which use mostly medicinal plants as raw materials. Medicinal plants have so far largely been collected from wild resources. Moreover, the plant material collected from these sources is replete with the problems of adulteration and misidentification. Therefore, cultivation of genuine, authentic variety of medicinal plants may be the only way to have raw material of required quality. The non-availability of proper techniques and authentic planting material are the main constraints in cultivation of medicinal plants.

National Medicinal Plants Board is striving hard to promote and propagate the Medicinal Plants for inter-alia ensuring sustainable supply of raw material to Ayurveda, Siddha and Unani (ASU) industry. Keeping in view the need of development of Agro-techniques, the Department of AYUSH implemented “Central Scheme for Development of Agro-techniques and Cultivation of Medicinal Plants” through reputed scientific institutions, engaged in this area and with expertise in this field.

This book has been compiled in continuation of the “Agro-techniques of Selected Medicinal Plants”(Volume-1) which included agro-techniques of fifty plants, primarily for growers and research workers with the aim to provide standardized cultivation techniques. This book contains thirty two important medicinal plants, which were not covered in the first Volume.

Need for Agro-techniques

Medicinal plants have so far been collected from wild resources. However, the plant material collected from these sources is replete with the problems of adulteration and mis-identification. Further, the plant material collected from the wild may also be contaminated by other species or parts thereof. The wild varieties also differ with respect to the presence of the active constituents from area to area. All such conditions may have adverse consequences on the quality and efficacy of the ASU drugs. In view of this, cultivation of genuine, authentic variety of plants may be the only way to have raw material of required quality. However, cultivation of these plants has never been easy and commercially viable. This is the basic reason for their exploitation from wild sources. Non-availability of proper techniques and authentic planting material are also some of the main constraints.

The safety and quality of medicinal plant materials and finished products depend on various factors like genetic makeup, environmental conditions, collection and cultivation practices, harvest and post-harvest processing, transport, storage practices *etc.*

The Agro-techniques included in this book provide information on propagation material, nursery technique (raising propagules, propagule rate and pre-treatment), planting in the field (land preparation & fertilizer application, transplanting & optimum spacing, intercropping, interculture & maintenance practices, irrigation practices and disease & pest management), harvest management (crop maturity & harvesting, post harvest management, viability of seed, chemical constituents, yield & cost of cultivation).

The medicinal plants are the basic source of raw-material for preparation of Ayurvedic medicines. Therefore, the quality of Ayurvedic products critically depends upon the quality of raw-material. By adopting good agro-technique of medicinal plants, the safety and quality of medicinal plant materials and finished products could be assured.

Good Agricultural Practices

Government of India has notified Good Manufacturing Practices (GMPs) under Drugs and Cosmetics Act, 1940. The quality of raw-material, however, depends upon the collection and cultivation practices used for procurement of medicinal plants. World Health Organization (WHO) has already published guidelines on Good Agriculture & Collection Practices of medicinal plants. National Medicinal Plants Board has also finalized guidelines for cultivation of medicinal plants and collection from wild sources. The Board has also approved Scheme for voluntary certification of standards under Good Agriculture Practices (GAPs) and Good Field Collection Practices (GFCPs) through the Quality Council of India, which is the national nodal agency for accreditation of certification bodies. Adoption of the agro-techniques available in the book would help in following Good Agriculture Practices as well as getting certificates.

Agro-techniques of Selected Medicinal Plants

Andrographis paniculata (Burm. f.) Wall. ex Nees

Syn. *Justicia paniculata* Burm. f.
Fam. Acanthaceae

Ayurvedic name	Kalmegh, Bhunimba
Unani name	Kalmegh, Chirayita Desi
Hindi name	Kalmegh
English name	Creat
Trade name	Kalmegh
Parts used	Dried Leaves and Tender Shoots



Andrographis paniculata

Morphological Characteristics

It is an erect, annual herb and 30-90 cm tall with upper part of stem quadrangular while the lower part nearly rounded stem. Leaves are opposite sessile or subsessile, linear-lanceolate or lanceolate, 3-8 cm long, acute, glabrous or minutely puberulous beneath and base cuneate, margin slightly undulate.

Floral Characteristics

Flowers are pedicelled, biliped, white-purple or spotted purple and solitary. Pedicel is 2.5–10 mm in size, slender and glandular pubescent. Bracts are acicular and 2.5 mm long. Calyx lobes are subacute, 2.5-3.7 mm long and glandular. Corolla is 7.5-12.5 mm in size, tube about half as long as the corolla. Filaments are hairy and anthers are purple beared at base. Fruit is a capsule, oblong, 18-20X4.5–5.0 mm, young ones sparsely glandular and hairy; when mature it is glabrous. Seeds are subquadrate, yellow to brownish in colour and rugose. Flowering and fruiting occurs in October – December (North India).

Distribution

The species is a native of tropical South-East Asia and occurs throughout hotter parts of India.

Climate and Soil

The plant comes up well in tropical and subtropical regions all over India. It is a hardy species,



therefore, can be grown in medium fertile sandy loam to clay-loam soils, possibly with irrigation. It can withstand partial shade of trees, say few hours, but it is cultivated in open fields.

Propagation Material

It can be easily raised through seed and vegetative methods. But in commercial cultivation, propagation through seed is easy and economical.

Agro-technique¹

This crop is grown during cooler climate and it remains for 120 days in field; usually, ratoon crop is also taken all over north India. Cooler climate helps plants in synthesizing more bitter ingredients.

Nursery Technique

- **Raising of Nursery:** Seeds are soaked in water for 24 hours and sown in the nursery beds in early September. About 650-750 gm seeds are required for raising nursery for one hectare of land. Nursery is prepared with soil, sand and organic matter in 1:1:1 ratio and sown in early September at 5 cm spacing in rows and it takes 8-10 days for germination to commence. Six weeks old seedlings are planted in field at 30X15 cm or 15X15 cm spacing. Direct sown crop is broadcasted thinly and has a seed rate of 1.5 kg/ha. It matures early, but nursery raising is preferred. For nursery beds, FYM @ 20 kg per square meter as basal dose is mixed in the soil.

Planting in the Field

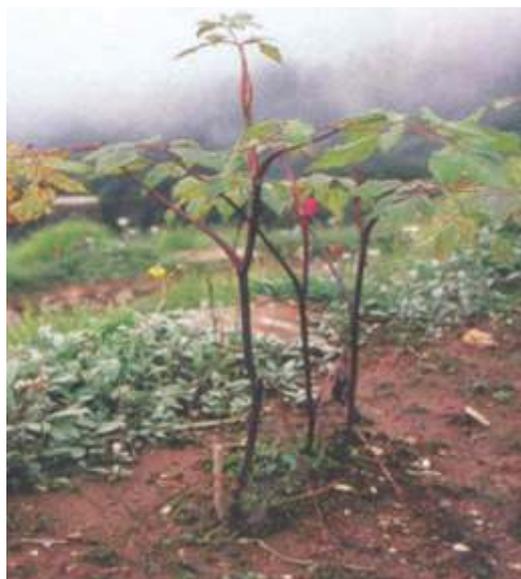
- **Land Preparation and Fertilizer Application:** The land should be prepared well by repeated ploughing to make soil pulverized. For main field, FYM @ 20 t/ha is given as basal application. It is given NPK (75:75:50 kg/ha) in two split doses *i.e.* first at planting stage and second 40 days after plantation. Use of 5 kg Azospirillum + 5 kg Phosphobacteria per hectare has also given good results.
- **Transplanting and Optimum Spacing:** 10-25 cm long seedlings raised in the nursery beds during September are transplanted in the main field (after 6 weeks of sowing) at a distance of 30X15 cm between plant to plant and row to row.
- **Irrigation:** 4-6 light irrigations are required till harvesting the crop.
- **Weeding:** Since it is a herbaceous plant, the field should be free from weeds. Two to three weedings are essential during the crop season *viz.* at 20 days and 60 days after transplantation.
- **Disease and Pest Control:** It is a hardy plant and not attacked by any pest and disease.

¹ Agro-technique study carried out by Centre for Advanced Studies in Botany, University of Madras, Guindy Campus, Chennai – 600 025.

Angelica glauca Edgew.

Fam. Apiaceae

Ayurvedic name	Chorak
Hindi name	Chora, Choru, Gandrayan
Trade name	Gandrayan
English name	Angelica
Parts used	Roots/ Rhizome



Angelica glauca

Morphological Characteristics

It is a glabrous aromatic perennial or biennial herb, 1-2 meter tall. Stem is hollow. Root is thick rhizomatous. Leaves are unipinnate, bipinnate, or tripinnate, large pinna is toothed, ovate or lanceolate.

Floral Characteristics

Inflorescence is compound umbel with numerous rays. Flowers are white, yellow or purple in colour, bracteate; florets white or purple. Seeds are small in size and winged. Fruits/seeds are 1.25 cm by 0.6 cm in size.

Distribution

The plant is endangered in status, which is distributed in Western Himalaya from Kashmir to Uttarakhand, in alpine scrub and forest shades between 2700-3700 meters.

Climate and Soil

It requires cool and temperate climate. It can be cultivated between 2000-3000 meters above msl. It requires deep rich porous and moist soil with shady situations. For its ideal cultivation, the plenty of organic manure is required.



required, manuring should be done after the completion of the vegetative growth phase during October or in the winter after two or three years of cultivation. At higher elevations, where forest litter is available, it enhances growth as well as survival and yield.

- **Transplanting the Seedlings to Main Field and Optimum Spacing:** After four to six months growth of seedlings raised inside a greenhouse or in a small nursery, transplanting is done at the beginning of the rainy season. Raised beds are better for growth. If the site is moist or has good irrigation facilities, transplanting can be done during April and May.
- **Intercropping System:** It requires similar climatic and edaphic conditions as *Saussurea costus*, so intercropping with this plant is beneficial.
- **Intercultural and Maintenance Practices:** The intercultural operation like weeding/hoeing is carried out periodically as and when required.
- **Irrigation Practices:** Irrigation twice a week during the dry season is required.
- **Weed Control:** Weeding once a month and earthing every month during the rainy season and every two to three months during the dry season is essential.
- **Disease and Pest Control:** No disease and pests have been reported.

Harvest Management

- **Crop Maturity and Harvesting:** Under cultivation, harvesting can be done within two to three years. Roots are harvested during September and October when seeds become partially mature. Harvesting can be done after every two years, once the cultivation is well established and gives the maximum yield.
- **Post-harvest Management:** After harvesting the rhizomes, an apical portion is transplanted in a field for future crops. The remaining portion is washed with water to remove soil, and roots are cut into small pieces and put in partial shade for drying. After complete drying, roots are stored and packed in cloth bags.
- **Chemical Constituents:** Roots contain 1-1.5% volatile oil, valeric acid, angelic acid, lactones, sesquiterpenes, δ - α -cadinene, umbelliprenin, terpene alcohol and angelisine resin.
- **Yield:** At high altitudes of Garhwal, nearly 593-600 kg/ha yield is estimated under



Seedlings

Aquilaria malaccensis Lam.

Syn. *A. agallocha* Roxb.

Fam. Thymelaeaceae

Ayurvedic name	Agaru
Unani name	Ood Hindi /Agar
Hindi name	Agar
English name	Aloewood, Eaglewood, Agarwood
Trade name	Agar
Parts used	Fragrant Resinous Wood and Oil



Aquilaria malaccensis

Morphological Characteristics

This plant is a large evergreen tree about 20 meters tall and 1.5–2.4 meters in girth with somewhat straight and fluted bole. Leaves are alternate 0.5-10 cm by 2-5 cm, oblong, lanceolate or elliptic, caudate, acuminate and glabrous with slender nerves. Venation is parallel. Petiole is 0.3-0.5 cm long. It is commercially used as fragrant and in preparation of drugs. The tree contains plenty of oleoresin and has irregular dark patches. The wood burns with a bright flame giving off pleasant smell.

Floral Characteristics

Flowers are white in colour, bisexual, pedicellate, in both axillary and terminal umbellate cymes, shortly peduncled, perianth, campanulate, lobes 5 spreading and densely pilose. Pedicels is 0.5-0.8 cm long, slender. Perianth remains persistent in fruit and 1.3-1.5 cm long, silky densely villous, connate at the base. Stamens are 10, anthers 10 with subsessile disc. Ovary is subsessile, villous and two-celled. Stigma is large, subsessile. Fruit is capsular, 3-5 cm long, obovoid, pericarp coriaceous and densely tomentose. Seeds are ovoid with a long tail.

Distribution

Bengal and North-Eastern States of India namely Assam, Meghalaya, Manipur, Mizoram,



- **Disease and Pest Control:** Attack of *Heortia vitessoides* is observed during May-August. This causes defoliation of whole tree. Application of Thiodan @ 2 ml/lit at 15 days interval during infestation is found to control the pests effectively.

Harvest Management

Agar-wood develops a peculiar, persisting strong odour because of infestation by a fungal identified as *Zeuzera conferta*, it penetrates the hard wood, through wounds, injury or borers. All attempts to induce artificial infestation have failed; it is a natural phenomenon. It develops black patches and stores resinous oil which is separated through distillation of the woody chips. This oil has high value in medicine and perfumery industry.

- **Crop Maturity and Harvesting:** Time of harvesting depends on disease infestation in hard wood. Agar is regarded as a pathological product formed as result of infection. Black patches in the bark indicate occurrence of infection and can be used for harvesting hard wood to commercial use.
- **Post-harvest Management:** Wood chips or chips powdered mechanically without generating heat are soaked in water for 2-3 days and transferred to stainless steel vessel which is part of a distillation unit. The distillation is done for 30-36 hours. Oil and water is collected in a separator and stored. The oil and water ratio in the condenser is kept low on account of the high boiling point. Oil is stored in closed container preferable in Aluminum bottles.
- **Chemical Constituents:** The woody chips have an essential oil commonly known as Agar oil from 0.8% to 2.2% in fungal infested wood of 8-50 years old plant. The wood contains hexadecanoic acid (25.0%), pentadecanoic acid (6.7%) and oleic acid (4.9%); other constituents range from 0.1 to 2.1%.
- **Yield and Cost of Cultivation (Hectare):** This oil is exceptionally costly.

Therapeutic Uses

Wood is used as stimulant, aphrodisiac, tonic in diarrhea, vomiting and used in skin related ailments like wounds, injuries, pain, indigestion, heart related ailments, blood purifier against gout, impotence and urine related disorders. The plant acts as anti-inflammatory, stimulates the nervous system, antirheumatic and antiparalysis.



Aristolochia indica Linn.

Fam. Aristolochiaceae

Ayurvedic name	Isharmul
Unani name	Zarawand Hindi
Hindi name	Kiramar
English name	The Indian Birthwort
Trade name	Ishar-mul
Parts used	Leaves and Roots



Aristolochia indica

Morphological Characteristics

Aristolochia indica is a perennial creeper with a woody rootstock. Leaves are alternate, entire with more or less undulate margins, somewhat cordate, acuminate or obovate.

Floral Characteristics

Flowers constitute of greenish-white or light purplish perianth with inflorescence in axillary cymes or fascicles, 1-2 lipped, hairy within limbs dilated. Stamens are six in number, adnate and filaments are not distinguishable from the style. Anthers are adnate to column. Carpel is six locular with two ovules. The flowers are usually foetid in odour. Fruit is globose, oblong, septicidal, six valved capsule and opening from below upwards. Seeds are many in number, flat and winged.

Distribution

Plant is distributed in lower hills and plains of India, Bengal and Assam.

Climate and Soil

It grows in warm and moist climate, with temperature ranging from 20°C to 33°C, and annual



rainfall ranging 100-150 cm and spread out to a greater part of the year. It can also be cultivated over well drained sandy- loam soil rich in organic matter. It needs irrigation at lower elevation where rainfall is low.

Propagation Material

Seeds.

Agro-technique⁴

Nursery Technique

- **Raising Propagules:** Seeds mature during May-July. Germination of seed is about 80%. Seeds may be sown in rows over raised beds and 10 cm apart. Seedlings at 4-5 leaves stage can be transferred in polybags or kept in the nursery bed till it attains 15 cm height, when it is ready for transplantation. Seed viability remains at 70-80% up to one year. Seeds should be treated in Bavistin/Captan/Thiram before sowing. About 30,000 seedlings are needed for one hectare land.

Planting in the Field

- **Land Preparation and Fertilizer Application:** Land should be deeply ploughed and harrowed twice and made into good tilth. FYM @ 10 t/ha alongwith NPK @ 25:60:100 kg/ha during land preparation may be applied. Later N @ 25 kg/ha may be applied after planting and again at 3 months interval.
- **Transplanting and Optimum Spacing:** Seedlings may be raised in May-July and their transplantation done in August-September. 60X60 cm spacing is optimal requirement.
- **Intercropping System:** Annual herbs like chilli can be grown as intercrop.
- **Inter-culture and Maintenance Practices:** Hoeing and hand weedings are carried out simultaneously 45 days after planting, thereafter at 6 months interval in first year. In second year, periodicity of interculture remains same.
- **Irrigation Practices:** Usually rainfed crop, but supplementary irrigation is needed during dry seasons.
- **Weed Control:** Pre-emergence application of Pendimethaline @ 1.0 kg/ha or Simazine @ 2.0 kg/ha may be applied, thereafter hand weeding at 90 days after transplanting and later as per weed population. Application of post-emergence herbicides is not suggested.
- **Disease and Pest Control:** Leaf blight is observed in the plantation during winter season. Application of Dithane M-45 @ 3 gm/lit at 15 days interval is found to control

⁴ Agro-technique study carried out by North East Institute of Science Technology (NEIST) Jorhat – 785006, Assam.

Bergenia ciliata (Haw.) Sternb.

Fam. Saxifragaceae

Ayurvedic name	Shailagarbhaja, Pashanbheda
Unani name	Zakhmehayat, Pakhanbed
Hindi name	Pakhanabhed, Pashanbheda
English name	Hairy bergenia
Trade name	Pashanabhed
Parts used	Rhizomatous Rootstock or Rhizome



Bergenia ciliata

Morphological Characteristics

This is a rhizomatic herb with fleshy leaves, growing upto 30 cm tall, having a stout creeping rhizomatous rootstock with scars and intermittent axillary buds. Plant is quite hardy and able to survive frost during winter turning reddish in colour. It is evergreen and flowers in April to June. Its flowers are white-pink and purple in colour. Stem is short. The rhizome comes out from the cervices of rocks and hangs in the air in sloppy areas. Leaves are 5-30 cm long, glabrous, sparsely hairy in margins, broadly obovate or elliptic, finely or sparsely denticulate or shallowly sinuate-dentate.

Floral Characteristics

The flowers are bisexual, white, pink or purple with long cymose panicles 4-10 cm long. The fruit is a capsule and rounded in shape. Seeds are greyish in colour, minute and numerous in one capsule.

Distribution

The plant is endemic to Northern and Eastern temperate Himalayan region in Himachal Pradesh, Jammu & Kashmir, Uttarakhand and North Eastern hilly states between altitudes of



moist layer of forest litter or farmyard manure preferably under greenhouse conditions. The seeds take 60-90 days for germination. After germination, the seedlings are picked out at two-three leaved stage and planted in fresh nursery beds at spacing of 10X10 cm and takes a season to grow large before planting in the field in next summer.

- iii) **Propagule Rate and Pretreatment:** About 88,000-90,000 plants are needed to plant one hectare land for which approximately 18-20 quintals fresh biomass of rhizome is required. Before planting, the rhizome segments should be treated with 100 ppm IBA solution for two minutes or soaked in plain water for two hours.

Planting in the Field

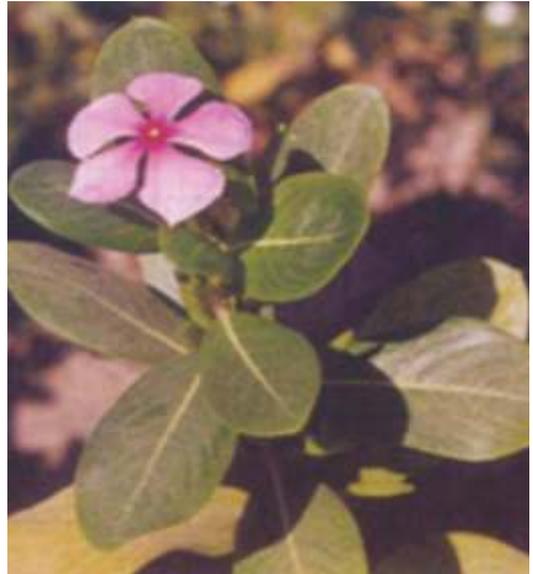
- **Land Preparation and Fertilizer Application:** It is a hardy plant hence it can be planted in spring as well as summer in the hills; although the best time for planting is monsoon time (July). Land preparation is as usual for growing crops in hills. Add 35 t/ha of FYM and plough the deep in the soil. After planting, make 9-12 cm raised beds or shallow ridges for intercultural operations. For proper water retention and enhancing the porosity of soil, add sufficient quantity of locally available peat moss or the forest litter. It enriches soil with useful microfauna and micorrhiza, which help growth.
- **Transplanting and Optimum Spacing:** The rooted plants should be transplanted in the field in 12-15 cm raised bed at a spacing of 30X30 cm. While planting in the raised beds, keep at least 5 cm space on each side of bed along the length so that three rows of plants can be adjusted.
- **Intercropping System:** The maximum height of plants which can be achieved under optimum growing conditions may be 30 cm with heavy leaf biomass. Intercropping is possible when the two crops growing together do not compete for same nutrients. Experimental study was also conducted by planting annual crop of *Swertia angustifolia* (Chirayita) plants in a spacing of 15 cm in straight line between the gaps of two rows which showed very encouraging results and it was concluded that because these two crops have different maturity period and crop cycle, hence they can be grown together successfully.
- **Interculture and Maintenance Practices:** The leaves of plants are prone to decay during rainy season. Such leaves must be removed immediately from the plants to avoid any fungal infection. The slope of water drainage can be put toward inner side of field to protect the fertile soil from washing away.
- **Irrigation Practices:** The crop should be given irrigation an interval of 15 days in summer season. Sprinkler irrigation can be tried to keep the humidity level high at canopy level.

Catharanthus roseus (Linn.) G. Don

Syn. *Vinca rosea* Linn.

Fam. Apocynaceae

Ayurvedic name	Nityakalyani (S)
Unani name	Sada Bahar
Hindi name	Bara Massi/ Sada Bahar
English name	Periwinkle
Trade name	Sada Bahar
Parts used	Root/ Leaves



Catharanthus roseus

Morphological Characteristics

Catharanthus roseus is a perennial small herb or sub-shrub, up to 90 cm in height. Stem is erect, lax branching with flexible long branches, purple or light green. Leaves are simple, cauline, opposite, ex-stipulate, petiolate, elliptic ovate to oblong, 4-10 by 2-4 cm glabrous to pubescent, base acute or cuneate, apex obtusely apiculate and lateral nerves 10-12 pairs. Petiole is 1.0- 1.5 cm long.

Floral Characteristics

Inflorescence is racemose axillary or terminal cyme or solitary/paired and shortly pedicellate. Flower colour is pink/white and tubular, swollen in the region of anthers, throat of corolla-tube hairy.

Androecium contains 5 stamens included in the corolla tube, filaments are very short, epipetalous, anthers forming a cone-like structure above the stigma. Gynoecium contains two



Dried leaves



Transplanting is done at 45X30 cm spacing. One hectare requires about 74,000 seedlings.

Planting in the Field

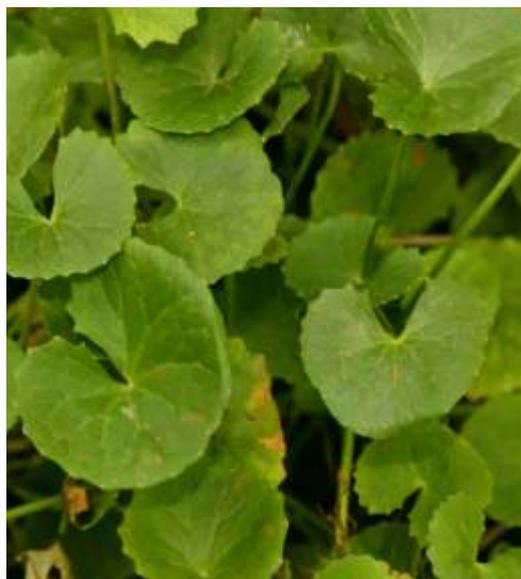
- **Land Preparation and Fertilizer Application:** The field should be ploughed thoroughly followed by harrowing to bring the soil to a fine tilth and free from weeds. After the green manure crop is ploughed in or after the application of farmyard manure, as the case may be, the land is prepared as usual practices for any other agricultural crop. A basal dose of 250 kg of superphosphate and 65 kg muriate of potash are also incorporated in the soil. 110 kg urea is applied to the crop in two splits. First application is made 10-15 days after transplanting and the second application is made one month later. This is for an irrigated crop. When the crop is grown under rainfed conditions, half the quantities of manure and fertilizers mentioned above should be applied.
- **Green Manuring:** Farm yard manure at the rate of about 10 t/ha is applied in those areas where it is available at reasonable rate. If irrigation is available, it is advantageous to grow a leguminous crop, such as sunhemp or horsegram, prior to sowing or transplanting and ploughing it when it attains flowering stage. When this is done, application of farmyard manure may be dispensed with. This helps in building up the fertility of the soil. The green manure seeds should preferably be treated with bacterial inoculum, prior to sowing, to increase the development of root nodules which absorb atmospheric nitrogen and fix it in the soil. For treating seeds with inoculums jaggery solution is prepared by dissolving about 50 gm of jaggery in 500 ml of water, boiled, cooled and green manure seeds are wetted with this solution. Then, rhizobium culture (@ 300 gm/ha) is sprinkled and mixed well. The stickiness of the jaggery helps the rhizobium culture to adhere to the seeds.
- **Irrigation and Intercultural Operations:** Places where rainfall is evenly distributed throughout the year, the plants do not require any irrigation. However, the areas where the monsoon is restricted to a particular period, 4-5 irrigations once in fifteen days during February, March and April months are needed to get optimum yield. The first weeding is done after about 60 days from sowing or transplanting and the second after additional 60 days.
- **Diseases and Pest Control:** The plant is generally resistant to the attack of various pests and diseases. Occasionally, some plants have been found to suffer from 'Little-leaf' disease, resulting in stunted growth of the plant. The disease can be checked from spreading by uprooting and destroying the affected plants and spraying organic phosphorus insecticides once in 15 days when the infection is prevalent. A, die-back, caused by *Pythium aphanidermatum* Edson Fitzp., has been found to affect the crop during the monsoon. It is observed that mulching between the rows with any straw

Centella asiatica (Linn.) Urban

Syn. *Hydrocotyle asiatica* Linn.

Fam. Apiaceae

Ayurvedic name	Mandookparni
Unani name	Khulakudi, Brahmi
Hindi name	Brahmi
English name	Asiatic Pennywort, Indian Pennywort, Gotu Kola
Trade name	Brahmi
Parts used	Whole Plant, Mainly Leaves



Centella asiatica

Morphological Characteristics

The plant is a small trailing herb. It is the only species of *Centella* found in India. Stem is glabrous, pink striated and rooting at nodes. Leaves are fleshy, orbicular to reniform and dentate. Petiole is long, smooth on upper surface and hairy below.

Floral Characteristics

Flowers are pink and white in fascicled umbels. The fruits are oblong, dull brown, laterally compressed, pericarp hard, thickened and woody white.

Distribution

The plant occurs in marshy places throughout the country in tropical and subtropical regions.

Climate and Soil

Plant naturally grows over moist, fertile, loose, sandy loam and clayey soil. Thrives best in monsoon periods in well drained beds.

Propagation Material

The plant is propagated by rooted suckers and seeds.



thankunside, centellose. Total triterpinoids are in leaves and they are approximately 1.0% of leaves.

- **Yield and Cost of Cultivation:** As a pure crop, 10-12 t/ha/years yield is obtained by 3 harvests in a year. After second year, the yield begins to decline, needing fresh planting. Rs. 40000/- is the cost of cultivation for one hectare.

Therapeutic Uses

The whole plant has therapeutic values. It is used as nervine tonic, for improving memory and mental disorders. It is anti-leprosy, diuretic, stomachic and used in insomnia, asthma, abdominal disorders and fever. Decoction of the plant is given in the treatment of leprosy.



Centella asiatica in field



Chlorophytum arundinaceum Baker

Fam. Liliaceae

Ayurvedic name	Musli Bhed
Unani name	Musli Safed, Biskandri
Hindi name	Safed Musli
English name	India Spider Plant
Trade name	Safed Musli
Parts used	Tuberous Root



Chlorophytum arundinaceum

Morphological Characteristics

It is a perennial herb with a short hard root stocks; roots often thick, fleshy and cylindrical. The leaves are 15-35 cm long and oblanceolate. The plant is considered endangered species in the country.

Floral Characteristics

Inflorescence is dense; flowers are arranged in raceme and shortly branched. Flowers white, anthers as long as or longer than the filaments and yellow in colour. Bracts are usually long and over topping the shortly pedicelled buds. Cells of the orbicular capsule are 3-4 seeded and black coloured.

Distribution

Plant is distributed sparsely over Eastern India, mainly Bengal, Sikkim, Bihar, Assam and few places in Orissa and Meghalaya.



Cluster of underground tuberous root

Dried root pieces



Climate and Soil

A tropical and subtropical climate with humid atmosphere is suitable for its growth. Temperature 20°C-25°C, rainfall 150-200 cm and relative humidity around 70% is suitable for its better performances. Sandy-loam and organic matter rich in clay loam soil is suitable for the plant.

Propagation Material

Seed and root tubers.

Agro-technique⁸

Nursery Technique

- **Raising Propagules:** Root stocks @ 7-10 quintals are required per hectare. Germination of untreated seeds is about 9-12%. Seed treatment with concentrated sulphuric acid for half an hour, followed by treatment of Gibberellic acid (GA) 100 ppm enhances germination upto 38%.
- **Propagule Rate and Pretreatment:** 45000-50000 seedlings per hectare as a mono crop; whereas 30000-40000 seedlings are required for plantation with *Cajanus cajan* (Pigeonpea) as a shade plant.

Planting in the Field

- **Land Preparation and Fertilizer Application:** Land should be ploughed, harrowed 2-3 times to make it to good tilth. FYM @ 20 t/ha may be applied during land preparation. NPK @ 90:30:30 kg/ha is recommended; of this, N is split in 3 doses. The first split of 30 kg N with entire quantity of P and K may be applied at the time of land preparation and rest of Nitrogen be applied after 3 and 6 months of planting.
- **Transplanting and Optimum Spacing:** Seeds may be sown in line during March in raised beds 10 cm apart. Frequent watering is necessary. By May-June seedlings are ready for transplantation. Shade must be provided in the plantation. 60X30 cm is recommended optimum spacing.
- **Intercropping System:** *Cajanus cajan* is found as a good intercrop providing shade to the growing plants.
- **Interculture and Maintenance Practices:** Hand weeding and hoeing at 4 months interval in first year; thereafter, twice in a year will keep the fields free from weeds.
- **Irrigation Practices:** Largely rain fed irrigated in dry season only or as required.
- **Weed Control:** Weed control is required at 45 days after planting and thereafter at 4 months interval. Pre-emergence application of Simazine 2.0 kg/ha or Pendimethaline @ 1.0 kg/ha is followed by hand weeding.

⁸ Agro-technique study carried out by North East Institute of Science Technology (NEIST) Jorhat – 785006, Assam.

Cineraria maritima Linn.

Syn. *Senecio maritima* DC.

Fam. Asteraceae

Hindi name	Cineraria
Trade name	Dusty miller, Silver Dust
Parts used	Leaves



Flowers of *Cineraria maritima*

Morphological Characteristics

Plants are usually annual herbs, but in suitable growing conditions turn into perennials. Roots are branched. Tap root is yellow in colour in young plants, but on maturity turn into light brown. Stem is erect, branched, solid and cylindrical, covered by woolly white hairs and appears silvery in colour. Leaves are cauline; 8.5-9.5X6.5-7.5 cm in size, surface woolly, silvery and white in colour with unicostate reticulate venation and petiolate. Petiole 3.0-3.5 cm long, exstipulate. The leaves are growing above ground, ovate spatulate, but on maturity these become pinnatifid with oblong and obtuse segments; lobes narrow at the base, but widening and toothed towards the apex.

Floral Characteristics

Inflorescence is a capitulum, 9-13 mm in diameter and arranged in corymbose branched raceme. Each capitulum is subtended by 12-14 involucre. Capitulum consists of two types of florets: ray and disc florets. Ray florets are peripheral, pistillate, zygomorphic, and epigynous. Pappus is hairy. Petals are 5, gamopetalous, ligulate and yellow in colour. Disc florets are in central, bisexual, actinomorphic, epigynous, tubular, aestivation valvate and yellow in colour. Stamens are 5, epipetalous, syngenesious, ditheous, introrse and opening by longitudinal



Transplanting stage of the seedlings

Planting in the Field

- **Land Preparation and Fertilizer Application:** Before planting the seedlings, the land should be ploughed and harrowed several times and leveled. Weeds, roots and stubbles are removed. During the cultivation, no chemical manure is applied and only farmyard manure is used. For good growth of the plants approximately 10 t/ha farmyard is required that can be divided into two doses of 5 t/ha each. First application should be just before the transplanting and second before flowering.
- **Transplanting and Optimum Spacing:** Seedlings should be transplanted in the field in late January or early February when they are about 5.0 cm tall. Immediately after transplanting, the fields should be properly irrigated. Plants exhibited good growth when the inter plant spacing in rows was 30 cm apart.
- **Intercropping System:** *C. maritima* plants grow usually upto 90 cm tall and require ample sunlight for its proper growth and flowering. Therefore, the plant for intercropping should be short and not of spreading type so that the plants may get proper sunlight. Some of the suitable plants that can be grown as intercrop are Kalmegh (*Andrographis paniculata*), Sadabahar (*Catharanthus roseus*), Sarpagandha (*Rauwolfia serpentina*), *Mentha* species, Garlic (*Allium sativum*), Onion (*Allium cepa*) and Chili (*Capsicum annum*) etc.



Establishment of young plants in the field

Clerodendrum serratum (Linn.) Moon

Syn. *Rothea serrata* (Linn.) Steane & Mabb.

Fam. Lamiaceae

Ayurvedic name	Bharangi
Unani name	Bharangi
Hindi name	Bharangi
English name	Blue-flowered Glory Tree,
Trade name	Bharangi
Parts used	Roots and Leaves



Clerodendrum serratum

Morphological Characteristics

It is a small shrub, 2-4 meter tall bearing opposite leaves and having woody rootstock. The plant has quadrangular, glabrous branches. Leaves are large and ovate or oblong, usually ternate whorled, coarsely and sharply serrate, glabrous and pale beneath with six pairs of lateral nerves.

Floral Characteristics

Flowers are large pinkish-white in colour and numerous appearing in May to August month. It has a stout deflexed compressed pedicel in lax, dichotomous, long terminal panicles. It has leafy bracts. Calyx is cup shaped 5 mm long. Corolla is pale to pinkish blue with tube about 6-7 mm long; the lower larger lip like lobe is sky blue in colour. Stamens are long, exerted, curved and bluish. The drupes are 1-4 lobed, bluish-black and glossy.

Distribution

The plant is distributed over scrub forests throughout the tropical and sub-tropical parts upto 1500 m particularly in Bengal, Orissa and peninsular India.

Climate and Soil

Light to medium, particularly in laterite or red loam soils. It grows all over tropical and sub tropical regions.

Propagation Material

Stem cuttings of semi hard wood.

Cryptolepis buchananii Roem & Schult.

Fam. Asclepiadaceae

Ayurvedic name	Krishna sariva
Hindi name	Karanta
English name	Indian Sarsaparilla
Trade name	Shyاملata
Parts used	Roots, Mature Stem



Cryptolepis buchananii

Morphological Characteristics

It is a large climbing shrub with glabrous, shining leaves. Stem is cylindrical; branches pale, glabrous, milky latex present, basal portion black and dotted. The external surface of the root is dark brown or blackish with few transverse cracks. Bark adheres closely to the wood and is odourless. Leaves are 7.5 – 12.5 cm X 3.8 – 6.3 cm in size, elliptic, oblong or oblong – lanceolate, apex retuse or acute, apiculate, green above and whitish beneath.

Floral Characteristics

Flowers are pale greenish-yellow in short axillary paniced cymes and bracteate. Bracts are ovate-lanceolate with scarious margins. Calyx is lobed, ovate and acute; corolla is lobed, lobes 0.6 cm long and linear or linear-lanceolate. Fruit is a follicle, 2.5-10 cm long, stout, straight, terete and tapering. Seeds are 0.5 cm long in size, ovate-oblong, compressed and black in colour.

Distribution

The plant is distributed all over tropical and sub-tropical regions in India.

Climate and Soil

The crop prefers well-drained sandy-loam acidic soils with abundant organic matter (4.5 to



Harvest Management

- **Crop Maturity and Harvesting:** The crop should be harvested in the month of August-September. But seed can be collected from plants older than three years.
- **Post-harvest Management:** After harvesting the branches should be sun dried till the moisture content is reduced to 10%. Only the dried materials are to be stored.
- **Chemical Constituents:** Stems possess alkaloids, b Buchananine identified as 6-O-nicotinoyl- α -glucopyranose and 1, 3, 6-O-trinicotinoyl-L-glucopyranose.
- **Yield and Cost of Cultivation:** A good crop yields around 17.74 tonnes of dry herbage. Rs. 42,561/- is the estimated cost of cultivation for one hectare for 12 months crop duration.

Therapeutic Uses

Root is demulcent, alterative, tonic and is useful in loss of appetite, fever and skin diseases. It is considered as a blood purifier and extensively used in skin diseases and leprosy. It is prescribed to children for rickets.



Cryptolepis buchananii in field



Eclipta alba (Linn.) Hassk

Syn. *E. prostrata* Linn.

Fam. Asteraceae

Ayurvedic name	Bhringaraja
Unani name	Bharangi
Hindi name	Bhangara, Bhringraj
English name	Trailing Eclipta Plant
Trade name	Bhangara
Parts used	Whole plant



Eclipta alba

Morphological Characteristics

It is an erect or prostrate, branched (occasionally rooting at nodes) annual herb upto 30-40 cm high. Stem is cylindrical or flat, rough due to appressed white hairs, nodes distinct and greenish occasionally brownish. Leaves are opposite, sessile to sub-sessile 2.0 to 6.2 cm long, 1.5-1.9 cm wide, oblong, lanceolate, sub-entire, acute to sub-acute and strigose with appressed hairs on both surfaces.

Floral Characteristics

Flowers are white, solitary or two on unequal axillary peduncles involucre bracts are about 8 in number, ovate, obtuse or acute and strigose with appressed hairs. Disc flowers are tubular. Corolla is often 4 toothed. Stamens are 5, filament epipetalous, free, anther united into a tube with base obtuse. Pistil is bicarpellary. Ovary is inferior and unilocular with one basal ovule. Fruit is achenial cypsela, one seeded, cuneate, with a narrow wing and brown in colour.

Distribution

The plant is distributed throughout India, ascending upto 2000 meter in moist places.

Climate and Soil

The plant is found to grow wild in a variety of soils viz. sandy to clay soil and vary common on

Embelia ribes Burm. f.

Fam. Myrsinaceae

Ayurvedic name	Viavidang, Bai bidang Krimighna, Chitramandula, Valle
Unani name	Baobarang, Babrang
Hindi name	Baberana, Wawrung
English name	Embelia
Trade name	Vidanga
Parts used	Berries, Roots



Embelia ribes

Morphological Characteristics

It is a large scandant shrub with long branches, slender, flexible, terete and long internodes. The bark is studded with lenticels. Leaves are coriaceous, 5X2-4 cm long, elliptic or elliptic-lanceolate, shortly and obtusely acuminate, entire, glabrous on both sides, shining above, pales and somewhat silvery beneath, base rounded or acute and main nerves numerous. Petioles are more or less margined and glabrous.

Floral Characteristics

Flowers are small, greenish-yellow, numerous in lax paniced racemes. Calyx is minute, sepals connate, broadly triangular, ovate and ciliate. Petals are 5 and free. Stamens are 5, but shorter than the petals. Flowering time is February. Fruits are 2.4-4.0 mm in diameter and globular with warty surface, smooth, succulent. The colour of fruit is dull black and rarely dull red.

Distribution

The plant is found in moist and shady places upto an altitude of 1500 meter.

Climate and Soil

Tropical and subtropical climate is required for the cultivation of this crop. Medium black well drained soils are best suited for the crop. The optimum temperature required for the crop is 18⁰C-35⁰C, with annual precipitation of 700 to 1500 mm.

Evolvulus alsinoides Linn.

Syn. *Convolvulus alsinoides* Linn.

Fam. Convolvulaceae

Ayurvedic name	Vishnugandhi, Shankhapushpi
Unani name	Sankhaholi
Hindi name	Phooli, Sharikha-pushpi
English name	English Speed-wheel
Trade name	Shankhapuspi
Parts used	Whole Plant



Evolvulus alsinoides

Morphological Characteristics

It is an annual/perennial herb with prostrate spreading branches in all directions. The root system is deep. Leaflets are 2.5-5 cm long, elliptical, oblong and rounded at base. Leaves are densely clothed with white appressed and long spreading hairs. In nature, seedlings appear after 2-3 showers during July-August. Generally, the seedlings are abundant under the canopy of trees or shrubs. The young seedling grows straight and produces lateral branches during first week of August. The lateral branches spread in all directions. The flowering starts during first week of August. Fruit formation takes place in the last week of August, while flowering still continues. The dispersal of the seeds takes place from September to December. Plant dries during November – December.

Floral Characteristics

Flowers are blue in colour and axillary in position. They are either solitary or in pairs on the long stalk. Styles are two and each is bifid. Fruit is globose with four-valved capsule containing dark brown to black smooth seeds. The flower colour varies from dark purple to whitish-purple.

Distribution

Plant is commonly found growing in open and grassy places, almost throughout India,



Harvest Management

- **Crop Maturity and Harvesting:** It is a rainy season crop and takes about four months to complete its life cycle. The seedlings transplanted in the month of July attain its full growth during September-October. This is the appropriate time for harvesting the plant.
- **Post-harvest Management:** Fresh herbage is perishable and should be stored in gunny bags for marketing after proper drying.
- **Chemical Constituents:** Plant contains an alkaloid evolvine; β -sitosterol, stearic, oleic and linoleic acid, betaine, pentatriacontane and triacotane.
- **Yield and Cost of Cultivation:** As a pure crop, 18.6 quintal (fresh herbage) per hectare is obtained which is reduced to 1/3rd after drying. The dry herb is stored in cool and dry places. Rs. 5930/- is the cost of cultivation for one hectare.

Therapeutic Uses

The whole plant is used in form of decoction in nervous debility and loss of memory. The plant is also useful as blood purifier and in bleeding piles. The fresh flowers with sugar are eaten as a brain tonic. The leaves are made into cigarettes and smoked in chronic bronchitis and asthma. It also improves complexion, voice and cures from intestinal worms. It promotes 'medha', the power of memory.



Fumaria parviflora Lam.

Fam. Fumariaceae

Ayurvedic name	Pittapapra
Unani name	Shahtaraa
Hindi name	Shahatra, Pitpapra
English name	Fumitory
Trade name	Pitpapra
Parts used	Whole Plant



Fumaria parviflora

Morphological Characteristics

It is an annual, much branched, diffusely spreading herb with watery latex. It shows much variation in height; *i.e.* 15-60 cm. Leaves are glaucous, segments linear or oblong linear, pointed at the tip, rarely broader than 1 mm short.

Floral Characteristics

Flowers are small, rose to purple in colour, borne in racemes of 15-20 flowers. Racemes are very often sessile and short. The fruit is slightly elongated and bracts are much longer. Sepals are absent or minute (about 0.5 mm long), triangular-ovate acuminate and whitish. Corolla is very small, about 4 mm long, white; upper petal with narrow wings, inner petals with a purple or greenish tip. Fruit is 2 mm long and slightly broader, subround-obovate, very obtuse or subtruncate, obscurely short articulate, rugose when dry and one seeded. Seeds are dark brown in colour having a bitter acrid and astringent taste.

Distribution

Plant is a native of Europe commonly found over the greater parts of India as a winter season weed, mostly in wheat field.

Climate and Soil

Farm land and sunny situation are favourable for its cultivation. It can be grown successfully



on a wide range of soils. However, it thrives best on well drained, loose and friable sandy-loam soils. The favourable pH of soil is 6.5-7.5. It is a cool weather crop and grows best at mean monthly temperature of 15-25⁰ C. The optimum temperature for germination is about 20-26⁰ C. The plants withstand low temperature, but not below 10⁰ C. Those plants grown in temperature below 10⁰ C, become stunted and bushy in appearance. It can be grown in open sun and lower rainfall areas with irrigation facilities.

Propagation Material

The crop is raised through seed. Mature seeds are collected in the month of March-April.

Agro-technique¹⁵

Nursery Technique

Crop raised by direct sowing.

- **Raising Propagules:** Seeds are directly sown in the field at a distance of 30X15 cm apart at 0.5–1.0 cm depth during November in moist soil. This is followed by irrigation after 8-10 days of sowing. Broadcasting is not recommended due to high seed rate as well as inconvenience in cultural operations and harvesting. The seeds germinate in about 12-15 days after sowing.
- **Propagule Rate and Pretreatment:** Before sowing, the seeds should be treated with Thiram or Captan @ 2-3 gm/kg of seeds to avoid damage from fungal diseases. About 4-5 kg seeds are sufficient for planting one hectare land area.

Planting in the Field

- **Land Preparation and Fertilizer Application:** Pitpapra does not require heavy fertilizers. Well rotten FYM @ 12-15 t/ha should be applied at the time of field preparation. This should be supplemented with a fertilizer dose of 40 kg N, 50 kg P₂O₅ and 20 kg K₂O/ha.
- **Transplanting and Optimum Spacing:** It has been observed at Jobner (Rajasthan) that 2.25 lakhs plants/ha can be accommodated at 30X15cm spacing.
- **Intercropping:** The crop can also be grown as an intercrop with wheat and barley.
- **Interculture Operations:** About two weeding and hoeing are required for proper soil aeration. First weeding and hoeing should be done at 35 days after sowing and second at 60 days. In order to maintain optimum plant population, thinning can be done at the time of first hoeing and weeding.
- **Manure and Fertilizers:** The basal dose 40 kg N, 40 kg P₂O₅ and 40 kg K₂O per hectare should be applied before sowing. Besides basal dose, 40 kg of N should be applied as top dressing after 35-40 days of sowing.

¹⁵ Agro-technique study carried out by SKN College of Agriculture, Rajasthan Agriculture University, Jobner, Rajasthan.



Therapeutic Uses

The plant is bitter in taste, cooling and expectorant. It increases 'Vata', removes indigestion, biliousness, fever, burning of the body, fatigue, urinary discharges, vomiting, thirst, enriches the blood and is useful in leprosy. The leaves are bitter and cooling. They cure bilious fever, blood diseases and allay thirst. The dried plant is regarded as efficacious in low fever, and is also used as an anthelmintic, diuretic, diaphoretic and aperients and to purify the blood in skin diseases.



Glycyrrhiza glabra Linn.

Syn. *Loquiritae officinalis* Moench

Fam. Fabaceae

Ayurvedic name	Yashtimadhu,
Unani name	Mulethi, Asl-us-soos
Hindi name	Mulathi
English name	Liquorice
Trade name	Mulhatti, Liquorice
Parts used	Roots and Stolon



Glycyrrhiza glabra

Morphological Characteristics

It is a perennial under shrub, reaching up to 120 cm height under cultivation. The stolon crown gives rise to a number of long semi-woody stems which bear compound pinnate leaves. Stolon is nearly cylindrical, upto 2 cm in diameter. Outer surface is yellowish-brown or longitudinally wrinkled with patches of cork. Its odour is characteristics and taste is sweet.

Floral Characteristics

Flowers are pale blue in colour and flowering occurs from 2-3 years of planting onwards. Pod is 2.0 - 2.5 cm long with 2 to 5 seeds.

Distribution

The plant thrives in a dry and sunny climate and is cultivated in the sub-tropical and warm temperate regions, chiefly in the Mediterranean region.

Climate and Soil

It grows well in sub-tropical climate in North-West India. Mulethi is a hardy plant and grows over rich forest soils, ranging from pH 5.5 to 8.2. In nature, it has wide distribution from dry cold temperate parts of Asia to Mediterranean climates, where annual temperature varies from 25°C in summer and 5°C in winter season.



Sandy-loam fertile soils with pH 6.0 to 7.5 have been found to promote good root development in India. The plant thrives in cultivation, where the locality receives 50- 100 cm rainfall annually and cultivation is supported with irrigation.

Propagation Material

Propagation is usually carried through stolons cuttings of about 10-15 cm. Seed can be used, but seed-set is poor in India and seed germination is low. Vegetative method of propagation is, thus recommended. A variety “Haryana Mulhatti-1” released from Ch. Charan Singh Haryana Agricultural University, Hissar is recommended.

Agro-technique¹⁶

Nursery Technique

- **Raising Propagules:** The old crown of roots dry out in autumn may be divided into 10-15 cm long pieces having 2-3 buds. These are used as planting material. It could be placed in furrows made in rows at planting. The crop remains in the field for 3-4 years duration for proper growth of stolon for high yield. It requires 300 kg of planting material for one hectare land.
- **Propagule Rate and Pre-treatment:** It was found that the capacity of seeds to germinate differ with the stages of their maturation. During milky waxy ripe stages, the seeds have poor germination capacity and the shoots have low survival capacity, but if seeds are collected in July, they show highest germinating capacity. This is a long duration crop and the preparation of field should be of good tilth and the fields be leveled well to avoid stagnation of water. It was observed in a particular case that scarified seeds germinated slowly and their germination reached upto 29.4% with the 75% survival.

Planting in the Field

- **Land Preparation and Fertilizer Application:** The field should be ploughed thoroughly followed by harrowing to bring the soil to a fine tilth and free from weeds. Farm Yard Manure (FYM) has been found useful for good development and growth of underground roots and should be applied at the rate of 10 t/ha at the time of field preparation.
- **Transplanting the Seedlings to Main Field and Optimum Spacing:** As stated, the cuttings of the underground stem/ stolon of 10-15 cm length, possessing 2- 3 eye buds are planted 6- 8 cm deep in the soil at a distance 60X45 cm or 90X45 cm during spring seasons. The stolon begins sprouting in 15- 20 days after planting. Light and frequent irrigation is necessary during spring planting until the cuttings sprout and establish themselves in the field. Once the plants grow upto 20 to 30 cm tall, the rows are raised

¹⁶ Agro-technique study carried out by (a) Indian Institute of Horticultural Research (IIHR), Bangalore and updated from published work of (b) Gujarat Agricultural University, Anand, Gujarat and (c) College of Agriculture, CCS Haryana Agricultural University, Hissar.



- **Yield and Cost of Cultivation:** The yield of dry root at Hissar (Haryana) is recorded around 7 t/ha. While at Anand (Gujarat) 10 to 20 months crop has given an average yielded of 2.5-5.0 t/ha. Rs. 100000/- is the cost of cultivation for one hectare.

Therapeutic Uses

The plant root is a demulcent, mild expectorant and anti-inflammatory agent. An extract of the root provide relief in treating peptic ulcers. It has glycyrrhizic acid as main constituent and this has showed anti-viral and anti-inflammatory actions. The plant extract is used as a sweetener in tonic, laxative and given in sore throat and in cough remedies.



Glycyrrhiza glabra in field



Habenaria intermedia D. Don

Fam. Orchidaceae

Ayurvedic name	Riddhi, Vrddhi
Hindi Name	Riddhi
Trade name	Riddhi
Parts used	Tuber

Morphological Characteristics

Habenaria intermedia D. Don is a tuberous rooted, monopodial terrestrial orchid found at an elevation of 1500-2800 meter in Western Himalaya. Stem is terete, 25-50 cm long, bears four to many leaves; leaves are rounded at the base, long and acuminate.

Floral Characteristics

Flowers are large, greenish-white and 1-6 in an inflorescence. Petals are white and crescent shaped, recurved and adherent to dorsal sepal, lip is pale yellowish-green in colour. Life cycle of the *Habenaria* in its natural habitat starts in mid May, marked by sprouting of tubers and it comes in full bloom up to September. After fruiting, it enters into a dormant period of its life cycle in October.

Distribution

The species is well distributed in open grassland at high altitudes 1500 to 2800 meter above msl. Being a light demanding species, it prefers southern or eastern slopes. It is more often found in open exposed soils, a characteristic of pioneer species in succession.



Habenaria intermedia



Flowers of *Habenaria intermedia*



Therapeutic Uses

The drug belongs to the group of the “Eight Tonic Herbs”, known as Ashtavarga, which is rejuvenating and age sustaining. It is used as one of the ingredients of Chywanaprasha preparation.



Leonotis nepetaefolia (Linn.) R. Br.

Syn. *Phlomis nepetaefolia* Linn.

Fam. Lamiaceae

Ayurvedic name	Granthiparni
Hindi Name	Hejurchei
Trade name	Barchi Buti
Parts used	Whole plant



Leonotis nepetaefolia

Morphological Characteristics

The plant is a tall and erect with height 1-2 meters. The stem is stout, obtusely quadrangular with thickened angles and deeply sulcate. Leaves are 5-15X3.5-10 cm, membranous, ovate, acute, coarsely crenate-serrate and finely pubescent on both sides and base shortly cuneate. Petioles are 2.5-10 cm long and winged in the upper part.

Floral Characteristics

Flowers are orange-scarlet, in axillary, dense, globose and many flowers are in whorls. Fruits are oblong, ovoid or obovoid, dry angular, obtuse or truncate nutlets.

Distribution

Plant is originally native to tropical and subtropical Africa; it is now naturalized all over the world. In India it grows along road sides in abandoned fields in tropical and subtropical region.

Climate and Soil

The crop prefers warm temperature of more than 30⁰ C and well distributed rainfall of 1600-2000 mm. It also prefers sandy loam to loamy soil with sufficient humus content having pH of 4.6 to 6.5.

Propagation Material

Seeds.



Agro-technique¹⁸

Nursery Technique

- **Raising Propagules:** The crop is raised through direct sowing of seeds in the field which gives best results. For one hectare of land 20 kg seeds are required.

Planting in the Field

- **Land Preparation and Fertilizer Application:** Generally one deep ploughing or disking, followed by 2-3 harrowing are sufficient for land preparation. Organic manure (FYM) @ 5 t/ha should be incorporated in the main field at the time of land preparation. Inorganic fertilizers should be applied @ 100: 80: 60 kg/ha of N:P₂O₅:K₂O respectively. Half of N and doses of P₂O₅ and K₂O should be applied as basal dose. Remaining half of nitrogen should be top dressed in two splits at 60 days and 90 days after sowing.
- **Transplanting and Optimum Spacing:** In this region, June is the ideal time for sowing in the main field. Row to row distance of 30 cm and plant to plant distance 30 cm. should be maintained. Seed should be sown at 4-5 cm depth.
- **Intercultural and Maintenance Practices:** Two or three hand / manual weeding at 60 days, 90 days and 120 days after sowing should be carried out.
- **Irrigation Practices:** Grown as rainfed crop.
- **Weed Control:** Manual hand weeding.
- **Disease and Pest Control:** The crop is free from any serious diseases and pests except leaf rust (*Puccinia* sps.) which can be controlled by spraying Hexaconazol (5% EC) @ 5 ml/l at monthly intervals.

Harvest Management

- **Crop Maturity and Harvesting:** Keeping in view the yield of active chemical ingredients, the best time for harvesting of leaves is November and that for whole plant is March.
- **Post-harvest Management:** After harvesting the plant parts are dried in shade to bring down the moisture content to 15% and then it is cut into pieces and stored in gunny bags.
- **Chemical Constituents:** Steam distillation of seeds yield 2% of volatile oil containing linoleic acid (11.9%), oleic acid (64.6%). The leaves yield a bitter principle, fatty oil 1%, a resin, resinic acid and ash 7%.
- **Yield and Cost of Cultivation:** A good crop yields around 27 t/ha of whole plant. Rs. 29,775/- is the estimated cost of cultivation for one hectare.

Therapeutic Uses

Flowers ash is applied to burns, in ringworm and other skin diseases. Leaves are used for rheumatism and act as spasmolytic, anticancerous, antidermatophytic and mild anthelmintic.

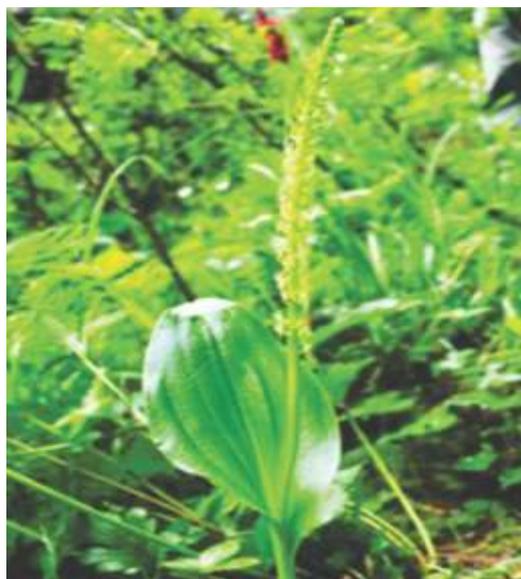
¹⁸ Agro-technique study carried out by National Bureau of Plant Genetic Resource (NBPGR), Regional Station, Shillong, Meghalaya.

Malaxis muscifera (Lindley) O. Kuntze

Syn. *Microstylis muscifera* (Lindley) Ridl.

Fam. Orchidaceae

Ayurvedic name	Rishabhak/Jeevak
Hindi Name	Jeevak
Trade name	Risabhakah/Jeevak
Parts used	Bulb



Malaxis muscifera

Morphological Characteristics

This is a terrestrial and glabrous orchid less than 30 cm tall with small ovoid bulbs, underground stem and fibrous root. Roots are fibrous; bulbs ovoid; stem is 15-30 cm long, erect and swollen at base. Leaves are two elliptic-lanceolate or ovate, obtuse, unequal, arising from the base of the stem and sessile.

Floral Characteristics

Flowers are pale yellowish-green in colour; terminal racemes 8-20 cm long spikes borne in autumn season in second year and onward. It has 2-3 mm long bracts, lanceolate with acute apex. Sepals are broadly lanceolate and laterals recurved; petals are linear but shorter than sepals; lips are adnate to the base of column, sessile, ovate-rounded, abruptly pointed; basal lobes thick, obscure. Column is very short, anthers sessile on its top; pollinia ovoid and free. Fruit is a capsule, 6-8 mm long, broadly ovoid-oblong, ribbed and of light yellow colour.

Distribution

Plant is distributed throughout hilly areas in India, upto 4000 meter above msl. It is found in forests, shrubberies and grassy slopes. This plant is one of the threatened medicinal orchids inhabiting hills in India.

Climate and Soil

The plant has been observed to grow well in sandy loam soil with high organic matter. It prefers temperate climatic conditions with low rainfall.

Propagation Material

Bulbs (mother and daughter bulbs).

Agro-technique¹⁹

Nursery Technique

- **Raising Propagules:** In nature, plants normally bears flowers and fruits during September-October. Since the seeds of *M. muscifera* are microscopic, it is hard to get seed germination under *ex-situ* and laboratory conditions. Hence, bulbs are used for raising the crop.
- **Propagule Rate and Pretreatment:** About 1,11,100 bulbs are required for planting in one hectare area. Mother bulbs after about 2 years' growth are chosen for target usage and the daughter bulbs should be used for planting subsequent crop. However, sprouting in mother bulbs is better than that in daughter bulbs younger than 1 year. Damaged bulbs are not to be used for planting.

Planting in the Field

- **Land Preparation and Fertilizer Application:** The field should be ploughed during October to make the soil well pulverized. A basal dose of 25 t/ha of farmyard manure should be applied at the time of land preparation.
- **Transplanting and Optimum Spacing:** The pseudobulbs should be planted during mid October to early November at 30X30 cm spacing accommodating about 1,11,100 plants/ha as a sole crop.
- **Irrigation Practices:** The crop requires light irrigation at the time of establishment soon after transplanting.
- **Weed Control:** Hand weeding two times at 25-30 days interval is necessary till rainy season.
- **Disease and Pest Control:** No disease or insect pest has been noticed in this crop.

Harvest Management:

- **Crop Maturity and Harvesting:** The crop attains senescence during October-November of second year which is the right time of harvesting the crop.

¹⁹ Agro-technique study carried out by Institute of Himalayan Bioresource Technology (Council of Scientific and Industrial Research), Palampur-176061, Himachal Pradesh.

Mucuna pruriens (Linn.) DC.

Syn. *Mucuna prurita* Hook.

Fam. Fabaceae

Ayurvedic name	Kapikachu, Atmagupta
Unani name	Konch
Hindi name	Gonca, Kauncha, Kavach
English name	Cowhage, Horse-eye Bean
Trade name	Koncha, Kaunch beej
Parts used	Seeds



Mucuna pruriens

Morphological Characteristics

The plant is an annual, climbing shrub with long vines that can reach over 15 meters in length. When the plant is young, it is almost completely covered with fuzzy hairs, shed with age. The leaves are tri-pinnate, ovate, or rhomboid shaped. In young plants, both sides of the leaves are hairy.

Floral Characteristics

The flowers are arranged in axillary arrayed panicles, 15 to 32 cm long and each have two to many flowers. The accompanying leaves are about 12.5 cm long. The vines come into flowering after 120-125 days of sowing and continue to bear flowers and fruits till 180-200 days. *Mucuna pruriens* bears white, lavender or purple flowers. Its pods are about 10-20 cm long and are covered with loose white to creamish hairs that cause a severe itching if they come in contact with skin. The chemical compounds responsible for the itch are a protein, mucunain and serotonin. The seeds are shiny black, brown or spotted white in colour.

Pod Characteristics

Pods are 4 to 10 cm long, 1 to 2 cm wide at the time of maturity. The husk is very hairy and carries upto seven seeds. The seeds are round or flattened, uniform, ellipsoid, 1.0 to 1.9 cm long, 0.8 to 1.3 cm wide and 4 to 6.5 cm thick. The hilum, the base of the funiculus (connection between placenta and seeds) is surrounded by a significant arillus (fleshy seeds shell).



75, 50 and 50 kg/ha of N, P₂O₅ and K₂O respectively produce high seed yield. They are applied preferably in 2 to 3 doses. The fertilizers P and K are applied along with FYM at the time of sowing. The crop begins to produce mature pods after 140 days and 2 to 3 pickings of pods are taken at the interval of 20 days during pod maturing. The pods are plucked when they turn brown and appear drying.

- **Irrigation:** It is given fortnightly irrigation during dry season and one irrigation per month is required in winter during pod picking.
- **Disease and Pest Control:** Sometimes, collar rot during initial stages of seedling growth has been found which can be managed by applications of 2 kg Trichorich (a formulation of trichoderma in neem cake) and 2 kg *Pseudomonas fluorescens* mixed with 500 kg FYM and applied to the root region. Amongst insect pests, the leaf eating hairy caterpillar is found to damage the crop during pre-flowering stage. To control the pest, Neem soap is recommended to be sprayed at the rate of 5 gm/lit.

Harvest Management

- **Crop Maturity and Harvesting:** The crop matures in about 140 days after sowing. Mature pods are harvested to collect seeds from the pods. At the time of harvesting the pods turn to greyish-brown in colour indicating maturity for picking. Normally 3-7 seeds are found in a pod and 5-6 pods per inflorescence are generally available. Thus, about 25-30 bunches can be harvested per plant. Normally 100 seeds weigh 90-110 gm.
- **Post-harvest Management:** The pods thus harvested from the field are dried in the sunlight for 4-7 days; the seeds are further dried in shade to reach approximately 7-8% moisture in the seeds. The seeds are normally stored in gunny bags made of jute and then covered with polythene to protect from absorption of atmospheric moisture.
- **Chemical Constituents:** The seeds contain high amounts of L-DOPA that is used in the treatment of Parkinson's disease. It also contains lecithin, a glucoside and a number of alkaloids including nicotine, prurienine, pruriedine, the seed kernel contain fatty oil.
- **Yield:** Seed yield is high between 2.5 to 3.0 t/ha on large scale cultivation. The L-DOPA content from the seed range between 3 to 4%. A high yielding culture called "Zhandu Kanchha" is developed through crossing and selection by Zandu Foundation of Health Care. It yields high L-DOPA (4.5%) and high seed yield; the seed is devoid of stinging hairs. Rs. 20000/- is the cost of cultivation for one hectare.

Therapeutic Uses

Seeds are used as tonic, aphrodisiac and the in treatment of Parkinson's disease. The decoction of the seeds is used in rheumatic ailments. Farmers raise it as a fodder and green manuring crop in Central and Southern Indian States.

Paederia scandens (Lour.) Merr.

Syn. *Paederia foetida* Linn.

Fam. Rubiaceae

Ayurvedic name	Gandha Prasarani
Unani name	Gandhali, Parsarini
Hindi name	Gandheli
Trade name	Gandha Prasarini
Parts used	Whole Plant



Paederia scandens

Morphological Characteristics

Paederia scandens is a slender, glabrous, twining shrub, foetid when bruised. Its leaves are opposite 5-15X1.8- 5.0 cm in dimension with long petiole, ovate or lanceolate, base acute or rounded. Petiole is 1.0- 2.5 cm long. Flowers are in panicles, 5-12 cm long, puberulous, cymose at the extremity and bracts are minute and ovate.

Floral Characteristics

Flowers are sessile and pedicelled; calyx is small, tube campanulate; corolla is tomentose. Fruit is crowned by the conical disk and minute calyx-teeth.

Distribution

It is mainly found in lower tracts of Eastern Himalayan States viz. Assam, Bengal and Bihar, North East States upto 800 meter.

Climate and Soil

The crop can be grown under the hot and humid climatic conditions, where average relative humidity is high (85%) and maximum & minimum temperature varies between 16^oC and 30^oC

respectively and rainfall is 150-200 cm. It is cultivated in plains to a higher altitude upto 600 m above msl. Soil should be sandy-loam and acidic in nature.

Propagation Material

Vegetative propagation by cuttings.

Agro-technique²¹

Nursery Technique

- **Raising Propagules:** Cuttings may be planted in raised beds at 10 cm apart row and 5 cm within a row. Double node stem with leaves is recommended for planting in the month of August and September. Seed germination is low around 25-30%.
- **Propagule Rate and Pretreatment:** 22,400 cuttings/ha are required. Growth hormone like IBA may be used for early sprouting.

Planting in the Field

- **Land Preparation and Fertilizer Application:** Land should be prepared to fine tilth before planting. FYM @ 15- 20 t/ha can be applied for good initial growth. NPK @ 100:50:50 kg/ha may be applied by broadcasting. A dose of nitrogen based fertilizer at 40 kg may be applied after each harvest.
- **Transplanting and Optimum Spacing:** Best time of transplanting sprouted cuttings is during September in Assam. Staking is to be provided when it attains a height of 90 cm or over. Optimum spacing is recommended at 60X60 cm.
- **Intercropping System:** Winter vegetables may be grown as intercrop.
- **Interculture and Maintenance Practices:** Hoeing along with weeding, is necessary at 45 days after planting; thereafter, once in a year.
- **Irrigation Practices:** It is a rainfed crop in Assam.
- **Weed Control:** Weeding is done at 60 and 90 days after transplantation. However, where-ever pre-emergence weedicide like simazine @ 2.0 kg/ha, or oxyflurefen @ 2.0 kg/ha is applied, the weeding could be delayed to 120 days and thereafter after each harvest.
- **Disease and Pest Control:** No pest and diseases have been observed in the trial plantation.

²¹ Agro-technique study carried out by North East Institute of Science Technology (NEIST), Jorhat – 785006, Assam.

Phyllanthus amarus Schum. & Thonn.

Fam. Phyllanthaceae

Ayurvedic name	Bhui-amalaki, Tamalki
Unani name	Bhui-amla
Hindi name	Bhui Aamla
Trade name	Bhui-amla
Parts used	Whole plant



Phyllanthus amarus

Morphological Characteristics

Phyllanthus amarus is an annual herb 60 to 75 cm tall, quite glabrous. Root is stout and woody. Stems are often branched at base and angular. Leaves are numerous, sub-sessile, distichious, stipulate and paripinnate with small leaflets. The leaflets are oblong, having nerve obscure and base rounded. Root is stout tortuous and woody.

Floral Characteristics

Flowers are very minute, shortly pedicelled numerous and axillary and yellowish in colour. Sepals are 5-6, ovate-oblong outer acute, coriaceous with pale margins; disk in both sexes of glands; male flowers 1-3 pedicelled; female flowers are solitary, larger and erect. Stamens are 3, sessile on a short column didynamous, styles minute, reflexed very short. The fruit is capsule, minute, globose and dehiscent. Seeds are with strong parallel and transverse ribs.

Distribution

The plant is distributed throughout India mainly in tropical and subtropical parts of Country.



Harvest Management

- **Crop Maturity and Harvesting:** The crop matures in 80-90 days when it should be harvested; it has maximum active chemical ingredients at fruiting. However, seeds collection is done after 110-120 days old crop.
- **Post-harvest Management:** Whole plant is pulled manually and shade dried. The dried herb is stored in polythene lined gunny bags at cool, well ventilated godowns.
- **Chemical Constituents:** The herb contains three crystalline lignans including phyllanthine and hypophyllanthine (non-bitter part). In addition, five flavonoids have been identified *viz.* quercetine, astralgin, quercitrin, isoquercitrin and rutin. Four alkaloids have also been separated. The total phyllanthin lignans range between 1 to 1.2% in the dry herb.
- **Yield and Cost of Cultivation:** A yield of 2 to 3 t/ha of dry herb is obtained. Rs. 27,500/- is the cost of cultivation for one hectare.

Therapeutic Uses

The plant is widely used to tone-up sluggish liver and also given in chronic liver condition and jaundice. In Unani medicine, the plant is used in jaundice as deobstruent, diuretic, cooling and astringent. In recent studies, the herb and its root have exhibited antiviral actions on Hepatitis-B.



Piper longum Linn.

Fam. Piperaceae

Ayurvedic name	Pippali, Pipplamul
Unani name	Filfil Daraz
Hindi name	Pippal
English name	Long Pepper
Trade name	Piplamul
Parts used	Dried Spikes and Roots



Piper longum

Morphological Characteristics

Long pepper is the fruit of *Piper longum* which is a slender, much branched, ascending herb and needs support for its proper growth. The leaves are 5-9 cm long and 5 cm wide; lower leaves are broadly ovate, deeply cordate with big lobes at the base, sub acute, entire and glabrous; upper leaves are dark green and cordate with short petiole or nearly sessile. The young shoots are drooping type.

Floral Characteristics

Flowers are unisexual arranged in erect spikes. Female spikes are 1.25-2.00 cm long arising singly from leaf axil are cylindrical, short and stout. It gives rise to multiple fruit, which is shining dark green when immature and blackish-green when fully mature. Male spikes are longer, slender and are 2.5-7.5 cm long. The male spikes are dehiscent and non-productive.

Distribution

Long pepper is a native of the Indo-Malaya region. It is found growing wild in the tropical rainforests of India. Indian long pepper is mostly derived from the wild plants, but is also grown in small area in the Khasi hills, the lower hills of West Bengal, Eastern Uttar Pradesh,



Madhya Pradesh, Maharashtra, Kerala, Karnataka and Tamil Nadu. It occurs wild in the forests of Andhra Pradesh and Andaman & Nicobar Islands as well.

Climate and Soil

The plant requires hot, humid climate and an elevation between 100 to 1000 msl. Higher elevations are not conducive to high yields. It needs partial shade for its ideal growth. Partial shade of about 20-25 % intensity is found to be optimum. The crop thrives well in a variety of soils. It is cultivated successfully in laterite soils with high organic matter content, water holding capacity and well drained fertile black cotton soil. However, light, porous and well-drained soil rich in organic content is most suitable for its cultivation.

Propagation Material

Long pepper is propagated through stem/vine cuttings at the beginning of rainy season. However, it can be easily propagated through the terminal stem cuttings obtained from one year old growth and 3-5 internodes. Vine cuttings can be rooted in polythene bags, filled with the common pot mixture. The nursery can be raised during March and April. The cuttings planted in March-April will be ready for planting in the main field by the end of May.

Agro-technique²³

Nursery Technique

- **Raising Propagules:** Stem/vine cuttings are transplanted soon after the setting in of monsoon rains. The best time for raising nursery is during March and April to avoid mealy-bug attack on roots, 10 % DP is to be mixed with the potting mixture. Normal irrigation may be given on alternate days. The cutting will be ready for planting where excess moisture is available by the end of May.
- **Transplanting the Seedlings:** The crop cannot survive in water logging conditions. Raised beds of 3.0X2.5 meter are prepared and pits are dug at a distance of 60X60 cm and dried cow-dung or farmyard manure at the rate of 100 gm/pit is applied and mixed with soil. Two rooted cuttings or suckers with roots are planted in each pit. To avoid any water stagnation in beds, channels are laid out to drain excess rainwater.

Planting in the Field

- **Land Preparation and Fertilizer Application:** The field needs 2-3 ploughings followed by harrowing and leveling considering the slope of land to facilitate drainage of excess water. Pippali needs heavy manuring. In soils with low fertility,

²³ Agro-technique is carried out by Directorate of Medicinal & Aromatic Plants Research (formerly it was National Research Centre for Medicinal & Aromatic Plants) DMAPR, Anand, Gujarat.



- **Grading:** The dried thicker parts of the stem and roots are called piplamool. There are three grades of piplamool. Grade I with thick roots and underground stem, it fetches a higher price than Grade II and III which consists of either roots, stems or fragments.
- **Chemical Constituents:** Fruits contain about 20 % dry matter, volatile oil, resin, alkaloids (4-5% piperine) and a terpenoid substance. Root contains piperlon gumine as major alkaloid in addition to piperine.
- **Yield and Cost of Cultivation:** Yield of dry fruits in first year is about 100-150 kg/ha and it attains up to 0.75-1.00 t/ha in third to fourth year. The yield of dry spike during first year is around 0.5 t/ha. It increases upto 1.2 t/ha in the third year. After third year, the vines become less productive and should be replanted. The average yield of roots is 0.5 t/ha. Rs. 62500/- is the cost of cultivation for one hectare.

Therapeutic Uses

Plant root is used in Ayurveda as a carminative, tonic to the liver, stomachic, emmenagogue, abortifacient and aphrodisiac. Fruits contain haematinic, diuretic, digestive and general tonic properties, besides being useful in inflammation of the lever, pains in the joints, snakebite, scorpion sting and night blindness. The plant is also used in dyspepsia, abdominal pain and diuretic splenopathy, anorexia, asthma, fever and act as anti-haemorrhoidal and appetiser.



Pluchea lanceolata (DC.) Oliv. & Hiern

Fam. Asteraceae

Ayurvedic name	Rasna
Hindi name	Rasna, Roshna
Trade name	Rasna, Baisurai
Parts used	Leaves



Pluchea lanceolata

Morphological Characteristics

It is a perennial herb, occurring in Indo-Gangetic plains, 30-60 cm tall. Stem and branches are terete, slender and softly pubescent. Leaves are 2-6 cm in length, sessile, oblanceolate or oblong, coriaceous, finely silky and pubescent on both surfaces, margins entire or obscurely dentate near the apex.

Floral Characteristics

Flowers are white or purple, yellow or lilac in many headed compound corymbs. Capitulum is ovoid or campanulate, 6-7 mm in compound pubescent and corymbs. Involucre is ovoid or broadly campanulate of imbricated scales; outer involucral-scale is 2.5-4.0 mm long, 2 mm broad, 5-3 serrate, obtuse, silky pubescent, tinged with purple outside apex. The innermost scales are few, linear, scarious, subacute, slightly narrower and longer than the outer; all rigid when dry and tip of outer ones often breaking into 1-2 shallow lobes. Receptacle is flat and naked.

Distribution

Plant is found in Punjab, upper Gangetic plains, Rajasthan and Gujarat.

Climate and Soil

Plant grows in open waste lands over sandy-saline lands in low rainfall areas.



Propagation Material

Seeds.

Agro-technique²⁴

Seeds can be directly sown in field.

- **Raising Propagules:** Seedlings of crop could be produced through planting of transition zone cuttings of the plant in the main field during September-March.

Planting in the Field

- **Land Preparation and Fertilizer Application:** The field is ploughed and harrowed well, to make a fine tilth. The crop responds well to the basal application of nitrogenous fertilizer.
- **Sowing of Seeds and Optimum Spacing:** Fresh seeds collected during October-March are directly sown in rows in the field. The spacing of 90 cm plant to plant and 120 cm row to row, gives optimum crop stand of 5000 plants/ha.
- **Intercropping System:** No information available.
- **Irrigation Practices:** Rainfed crop, irrigated when required.
- **Weed Control:** Two manual weedings are required at an interval of one month each after the crop is 40 days old.
- **Disease and Pest Control:** No disease and pests have been noticed in trial plots.

Harvest Management

- **Crop Maturity and Harvesting:** The crop is manually harvested at flowering stage when chemical contents are maximum.
- **Post-harvest Management:** The harvested crop is shade dried and stored in gunny bags in air-cooled rooms for marketing.
- **Chemical Constituents:** Plant contains choline, pluchine taraxsterol, β - and γ -sitosterol, leaves give quercetin and iso-rhamnctin.
- **Yield and Cost of Cultivation:** An average crop produces 40 t/ha of dry herb. Rs. 15000/- is the estimated cost of cultivation for hectare.

Therapeutic Uses

Whole plant is used in Ayurvedic medicine. *Pluchea lanceolata* is accepted as classical drug for arthritis. Its decoction is given for rheumatic conditions, muscular pains, edema, and fever and also applied externally as massage oil. The leaves are aperients, used as a laxative, analgesic and antipyretic.

²⁴ Agro-technique study carried out by (a) Narendra Dev University of Agriculture and Technology (NDUAT), Faizabad, Uttar Pradesh and (b) Jamia Hamdard, Hamdard Nagar, New Delhi.

Premna mucronata Roxb.

Syn. *Premna mollissima* Roth

Fam. Verbenaceae

Ayurvedic name	Agnimantha (Brhat)
Unani name	Arni
Hindi name	Arni, Agethu
English name	Dusky Fire Brand Bark
Trade name	Agnimanth
Parts used	Root and Root Bark



Premna mucronata

Morphological Characteristics

It is a small tree. The branches are spiny; bark is thin, pale and exfoliating; wood is light brown and scented; leaves are ovate or ovate-oblong, long-acuminate, base rounded, cordate or tapering, entire or irregularly dentate; blade 7-15 cm long; petiole 2.5 cm long.

Floral Characteristics

Flowers are arranged in terminal, corymbose, trichotomous panicles and are greenish in colour. Calyx comprised of 4 or 5 sepals, with rounded and nearly equal teeth. Corolla lobes are equal or bilabiate, upper lip retuse or emarginate, lower lip of 3 equal lobes and throat closed with white hairs. Fruit is a globose drupe, green when young, dark at maturity, 3.5-4.5 mm in diameter. The mature trees start flowering in April and fruiting in May & June.

Distribution

It is a natural inhabitant of lower and outer sub-tropical, Himalayan tracts extending from Chenab in north-west India to Bhutan in the east and extending to an elevation of 1400 meter. It is also found in dry forests tracts of South-West Bengal, Orissa and coastal Peninsular India.

Climate and Soil

The plant is well adapted to the sub-tropical hilly tracts in outer Himalayas with average



annual rainfall around 100 cm, and the tropical regions of eastern and Peninsular India. In north India, it is often found on dry slopes and large, natural, degraded soil bunds. The plant is able to thrive on average clayey or pebbled shallow soils. It has done equally well under experimental plantation on deep loamy soil with good drainage and a pH range of 7.3 to 8.0.

Propagation Material

Seed is the best propagation material, even though it has a short viability of about three months. Seeds can be collected from mature plants from mid May to June.

Agro-technique²⁵

Nursery Technique

- **Raising Propagules:** Seed should be sown in June, preferably in poly bags, immediately after collection and drying for a few days. The pulp of the fruit withers off after drying. As the seed is hard and stony, soaking it in water for a minimum of 72 hours is necessary. Seed germination is around 70%. Mechanical or acid scarification improves seed germination to 85%. About 100 gm seed is sufficient to raise plants for one hectare of land. Vegetative propagation through air layering and root coppices should be taken up during the rainy season in the month of July.

Planting in the Field

- **Land Preparation and Fertilizer Application:** The land is cleared of weeds and vegetation and ploughed twice to loosen the soil. It may be left as such for few days, tilled again and planked to bring it in fine tilth. Pits, approximately of 1.0X1.0X1.0 meter size, are dug up uniformly at 4.5X4.5 meter distance in the field. 50 gm of Phorate 10 gm granules or 10 litres of 5% suspension of Chlorpyrifos in water are added to the pit as anti-termite treatment, before filling it with the soil mixture. The soil of each pit is mixed with 5-10 kg FYM, 90 gm nitrogen, 100 gm P₂O₅ and 80 gm of K₂O. The pit is filled up with this soil mixture up to the ground level. The growing plants are given 90 gm of nitrogen and 5-10 kg of organic manure after every 6 months.
- **Transplanting and Optimum Spacing:** Plants raised from seeds and vegetative propagation in the month of June are ready for transplantation after about 75 days when they acquire 5-7 leaves and become 25 cm tall. Transplantation at this stage has shown a sizable rate of mortality. However, plants retained in poly bags during winter season and transplanted in the following June-July months give over 90% survival rate. In all, 500 plants are required for one hectare.
- **Intercropping System:** The tree can be planted over bunds of fields which are used for growing fodder and vegetables, both in summer and winter months. In addition to its roots, which are used for medicinal purpose, the tree can be lopped for fodder in lean

²⁵ Agro-technique study carried out by National Institute of Pharmaceutical Education and Research (NIPER), S.A.S Nagar, Mohali, Punjab.



tree. Thus, about 3 tonnes of root is expected per hectare of plantation in the forest. Rs. 26900/- is the cost of cultivation for one hectare in the first year which comes down to Rs. 10,500/ha for subsequent years.

Therapeutic Uses

The root is an important ingredient of “Dasmoolarishta” a traditional Ayurvedic preparation given as cure for obstinate fevers. It has febrifuge, cardio-tonic, and stomachic properties, and is considered a nervine tonic. Traditionally, the root preparations are valued for anti-inflammatory conditions and neurological problems.



Psoralea corylifolia Linn.

Syn. *Cullen corylifolium* (Linn.) Medik.

Fam. Fabaceae

Ayurvedic name	Bakuchi
Unani name	Babchi
Hindi name	Babchi, Bakuchi
English name	Purple Fleabane
Trade name	Bavchi, Bakuchi
Parts used	Seeds



Psoralea corylifolia

Morphological Characteristics

Babchi is leguminous, erect, annual herb that grows 60-100 cm tall. The plant branches profusely and its stem and branches are covered with white hairs. Leaves are simple, 2.5-7.0 cm long, petiolate, rounded, with toothed margin and both sides covered with conspicuous black glandular dots. The seeds are surrounded by a sticky oily pericarp which contains psoralein.

Floral Characteristics

Flowers are axillary, blue in colour and arranged in 10-30 flowered racemes. Calyx is nearly sessile. Corolla is yellowish-blue and little exerted. Pods are 5 cm long, subglobose, slightly compressed, closely pitted and beaked; seeds are oblong, flattened dark brown and covered with a mucilaginous layer. The seeds swell when placed in water. When the seeds are rubbed they give an aromatic odour and tastes slightly bitter.

Distribution

It is mainly found in plains of Central India and Eastern part of Rajasthan, Punjab, and adjoining areas of Uttar Pradesh. It is sporadically cultivated in Rajasthan, Uttar Pradesh and Tamil Nadu States.



Climate and Soil

The crops can be grown well in sub-tropical climate receiving low to medium rainfall over a variety of soils ranging from sandy medium loam to black cotton soils. Red loamy soil with good organic matters and a pH ranging from 6.5-7.5 are good for cultivation.

Propagation Material

Seeds.

Agro-technique²⁶

Nursery Technique

- **Raising Propagules:** No propagules are raised. The crop is raised through direct sowing of seeds which germinate easily. As a sole crop 8 kg seeds are needed for one hectare area.
- **Prapagule Rate and Pretreatment:** No specific pre-treatment is required for seeds before germination.

Planting in the Field

- **Land Preparation and Fertilizer Application:** The land is prepared by ploughing 2-3 times with disc plough harrowed and planked to make the soil to a fine tilth before onset of monsoon. The area is divided into plots of convenient size. The main and sub-irrigation channels are laid out. NPK (Nitrogen, Phosphorous, Potassium) at the rate of 60: 60: 30 kg/ha are given as basal dose and mixed in the soil together with 10 t/ha of FYM.
- **Transplanting and Optimum Spacing:** Seeds are directly sown in lines at an optimum spacing of 60X30 cm to raise crop.
- **Intercropping System:** This crop can be cultivated as intercrop in tree plantation in orchards.
- **Interculture and Maintenance Practices:** Regular weeding (2-3) and hoeing operations are needed during early period of growth to control weeds.
- **Irrigation Practices:** The crop is rainfed and can stand partial drought conditions. However, 2-3 irrigations are required after sowing, depending on soil conditions and distribution of monsoon rains.
- **Disease and Pest Control:** Powder mildew is common problem during the winter months. Control measures involve spraying wetttable sulphur (sulfex) at the rate of 3% at weekly interval for 3 to 4 times. Leaf roller caterpillar is another menace and is controlled by 2-3 spray of 0.2% Endosulfan at fortnightly interval.

²⁶ Agro technique study carried out by Mahatma Phule Krishi Vidyapeeth (MPKV), Rahuri, Maharashtra.

Roscoea purpurea Smith

Fam. Zingiberaceae

Ayurvedic name	Kakoli
Hindi name	Kakoli
Trade name	-----
Parts used	Fasciculated Tuberous Roots



Roscoea purpurea

Morphological Characteristics

It is a terrestrial, herbaceous and tuberous perennial herb. Root is thick, fleshy and fasciculated. Stem is leafy, elongate, leaves 5-6, lanceolate. Flowers are few in a sessile spike borne in autumn and pale-lilac, purple or white in colour.

Floral Characteristics

Flowers are few in a sessile spike, pale lilac or white. Floral bracts are oblong, hidden in the sheaths of the upper leaves. Calyx is green and slit deeply down one side of the flower expand. Corolla tube is dilated upwards, lip 2-3 lobed; upper segment is ovate and lower lanceolate. The staminode is oblanceolate in shape, half as long as the upper segment; whereas fertile stamen is as long as the staminode. Capsule is cylindrical and varies greatly in size.

Distribution

The plant is distributed from an elevation of 1500-2500 meter in Himalayan region and Khasi hills.

Climate and Soil

The plant grows in moist shady places over sandy-loam soils rich in humus. Soils having

rotten FYM should be applied in the field. Second ploughing should be done in the first fortnight of April depending upon the soil moisture. Planking should be done after 2nd and 3rd ploughing to break remaining clods and make the soil friable. If sufficient winter residual moisture is not present in the soil then a light irrigation should be given before planting the tubers.

- **Manure and Fertilizer Used (Basal):** It grows very well in humus rich soils. FYM dose of 25-30 t/ha is recommended. It should be spread uniformly in the field and mixed well in the soil. Unlike annual crops, the entire quantity of FYM is applied in split doses. First applications of $\frac{3}{4}$ th of the total FYM is done at the time of area preparation and rest $\frac{1}{4}$ th should be applied at the time earthing which is carried out in the beginning of next rainy season.
- **Days for Completion of Germination/Sprouting:** Sprouting takes one month period.
- **Optimum Crop Stand /Hectare:** 32,000- 40,000 plants/ha.
- **Inter-cropping System (If Grown in Orchard/Plantations etc.):** Intercropping trials were conducted in the peach and apricot orchard by adopting the same (sole crop) package of practices. The yield obtained per unit area was same as obtained from the sole crop.
- **Interculture Operations:** In areas of heavy rainfall, two earthings, one after about 30-35 days and second after the monsoon is recommended, so that tubers do not get exposed to sunlight. Hand weeding for 3-4 times is required, depending upon the intensity of weedy flora. There are no serious diseases, insect pests, nematodes noticed in trial plots. However, crops should be protected from water stagnation to avoid tuber rotting ensuring proper drainage.
- **Irrigation Practices:** The residual moisture of the winter rains is captured for the sowing. If the rains are not enough, a light irrigation should be applied before planting. Once tubers sprout, a weekly irrigation is required during summer season.
- **Weed Control:** Manual weeding at an interval of 30 days is required depending upon the frequency of weeds.

Harvest Management

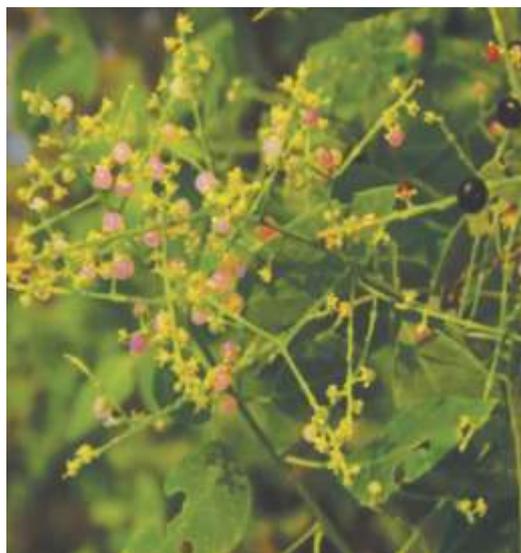
- **Crop Maturity and Harvesting:** The crop takes 2 years to produce mature tubers. The tubers are harvested by digging in autumn preferably in the month of October.
- **Post-harvest Management:** The tubers are washed in running water. Mother tubers should be removed and then rest of the tubers should be dried in shade or in partial sunlight. Dried tubers can be stored in well airy gunny bags / bamboo baskets. For seed purpose, healthy fresh tubers of uniform size can be selected and stored in soil pits in cooler areas or bamboo baskets. These should be treated with 0.01% Bavistin solution for half an hour followed by shade drying before storing to protect from fungal infection.

Salvadora persica Linn.

Syn. *S. indica* Wt.

Fam. Salvadoraceae

Ayurvedic name	Pilu
Unani name	Pilu, Miswak
Hindi name	Khara Jhal, Chota Pilu, Meswak
English name	Mustard Tree, Salt Bush Tree,
Trade name	Khara Jhal, Tooth Brush Tree
Parts used	Roots



Salvadora persica

Morphological Characteristics

Salvadora persica is a large shrub or small tree of Thar Desert. The branches are drooping, terete and glabrous. A typical desert plant grows as a mangrove perennial tree as well as under extreme saline (salt stress) and drought conditions. Thus the seeds are dispersed by the birds. The plant produces three types of fruits, *i.e.* pink, purple and white. The purple fruit bearing plants showed better seed traits, *viz.* seed weight, size, thickness, volume, density and viability and germination percentage as compared to other two types of fruit bearing plant. Hence, in the present studies seeds of purple fruit bearing plants were selected to develop agro-techniques. The leaves are shed twice in a year, *i.e.* October-November and February-March, but plant never becomes leafless throughout the year. New leaves appear twice in a year, first during April-May and second during September to December and thereafter new leaves develop slowly. During winter season (cold stress) anthocyanin pigments have been noticed in leaves. The gall formation has been commonly observed on every plant part except roots. These galls have been reported to possess some growth promoting principles.

Floral Characteristics

The plant bear flowers in September-October. The flowers are greenish-yellow borne in axillary and terminal compound panicles. Calyx is glabrous, lobes rounded; corolla is twice as long as calyx; stamens exerted; fruit is a drupe, globose, red when ripe. The plants produce



- **Weed Control:** Manual hand weeding is a better option for weed control in *S. persica* plantations.
- **Disease and Pest Control:** No serious insects, pests and nematodes were observed in this crop.

Harvest Management

- **Crop Maturity and Harvesting:** Seeded fruits require 4-5 months for maturity, *i.e.* from December to April-May. The whole plant is used medicinally, but roots are used for preparation of Meswak toothpaste. The plant may be uprooted after 2 years of growth at any time of the year for root production. The roots are separated and dried.
- **Post-harvest Management:** Uprooted whole plants are separated into leaf, stem and roots with the help of stainless knife/scalpels. Stem branches and roots are used freshly. If these are not used freshly, then these should be stored in well ventilated shady places, so that moisture loss takes place continuously.
- **Chemical Constituents:** Root contains elemental γ -monoclinic sulphur, benzyl glucosinolate, a methoxybenzyl derivative of urea named salvadourea, m-anisic acid and sitosterol. Root bark and stem bark contain trimethylamine. Seed oil is rich in myristic, lauric and palmitic acids.
- **Yield and Cost of Cultivation:** Plantation of crop at 5X5 meter spacing in one hectare area yielded 200 kg roots after two years. Rs. 6800/- is the estimated cost of cultivation for one hectare.

Therapeutic Uses

The root contains steam-distillable oil, which has 90% Benzyl isothiocyanate, a compound responsible for decreasing dental caries and used in the preparation of Meswak toothpaste. The chemical present in the plant can control gingivostomatitis, skin infection and conjunctiva. The root bark is tonic, stimulant, emmenagogue. The stem bark is good for gastropathy.



***Solanum surattense* Burm. f.**
Syn. *S. xanthocarpum* Sch. & Wendl.
Fam. Solanaceae

Ayurvedic name	Kantakari
Unani name	Katai khurd
Hindi name	Choti Kateri, Ringni
English name	Wild Eggplant, Yellow - Berried Nightshade
Trade name	Kantkari
Parts used	Whole Plant



Solanum surattense

Morphological Characteristics

Branches are spreading on the ground. The plant is very prickly diffused bright green perennial herb, somewhat woody at the base. Branches are numerous, the younger ones clothed with dense stellate tomentum, prickles compressed, straight, yellow, glabrous, shining often exceeding and 1.3 cm long. Leaves are 5-10X2.5-5.7 cm, ovate or elliptic, bearing stellate hairs on both sides (especially so beneath), sometimes becoming nearly glabrous with age. Petioles are 1.3-2.5 cm long.

Floral Characteristics

Mainly flowers are axillary but some flowers are cymes and bluish-violet in colour. Pedicels are short, curved with stellate hairy. Calyx is nearly 1.3 cm long, densely hairy and prickly, tube short, globose, lobes 11 mm long, linear-lanceolate, acute and prickly outside. Corolla is purple, 2 cm long, lobes deltoid, acute, hairy outside. Filament is 1.5 mm long, glabrous, anthers 8 mm long, oblong lanceolate and opening by small pores. Ovary is ovoid, glabrous and style glabrous. Fruits are berry, 1.3-2.0 cm in diameter, yellow or white with green veins and surrounded by the enlarged calyx. Seeds are 0.25 cm in diameter, glabrous, smooth, sub-reniform and yellowish-brown.

growth. Usually, two hoeing and weeding at 20 and 45 days after transplanting are needed for an effective control of weeds, proper aeration and good growth of the plants. The crop is spreading in nature and do not allow weeds to grow at later growth stages.

- **Disease and Pest Control:** No serious pest and diseases have been observed on this crop.

Harvest Management

The plants produce flowers at 50-60 days after transplanting. Generally, this period occurs in the month of October. Fruiting starts in the month of November. The plants have indeterminate growth, meaning that flowering and fruiting continues together.

- **Crop Maturity and Harvesting:** It takes about five months from transplanting for first picking of matured berries. Complete crop harvesting can be done in the month of March. The berries are harvested before its colour turns from green to yellowish. About 2 to 3 pickings are done at 20-25 days intervals. Fruits is picked manually and kept in open for sun drying. Similarly, complete plant including roots is harvested at the end of season. It should be done before abscission of leaves starts.
- **Post-harvest Management:** The whole plant should be uprooted after giving a shallow irrigation. The berries and whole herb should be dried in sun and dry herb is packed in gunny bags and stored in cool and dark place. Seed material for next crop should be obtained from fully matured and dry berries. After cleaning, seed should be treated with any fungicide, and then packed in polythene bags and kept at cool and dark place.
- **Chemical Constituents:** Carpesterol, solanocarpine, solasonine, solamargine and β -solamargine are the chief alkaloids of Kantkari.
- **Yield and Cost of Cultivation:** An average crop of Kantkari yields about 16-20 t/ha of dry biomass (Panchang) including 500 kg berries (dried) under good management practices. After drying, 15-20% dry matter can be obtained under these conditions. Rs. 21938/- is the estimated cost of cultivation for one hectare.

Therapeutic uses

Panchang (whole herb including roots) and berries, have anthelmintic property, useful in bronchitis, asthma, fever relieving, thirst and given in urinary concretions. The leaves have good application for piles. The fruit is laxative. Fumigations with the vapour of the burning seeds of this plant are found useful for the cure of toothache.



Tecomella undulata (Sm.) Seem.

Syn. *Tecoma undulata* (Sm.) G. Don

Fam. Bignoniaceae

Ayurvedic name	Rohitak, Rohira
Hindi name	Rugtrora, Rohitaka
English name	Rohida Tree
Trade name	Rakhta rohida (Rohida Tree)
Parts used	Bark



Tecomella undulata

Morphological Characteristics

Tecomella undulata is a slow growing small deciduous tree with drooping branches and stellately grey-tomentose innovations otherwise glabrous. Leaves are usually opposite, 5-10 cm long, simple, narrowly oblong, obtuse and entire with undulate margins.

Floral Characteristics

Flowers are pale-yellow to deep orange, arranged in few flowered corymbose racemes on short lateral branches. Calyx is campanulate, lobes broadly ovate, obtuse and mucronate. Corolla is companulate, veined, stamens exserted, filaments glabrous, stigma 2-lamillate. Capsules are slightly curved, smooth and seeds are winged.

Distribution

Plant is distributed in drier parts of North-West and Western India extending eastwards to the river Yamuna and ascending to an altitude of 1200 meter in the outer Himalaya.

Climate and Soil

The plant prefers subtropical climate having medium to light soil.



Propagation Material

Seed.

Agro-technique³⁰

Nursery Technique

- **Raising Propagules:** Seeds are sown in the month of May on flat beds/raised nursery bed or polybags.

Planting in the Field

- **Land Preparation and Fertilizer Application:** Pits of 60X60X60 cm are to be prepared at an optimum spacing of 4 meter between row to row and 3 meter between plant to plant and filled with FYM. NPK in the ratio of 750: 600:300 gm/plant is given as single basal dose.
- **Transplanting and Optimum Spacing:** Plantation of seedlings is done at a spacing of 3X4 meter in the month of July-August.
- **Intercropping System:** Aromatic grasses / annual species of medicinal plants can be cultivated as intercrop.
- **Interculture and Maintenance Practices:** One to two harrowing is to be given in the middle space for keeping the field clean.
- **Irrigation Practices:** Irrigation may be given as per the season during winter at 30-40 days interval and summer at 20-30 days interval. After establishment of the crop, it is not necessary to give frequent irrigations.
- **Weed Control:** Weeding is done as and when required to keep the field weed free.
- **Disease and Pest Control:** The plants need to be protected from termites and stem borer for which suitable insecticides are used.

Harvest Management

- **Crop Maturity and Harvesting:** The crop matures after 3-4 years and should be harvested for its bark during summer (April-May).
- **Post-harvest Management:** The bark is shade dried and stored in gunny bags in dry, ventilated places for marketing.
- **Chemical Constituents:** Bark contains alkanes; heart wood contains iridoid glycosides 6-o-veratroyl catalposide and tecomelloside and flowers contain flavonoids.

Therapeutic Uses

Plant is anti-leucorrhoeic, used in enlargement of spleen and leucoderma; bark febrifuge, anti-syphilitic, given in liver diseases. Flowers are used in diabetes.

³⁰ Agro-technique study carried out by (a) National Bureau of Plant Genetic Resources (NBPGR), Issapur Farms and (b) Mahatma Phule Krishi Vidyapeeth (MPKV), Rahuri, Maharashtra.

Tribulus terrestris Linn.

Fam. Zygophyllaceae

Ayurvedic name	Gokhru, Gokshura
Unani name	Gokharu, Khaar - e - Khasak Khurd
Hindi name	Chotagokhru
English name	Land-Caltrops, Puncture Vine
Trade name	Gokhru
Parts used	Entire Plant



Tribulus terrestris

Morphological Characteristics

It is a trailing perennial, hirsute, procumbent and branched herb. The stems and branches are pilose and young parts are silky-villous. Leaves are stipulate, opposite usually unequal and abruptly pinnate. Leaflets are 5-8 in pairs with length 0.5- 1.3 cm, sub-equal, oblong to linear oblong and mucronate; petiolules very short and pilose.

Floral Characteristics

Flowers are yellow, solitary, axillary, 8-12 mm in diameter and appear during July-August. Style is short and stout; ovary is bristly 5-10 lobed and with 5-12 celled; fruits are globose and spinosus produced during autumn. It consists of 5-12 woody cocci, each with two pairs of hard sharp spines, one pair longer than the other. Each coccus contains several seeds with transverse partition between them. The seeds are obliquely pendulous and have hard seed coat.

Distribution

The plant is found throughout sub-tropical parts of India, ascending upto 1000 meter as a weed along roadsides and waste places.

Climate and Soil

Gokhru requires tropical, subtropical and semiarid climate, preferably open sun with warm

temperature. The species thrives on all kinds of soil from clay- loam to light sandy-loam, and requires low rainfall. Water-logged and highly alkaline soil is unsuitable for cultivation.

Propagation Material

Seeds are used as planting material and collected during October-November.

Agro-technique³¹

Nursery Technique

- **Raising Propagules:** The crop is raised through direct sowing of seeds.
- **Propagule Rate and Pretreatment:** Approximately 1.0-2.0 kg seeds are required for planting one hectare area. These seeds are soaked in water over night and treated with 20 ppm GA₃ for 48 hours before sowing in the field during February-March.

Planting in the Field

- **Land Preparation and Fertilizer Application:** The field should be prepared well by giving one cross ploughing and harrowing followed by planking. Manure at the rate of 10 t/ha should be mixed with the soil at the time of field preparation. A fertilizer application of N, P and K at 60:40:40 kg/ha is recommended; the N is split in 2 doses, first applied basally and the rest after 60 days.
- **Optimum Spacing:** Optimum crop stands at a spacing of 90X120 cm per hectare is 6000 plants. It takes about 30 days to complete germination. Usually 1-2 weeding are needed to keep the crop weed-free.
- **Irrigation Practices:** The crop is essentially a rain-fed one and watering is done only during long dry spells.
- **Disease and Pest Control:** No significant pests and diseases have been observed in this crop.

Harvest Management

- **Crop Maturity and Harvesting:** It is long duration crop, remaining 240-250 days in the field. The seeds ripen in October when the crop is uprooted. Seeds and roots are separated and dried.
- **Post-harvest Management:** After harvesting the seeds and roots should be shade dried and stored in gunny bags in cool-airy godown.
- **Chemical Constituents:** The plant contains saponins, diosgenin, gitogenin, chlorogenin, ruscogenin and 2-5 D-spirosta-3-5-diene, kaempferol, kaempferol-3-glucoside, kaempferol-3-rutinoside and new flavonoid tribuloside. Accepted range of active constituents in produce: 19-32 µg/9 kg dry weight.

³¹ Agro-technique study carried out by Jamia Hamdard, Hamdard Nagar, New Delhi.

Withania somnifera (Linn.) Dunal

Syn. *Physalis somnifera* Linn.

Fam. Solanaceae

Ayurvedic name	Ashvagandha
Unani name	Asgand, Asgand Nagori
Hindi name	Asgandh
English name	Winter Cherry
Trade name	Ashwagandha
Parts used	Root, Leaf and Seed



Withania somnifera

Morphological Characteristics

It is a dense, hairy, erect, grayish-tomentose herb or under-shrub, grows up to a height of 1.5 meter. Its all parts are covered with whitish, stellate trichomes. Branching is extensive; leaves are simple, alternate or sub-opposite, ovate, entire, basis cunate, 10 cm long. The roots are stout, long tuberous, fleshy, whitish-brown.

Floral Characteristics

The flowers are greenish-yellow and found in few flowered clusters in axils; pedicels up to 4 mm long. Calyx is 5 mm long and stellately tomentose; teeth 2.5 mm long, linear, acute and form a deltoid base. Corolla is 8 mm long, divided rather more than ½ - way down; lobes lanceolate, acute and pubescent outside. Filaments are 3 mm long, slender, glabrous and anthers are broadly elliptic (almost orbicular), 1.25 mm long. Ovary and style are glabrous. The fruit is red-yellow berry, smooth, 6 mm in diameter, enclosed in the inflated calyx which reaches more than 25 mm diameter and is globose, slightly 5-angled, pointed with the connivent calyx-teeth and scurfy-pubescent outside. Seeds are 2.5 mm in diameter, yellow and somewhat scurfy.

Distribution

It is found throughout the drier parts in subtropical regions and upper Gangetic Plains.

Climate and Soil

Ashwagandha is grown on sub-marginal waste lands and low fertility areas. Plant grows well in red, sandy, black and loamy soil with pH 6.5- 8.0 with good water drainage. It can be cultivated upto an altitudes of 1000 meter. Ashwagandha prefers a sub-tropical climate. The

Madhya Pradesh, where it is grown on commercial scale, no fertilizer is applied and the crop is cultivated on only residual fertilizer. However, 200-300 kg FYM/ha may be applied. 5-6 times vermi-compost or FYM may be applied row to row.

- **Transplanting and Optimum Spacing:** The seedlings after 25-35 days are transplanted at distance of 20-25 cm to 10-15 cm row to row and plant to plant respectively. It may be noted that since “Asgandh” is a late rainy season the time of sowing is decided by the date of arrival of monsoon in that area. 30 to 60 plants/Sqm or 3 to 6 lakhs plants per hectare should be kept when $\frac{3}{4}$ rain have over in August or September sowing or transplanting should be completed.
- **Intercropping System:** *Withania* may be planted as intercrop with newly planted *Cocos nucifera* (coconut), *Mangifera indica* (mango), *Tectona grandis* (teak), *Simaruba officinalis* (simaruba), *Jatropha curcas* (jatropha), *Pinus* spp. (pine) and *Populus canadensis* (populus).
- **Interculture and Maintenance Practices:** The directly sown crop is thinned at 25 – 30 days to maintain a plant population of 20,000–25,000/ha. Hand-weeding at 30 days interval helps to control the weeds effectively. Total two weedings. 2nd weeding after 2 months.
- **Irrigation Practices:** Light shower after transplantation ensures establishment of seedlings. There is no need of irrigation if rainfall is at regular intervals. Excessive rainfall/water is harmful to the crop. Life saving irrigation may be applied at required intervals. Under irrigated conditions, the crop can be irrigated once in 10 days.
- **Pests and Diseases:** The early stages (seedling stage) of *Withania somnifera* caused from fungus disease like damping of fungus, seedling blight, seed rotting, die-back etc. Seed should be treated with thiram or captan (2-4 gm/kg) to reduce the effect of seedling blight and leaf blight. 0.3% phytolone, diethane- 78 or D-45 is also spread on crop. Leaf curl tobacco and urches broom disease were also recognized in *Withania*. These diseases are controlled through spraying of tetra-cyclinehydrochloride at the interval of 15-20 days. Best way to uproot and burn the infected plants. Some insect diseases were also identified on *Withania*, for controlling of insect diseases, 0.5% melathyone mixed with 0.1 – 0.3% kithane can be used as spray at 10-15 days interval.

Harvest Management

- **Crop Maturity and Harvesting:** Harvesting starts from January and continues till March. The plants start flowering and bearing fruits from December onwards. The crop is ready for harvest in January – March i.e. 150 to 180 days after sowing. The maturity of crop is judged by drying out of leaves and yellow red berries. The entire plant is uprooted for roots, which are separated from aerial parts by cutting the stem 1-2 cm, above the crown. The roots are cut transversely into small pieces (7 to 10 cm). Occasionally, the roots are dried as a whole. The berries are plucked from the dried plants and are threshed to obtain the seeds.

Glossary

Glossary of botanical terms

Abaxial	:	Located from the side away from the axis
Abscisic acid	:	Plant hormone that inhibits growth
Achene	:	Single seeded, unicellular, dry, indehiscent fruit also called caryopsis
Acicular	:	Needle like
Acuminate	:	Long, pointed, gradually tapering towards apex
Adaxial	:	Located on the side towards the axis. The adaxial surface of a leaf is the upper side
Aerial root	:	An aerial root is a plant's root that is produced above the ground
Agriculture	:	It is the science of farming, including growing plants and raising animals
Airspace	:	These are the inter-cellular gaps within the spongy mesophyll of leaves
Amplexicaule	:	Encircling of the node by leaf bases
Annual	:	An annual is a plant that goes through its entire life cycle within a year
Apex	:	Tip, uppermost part
Apices (apex)	:	Top
Arable	:	Arable land is suitable for growing crop plants
Arcuate	:	Leaves with arcuate venation have veins that are curve towards the apex (Tip)
Areole	:	Areoles are circular clusters of spines on a cactus
Aristate	:	Ending in bristle or awn
Articulate	:	Jointed
Auxin	:	Growth hormone found in plants
Awn	:	Bristle-like extension of a plant near its tip
Axillary bud	:	The axillary bud is a bud that develops in the axil (The angle between the stem and the leaf) of leaf
Bark	:	Outer covering of stem and roots of woody plants
Berry	:	Small juicy, fleshy, stoneless fruit that contains one or many seeds
Biennial	:	Plant which takes two years to complete the full life cycle
Bilateral	:	Two sides

Birch	:	These are broad-leafed, deciduous trees and shrubs with paper like bark
Bladder	:	Small air-filled sac
Blade	:	Narrow flat leaf
Bract	:	Reduced leaf-like structure associated with a flower
Bracteole	:	A small bract or leaf like structures below perianth in a flower
Bud	:	A small developing part of a plant that will grow into a flower, a new leaf or a stem
Bud scale	:	Modified leaf that covers and protects the bud
Bulb	:	An underground stem usually globular, that has fleshy leaves emerging from the top and roots emerging from the bottoms
Bulbils	:	Vegetative propagative spherical structure arising at the leaf base
Bulblet	:	A small bulb that grows from another bulb (for vegetative propagation)
Caducous	:	Falling soon
Campanulate	:	Bell-shaped
Canopy	:	It consist upper part of the trees of a rain forest
Capitulum	:	Head-shaped inflorescence, as in Asteraceae
Capsule	:	It is a seed pod that opens when it is dry and the seeds are mature
Carpel	:	Female reproductive organ of a flower
Caudex	:	An enlarged, woody base of the stem on some plants
Cauline	:	Arising from stem
Clade	:	A Clade is the group of all the organisms that share a particular common ancestors
Cladodes	:	Modification of dwarf branches into leaf-like structure
Clasping	:	Wrapping
Cleft	:	A cleft leaf is one in which the margins between the irregular teeth go more than half way to the mid rib
Comose	:	With long, white bunch of hair
Coppice shoots	:	It is a shoot that arise from an adventitious or dormant bud on a branch or stem of a plant
Coquina	:	It is a type of lime-stone that is mostly made of shells and shell fragments
Cordate	:	Heart-shaped
Coriaceous	:	Thick, stiff, leathery

Corm	:	A stem modification, underground spherical in shape with reserve food material
Corona	:	Bundle of hair between corolla and stamens arising from base of the corolla
Crenate	:	A crenate leaf has margins (edges) shaped like rounded teeth
Crisped	:	Tightly curled margin
Crystals	:	Solid, whose atoms form a regular pattern
Culm	:	Elongated straw or hollow stem of grasses
Cuneate	:	Wedge-shaped, tapering towards base
Cuspidate	:	Tapering to long point at tip
Cyme	:	Arrangement of flowers with older flower on top and younger flower towards base
Deciduous	:	Plants lose their leaves seasonally, usually for the dry season
Dehiscent Fruit	:	A fruit splits open when it is mature, causing the dispersal of its seeds
Diadelphous	:	Stamen divided into two groups 9+1 as in Fabaceae
Dicho.venation	:	It is a pattern of a leaf veins in which the veins branch in two over and over again
Didymous	:	Two-sized (filament of stamens)
Dimorphism	:	Two forms
Dioceous	:	Male and female flowers on different plants
Dirt	:	Another name of soil
Discoïd	:	Disc-shaped
Dispersal	:	It is a process in which an organism spreads out geographically
Dominant	:	It is the most abundant species in an area
Dormancy	:	It is a period in which a plant has no active growth in response to harsh environmental conditions
Elater	:	A cell or a part of a cell which assists in dispersing spores
Ellipsoid	:	Eclipse-shaped
Emarginate	:	Deeply and irregularly notched at apex
Embryo	:	An embryo is a developing plant still inside the seed
Entemophylous	:	Pollinated by insects
Endemic	:	Endemic plants are native to an area and are only found in that area
Entire	:	Even margin, complete margin, no cut or lobation on margin (of leaves)
Epigynous	:	Ovary seated above perianth

Epiphytes	:	A plant which grows upon another plants
Exstipulate	:	Without stipule, a leafy structure at the base of leaf
Extrose	:	Facing outward
Fascicled	:	Clustered at one point
Fertilizer	:	A material, added to soil to increase fertility and output
Fibrous root	:	A fibrous root is a type of root of a plant that has a lot of side branching
Fluted	:	Hollow
Foliage	:	Type of leaf
Follicle	:	Dry dehiscent fruit opening only by ventral suture
Fragrant	:	Emitting sweet smell
Gamo petalous	:	Petals united with each other
Gamo sepalous	:	Sepals united with each other
Gamo tepallus	:	Perianth united with each other
Glabrous	:	Without any hairy structure
Graft	:	A shoot or bud that has been joined to another plant
Gregarious	:	Very long – robust, profuge
Gynaecium	:	Female part of flower having ovary, style and stigma
Habit	:	The general growth pattern of a plant
Habitat	:	A space suitable for the survival and reproduction of an organism
Haustorial root	:	Root absorbs water and nutrients from another plant (not from soil)
Heart wood	:	Central hardest part of wood/trunk
Hormone	:	It is a chemical in plant that regulates the plant's growth, reproduction and another functions
Humus	:	Humus is the rich organic portion of the soil
Hydric	:	These are environmental conditions which are very wet
Hypogynous	:	Ovary inferior, sepals, petals and stamen above the ovary
Imbricate	:	Arrangement of corolla with two outer, one inner, and two with one side outer other side inner
Imparipinnate	:	Leaflet in odd number on top
Indehiscent	:	A fruit that remains closed at maturity is indehiscent
Indigenous	:	An organism is one that leaves naturally in a particular reason and were not introduced there by man
Inferior ovary	:	An ovary located below the flower parts
Inflorescence	:	Arrangement of flowers

Lanceolate	:	Shape of convex lens
Lateral	:	Near or from the side of an organism
Latex	:	Oozing milky sap or milky sap inside plant tissue
Leaflet	:	In a compound leaf the individual blades are known as leaflets
Lemma	:	A bract in a grass speculate that is located below the stamens and pistil of the flower
Lenticellate	:	Slit-like raised cortical structure on the branches
Liana	:	It is a woody climbing vine that grows on tree trunks in order to reach sun light in the rain forest
Linear	:	Very narrow, like a line
Loam	:	It is a type of rich crumbly soil that contains an almost equal amount of sand and silt, plus a small amount of clay
Lomentum	:	Single seeded cell of pod, septate, and constricted between two seeds
Mesophyte	:	A plant that has moderate water requirements
Mineral	:	A mineral is a naturally occurring solid of definite chemical compositions whose atom usually form a regular pattern
Moniliform	:	Beaded in a row like a garland
Monoculture	:	It is a system of agriculture in which a single type of crop is grown in an area
Monoecious	:	Unisexual, male and female flowers on the same plant
Mucronate	:	Small projection at the apex (acume)
Mycorrhizae	:	It is a fungus that grows in a symbiotic relationship with the roots of a plant
Nutrient	:	It is a chemical that an organism need to ingest in order to survive
Oblong	:	Longer than broad with narrowing margin towards base
Obpyramidal	:	Inverted pyramid shaped
Obsolete	:	Minute or wanting
Obtuse	:	Blunt top (apex)
Orbicular	:	Almost circular
Ovate	:	Egg shaped
Palmate	:	Hand like structure of a leaf
Peat	:	A type of soil which is composed of in completely decomposed plant material that waterlogged and low in oxygen
Pediceal	:	Stalk of flower
Pedicillate	:	Stalked flowers

Peduncle	:	Stalk of inflorescence
Perennial	:	A plant which continues to grow after it has reproduced, usually meaning that it lives for several years
Perianth	:	Vegetative covering of sexual organ in flower, sometime differentiated into calyx and corolla
Peripinnate	:	Leaflet in even number
Pesticide	:	An agent that kills unwanted plants and insects
Petiole	:	A petiole is a leaf stalk on a compound leaf, the petiole extends from the stem to the first set of leaflets
Petiolate	:	Petiolate means having a petiole
Phylloclade	:	Modified stem
Phyllode	:	Leaf has enlarged midrib without blades
Pinnate	:	Compound leaf with leaflets arranged on same rachis at length
Polyhedral	:	Many faced, many angled
Prickle	:	Sharp outgrowth of a plant's epidermis
Procumbent	:	Creeping on ground then rising up
Pubescent	:	Carpeting of small soft hair
Rachis	:	Midrib of a leaf
Radical	:	Arising from stem base (leaves or branches)
Receptacle	:	Terminal portion of the flower stock
Reniform	:	Almost kidney-shaped
Repand	:	Leaf has a wavy margin
Reticulate	:	Weaved
Rhizome	:	Subterranean part between stem and root bearing buds that may be used as a propagative part
Rhomboid	:	Quadrihedral with only opposite angles equal
Rosette	:	A series of whorls of leaves or leaf-like structure produced at the base of the stem, just above the ground
Rugose	:	Ridged, rough or wrinkled
Sapling	:	A small young tree
Sapwood	:	It is an outer layer of wood in a tree and contains living cells
Sarmentose	:	Growing among bushes, with long flexuous runners
Scale	:	Tiny green leaves
Scandent	:	Weak plants that need support; climbing without any climbing organ, and so on
Serrate	:	Margin of leaf cut into saw-shaped structure, pointing upwards
Sessile	:	Without any stalk

Sinuate	:	Wavy margins
Spathulate	:	Service spoon shaped
Spike	:	Sessile flowers arranged on peduncle
Spikelet	:	It is a secondary spike found in grasses; it is cluster of two or more flowers in the inflorescence
Staminode	:	Barren stamen (infertile anthers)
Stellate	:	Star-shaped arrangement of short stiff hair (trichomes)
Stipitate	:	Stalked
Stipule	:	Paired, appendages found at the base of the leaves
Striate	:	Marked with vertical lines
Succulent	:	Thick, soft and juicy
Suffruticose	:	A herb becoming perennial at base and herbaceous at apices
Syncarpous	:	Fused carpels
Tap root	:	Type of root
Terete	:	Lined
Terminal bud	:	A bud located at the apex of a stem
Terrestrial	:	Growing in soil
Tester	:	Seed coat
Thorn	:	Modified stem
Tomentose	:	Dense, soft, layer of hair or cotton easily scraped off
Truncate	:	Flat topped
Tuber	:	A swollen, subterranean root containing reserve food material
Turbinate	:	Tube shaped
Variegated	:	Spotted with various colour
Veinlet	:	Small vein
Venation	:	The arrangement and pattern of veins in a leaf
Villous	:	Long soft shaggy hair
Vine	:	A plant that needs support as it grows
Whorl	:	Arising more than two from one node (leaf or branches)
Wood	:	A secondary tissue found in seed plants which consists largely of xylem tissues
Xeric	:	Dry conditions
Zygomorphic	:	A symmetrical plain of flowers not divisible into equal halves

Glossary of medical terms

Aborticide	:	Expels and kills embryo
Abortifacient	:	A drug that induces foetus expulsion
Abortive	:	Effecting abortion
Abortion	:	Expulsion of foetus which is not viable during the first five months
Abscess	:	Localized collection of pus in any part of body
Absorbents	:	Agents which absorb toxins on its surface. Absorbents are used in diarrhea or vomiting
Acidity	:	Sign of indigestion- increase in the acid content in stomach
Acrid	:	Producing irritation or biting and pungent
Adjuvant	:	An impure ingredient introduced into a preparation
AIDS	:	(Acquired Immuno Deficiency Syndrome)- A disease caused by HIV virus, which suppresses an antidote
Alexipharmic	:	Which neutralizes a poison, acts as an antidote
Alexiteric	:	Developing resistance against infectious diseases
Alopecia	:	Baldness, loss of hair, a natural or abnormal condition
Alterative	:	A drug that alters body condition by improving metabolism; used against long effect of a medicine
Amenorrhoea	:	Failure of menstruation
Amoebicide	:	Kills amoebae (<i>e.g.</i> Ipecac)
Anaemia	:	Decreased oxygen carrying capacity of blood, decrease haemoglobin content of blood
Anaesthetics	:	Drugs that produce temporary loss of sensation (a)Affects whole system by bringing unconsciousness (b)Acts on specific parts of system
Analgesic	:	Pain killer
Anaphrodisiacs	:	Are agents which allay or diminish or weaken the sexual desire
Anasarca	:	Generalized oedema
Anodyne	:	A drug used to allay pain
Antacid	:	To neutralize acidic effect in abdomen
Antalkaline	:	Agents which neutralize an alkaline state of the system
Anthelmintic	:	A drug used to expel or destroy intestinal worms
Antiarthritic	:	A remedy against gout, rheumatism or affections of the joints

Antibiliary/A-bilious :	Which are useful in bilious affections
Antibiotics :	Agents produced by or derived from living cells of molds, bacteria or other plants which destroy or inhibit the growth of microbes (Antibacterial agents) in body
Antibodies :	Are specific protective substances produced by the tissue cells of the host in response to an antigen
Antibronchial :	Working against respiratory track infection and Congestion
Anticoagulant :	Substance which prevent clotting of blood
Anticonvulsant :	Agents which abort or prevent convulsion
Antidiabetic :	Medicine preventing or overcoming diabetes by lowering blood sugar
Antidote :	Counteracting the action or effect of poisons
Antidysenteric :	Medicine given against dysentery
Antiemetic :	A drug used to control vomiting
Antiepileptic :	Used to relieve or prevent convulsion in epilepsy
Antifertility :	A drug that inhibits formation of ova or sperm
Antigalactagogue :	That decreases the secretion of milk
Antihistaminic :	A drug used for controlling skin irritation and itching caused due to increase of blood histamine
Antihydrotic :	Drug which diminishes perspiration
Anti-inflammatory :	A drug used to cure swellings
Antilithics :	(Lithontriptrics)- Agents preventing or depositing of renal, vesicant or biliary calculous medicines used for the relief of calculous affections
Antimalarial :	Prevents or cures malaria
Antineuralgic :	Relieves neuralgic pain
Antiparasitic :	Destroys parasites infecting the surface of the body
Antiperiodic :	A drug that prevents recurrence of a disease
Antiphlogestic :	An agent used for reducing or subsiding Inflammations
Antipodagric :	Used in gout
Antipruritic :	Used to relieve itching
Antipyretic :	A drug or a medicine used to lower body temperature in fever
Anti-rheumatic :	A drug used against joint pain and swellings
Antirhinitis :	Clearing of nasal mucous by subsiding nasal membrane inflammation
Antiscorbutic :	A drug that corrects or cures scurvy

Antiseptic	:	Prevention of putrefaction or sepsis of wounds and cuts
Antisialagogues	:	Which decrease or check the secretion of saliva
Antispasmodic	:	A medicine that releases nervous irritability and reduces spasm or convulsion
Antisudorific	:	Anhydrotic
Antisyphilitic	:	A drug which is effective against syphilis
Antitubercular	:	Agents used against tuberculosis
Antitussive	:	A drug controlling cough
Antivirotic	:	Harmful to viruses; used to treat viral infections
Aperient	:	Mild laxative/cathartic
Aphrodisiac	:	Drug increasing the sexual desire and longevity
Aphthae	:	Small ulcers in the mouth
Appetizer	:	Increasing digestion and hunger
Aromatic	:	An agent that emits sweet smell
Arthritis	:	Inflammation of joints
Ascaricide	:	Drug that destroys round worms
Asthma	:	A disease characterized by wheezing, coughing
Astringent	:	A drug that contracts the muscular membrane
Atrophy	:	Wasting, emaciation, loss of tissue
Attenuant	:	An agent increasing the fluidity or thinness of the blood or other secretion
Bacteriostatic	:	Agents which tend to retard the growth of microorganisms but do not kill them
Balsamic	:	Medicine of healing or soothing kind
Bechic	:	Remedies for cough
Biliousness	:	Term used to describe the giddiness vomiting <i>etc.</i>
Bitters	:	Medicines that stimulate the gastrointestinal tract, without influencing the general system
Boil	:	An inflamed pus-filled swelling caused by infection of a hair follicle
Bronchitis	:	Inflammation of the mucuous membrane in the bronchial tubes
Bronchodilator	:	A drug that widens the trachea, thus easing Congestion
Cancer	:	A malignant new growth in any part of the body
Cardiac	:	Pertaining to the heart
Cardiac Depressant	:	Reduces frequency or force or both of heart action
Cardiac stimulant	:	(Cardiotonic)- Stimulates frequency or force of heart action

Caries	:	Destruction in teeth
Carminative	:	A drug that releases intestinal gases or flatulence
Cataract	:	Opacity or clouding of the lens of the eye
Catarrhal	:	Mucous membrane inflammation with excessive secretion of mucous
Cathartic	:	Drastic purgative, totally expelling rectal stool
Caustics	:	Substances that destroy or disorganize living tissue, by destroying the vitality of the part on which it is applied
Cephalic	:	Pertaining to head
Cerebral Depressant	:	(Sedative)- Decreases functional activity of higher centres of brain
Chalybeate	:	Contains iron and is used as a tonic in anaemia
Chicken pox	:	A contagious diseases resulting in sporadic eruption of papules
Cholagogue	:	A drug inducing excessive secretion of bile juice
Choleretic	:	Drug increases bile secretion or formation by liver
Coagulants	:	Drugs that hasten blood coagulation
Colic	:	Severe spasmodic and gripping pain in colon region
Convulsants	:	Agents that cause convulsions
Cordiacs	:	Pertaining to heart
Corrosive	:	Drug that destroys organic tissue either by direct chemic means or by causing inflammation, strong alkali or acid
Debility	:	Weakness of solid or muscular fibre
Deliriant	:	Blunt cerebral function so as to disorder or confuse the mentality
Demulcent	:	Soothing medicine for digestive function
Dengue fever	:	An epidemic viral disease having fever and body pain
Dentrifices	:	Powder or parts used for cleaning the teeth and gums
Deobstruent	:	Removes obstructions in bowel
Deodorants	:	Substances which destroy, remove or correct offensive or disagreeable or foetid odours and emanations
Depilatory	:	Kills growth or remove hair
Depressants	:	Diminishes functional activities of any cell, tissue, organ and system
Depurant	:	Purifier
Derivatvies	:	Withdraw blood from the seat of disease to some other part of body, usually to relieve Congestion

Dermatitis	:	Inflammation of the skin causing discomforts such as eczema
Dessicant	:	Dries up moist surfaces
Diabetes	:	A metabolic disorder characterized by excessive elimination of urine
Diaphoretic	:	Drug inducing perspiration
Diarrhoea	:	Gastro-intestinal disease resulting in the increased frequency or fluidity of stool
Digestants	:	Aids the process or speed of digestion, often by increasing the efficiency of break down and absorption of food in the stomach and intestines
Diphtheria	:	An infectious disease of throat and fauces in which false membrane form
Discutient	:	Causes a tumour, exudates or other pathological formation to disappear, reduces swelling
Diuretic	:	Increasing urination frequency
Dizziness	:	A condition of feeling giddy or unsteady
Dropsy	:	A leakage of the watery part of the blood into any tissues of the body
Dysentery	:	Bacterial or protozoal infections in mucous membrane of intestine, leading to blood or mucous in stool
Dysmenorrhoea	:	Painful menstrual flow
Dyspepsia	:	Indigestion with gastric pain
Ecbolics or Oxytoics	:	Increases uterine contraction and aids in or hastens expulsion or delivery of child during birth; those which produce abortion or facilitate parturition
Eczema	:	Acute non contagious inflammation of the skin
Emetic	:	Causes or produces vomiting
Emmenagogue	:	A drug that restores regularity in menstrual cycle
Emollient	:	Drug that soothes, softens, relaxes and protects the skin
Emulgent	:	An agent stimulates urinary or bile flow
Epilepsy	:	An affectation of the nervous system resulting from excessive or disordered discharge of cerebral neurons
Epistatic	:	Vesicatory or substance, which applied locally to the skin, produces a blister, causing redness of the surface
Errhines	:	Increases nasal secretions or discharge, resulting in sneezing
Escharotic	:	A powerful caustic, destroying tissue when in contact and producing eschars (scarce or dry crusts)

Euphoric	:	Produces an artificial state of happiness
Evacuant	:	Purgatives laxative, cathartics, aperients
Excitant	:	Stimulates vital activity in any part of organism
Expectorant	:	A drug expelling phlegm from trachea
Febrifuge	:	A drug used to cure fever
Fisture	:	A linear sore with a narrow base
Flatulance	:	That presence of an excess of gas in stomach and intestine
Foeticide	:	Drug that destroys the embryo in vitro
Fungistatic	:	An agent inhibits the growth of fungi
Galactagogue	:	Increasing and activating mammary gland
Galactophyge	:	Decreases secretion and/or flow of milk
Gangrene	:	Death of tissues followed by putrefaction
Gastric sedative	:	Reduces gastric irritation, thus allaying nausea and vomiting; increases gastric function, thus acting as tonic
Geriatric	:	Pertaining to old age
Germicide	:	An agent that kills germs and worms
Gleet	:	Chronic discharge from vagina
Goitre	:	Enlargement of thyroid glands
Gonorrhoea	:	Inflammation of the gentio-urinary passage with pain and discharges
Gout	:	A purine metabolic disease with raised level of serum uric acid (blood urea)
Gynaecological	:	Pertaining to female genital organ
Haematinic / Haematics	:	Are blood tonics, improves haemoglobin of the blood
Haemophilic	:	Loss of blood coagulation property in which blood continues to flow on cuts
Haemoptysies	:	Spitting of blood
Haemorrhage	:	Bleeding piles
Haemostatic	:	Blood coagulant, preventing bleeding
Helminthogogue	:	Wormifuge
Hemagogue	:	Destructive to the blood vessels
Hemolytic	:	Promotes destruction of red blood cells
Hepatic	:	Pertaining to liver
Hepatitis	:	Inflammation of the liver
Hepatic stimulant	:	Increases or stimulates liver function

Herpes	:	Viral disease with development of vesicles on inflammatory skin
Hodgkins disease	:	A disease characterized by progressive enlargement of lymph glands and spleen
Hydrocholeretic	:	Increases secretion of relatively thin bile with high water content
Hydrogogue	:	Promoting expulsion of water or serum
Hydrophobia	:	Dread of water contracted from bite of rabid animal
Hyper lipidemia	:	Reducing fat on joints
Hypertension	:	High blood pressure
HypnicorHypnotic	:	Agents to induce sleep
Hypoglycaemic	:	Lowering blood sugar
Hypotensive	:	Lowering blood pressure
Hysteria	:	Neurotic attack with unusual activities and symptoms
Impotence	:	Inability to engage in sexual intercourse
Impetigo	:	A streptococcal skin infection causing crusted erosions
Influenza	:	Acute infectious febrile disorder, cause by a virus
Insecticides	:	Agents kill insects and related microorganisms
Insomnia	:	Sleeplessness
Intoxicant	:	Excites or stupifies poisons
Irritant	:	Agent which induces inflammation or irritation
Jaundice	:	Deposition of bile pigments in body
Lactagogue	:	Increasing milk secretion
Lactation	:	Formation and secretion of milk
Laxative	:	Smoothening rectal wall and loosening the stool
Leprosy	:	Chronic contagious diseases due to infection with <i>Lepra bacillus</i>
Leucoderma	:	A skin condition characterized by defective whitish pigmentation
Leucorrhoea	:	White fluid discharge from vagina
Laukaemia	:	A disease of blood with great increase in numbers of white blood corpuscles
Lumbago	:	Muscular pain in the lumbar region
Malaria	:	Chronic fever caused by protozoa, <i>Plasmodium</i> , an acute infectious epidemic disease
Measles	:	An acute viral infectious disease with fever and rash

Menorrhagia	:	Excessive menstrual flow
Menses	:	The monthly uterine bleeding of women
Migraine	:	A painful headache often accompanied by giddiness
Mumps	:	Virus infection which causes acute inflammation of parotid glands
Myopia	:	An optical defect of near vision which prevents a clear focus
Narcotics	:	Tends to paralyze nervous system, producing systemic stupor and death
Nausea	:	Causes sensation of sickness of stomach, which may or may not proceed to emesis
Nervine	:	An agent that increases nerve strength
Nerualgia	:	Sudden severe pains radiating along the course of a nerve
Nerve sedative	:	Allays nervous excitement
Nerve stimulant	:	Increases nervous excitement and irritability (stimulates the nerves)
Neuropathy	:	Diseases related to CNS (central nervous system)
Neurotic	:	A drug acts on central nervous system
Nutrient(Nutritive)	:	Medicines included in tonic and stimulant
Odontralgics/Odontic	:	Relieves or reduces severity of toothache
Oedima	:	Inflammation
Ophthalmic	:	Pertaining to eye diseases like conjunctivitis
Opiate	:	Promotes sleep
Ophthalmia	:	Severe inflammation of the conjunctiva of the eye
Orchitis	:	Inflammation of testis with hypertrophy and pain
Orthopedic	:	Relates to the correction of physical deformities
Ocytotic	:	A drug increases expulsive power of uterus and aids in childbirth by stimulation of uterine contractions
Pactoral	:	Useful in diseases of respiratory tract
Panacea	:	It claimed to cure all or many diseases
Paralysis	:	Loss of the power of motion, sensation or function of any part of the body
Paraplegia	:	Paralysis, loss of ability to move or feel in the lower part of body
Parasiticide	:	Destroys parasites
Parturient	:	Parturifacient- Aids in child birth by inducing or accelerating labour

Peptic ulcer	:	Ulceration in stomach or duodenum due to hyper acidity
Phlegm	:	Mucous secretion in respiratory track
Phthisis	:	Pulmonary tuberculosis
Piles	:	Enlarged or dilated blood vessels or veins in swollen tissues of the anal canal
Pneumonia	:	Inflammation of the lungs, resulting the lungs becoming solid
Post-natal	:	After child birth
Prophylactic	:	Prevents diseases (Quinine)
Pruritus	:	Skin itching
Ptalagogue	:	Silagogue
Pulmonary	:	Pertaining to lungs
Pulmonary-sedative	:	A drug which reduces coughing by relieving irritation
Pungent	:	Agent has a sharp and acrid taste
Purgative	:	Loosening stool to help exersion, thus curing Constipation
Pustulants	:	Produces pustules (pus containing lesions) usually for purposes of counter-irritation
Pyorrhoea	:	A purulent discharge from gums
Rabies	:	A fatal virus disease passed on to man by the bite of infected animal
Refrigerant	:	Cooling effect
Rejuvenative	:	Antiageing, prolonging life
Relaxant	:	Reduces tension or strain of tissue, organ, system
Remittent fever	:	A fever which has the daily variation of 2°F but never falls to normal
Renal depressant	:	Decreases or suspends flow of urine by reducing kidney action
Resolvant	:	Causing resolution of a tumor or swelling
Respiratorysedative	:	Respiratory depressant- Decreases force or slows rate of respiration
Respiratorystimulant	:	Increases or accelerates force or frequency of respiration
Restorative	:	Resumptive- Renews strength and vigour
Revulsant/Revulsive	:	Acts as a derivative or counter-irritant, when applied locally
Rheumatism	:	A general term used for disease of muscle, joint, bone resulting in discomfort
Rickets	:	A vitamin-D deficiency disease of bones of children, marked by faulty ossification

Ringworm	:	A contagious disease produced by fungi that affects skin, hair or nails
Rubifacient	:	Producing counter effect on external application
Scabies	:	A contagious disease of skin caused by the mite <i>Sarcoptes scabi</i>
Sciatica	:	Neuralgic pain along the course of sciatic nerve
Sclerosis	:	Hardening of soft tissue resulting from overgrowth of fibrous tissues
Scrofula	:	Tubercular cervical adenitis, with or without ulceration
Scurvy	:	A vitamin-C deficiency disease, causing extreme weakness and spongy gums
Sedative	:	Central nervous system depressant in which a person is made calm or asleep
Sialagogue	:	Increases salivation by stimulating secretion and flow of saliva
Simple Purgative	:	Causes active purgation without inflammation or depression
Small pox	:	An eruptive contagious disease marked by chills, high fever, and headache
Somnifacient	:	Hypnotic; which produces sleep without delirium
Soporific	:	Drug that induces sleep
Sorbefacient	:	Produces or aids or promotes or facilitates absorption of exudates
Spasmodic	:	Pertaining to spasms
Specific	:	Has direct curative or prophylactic influence on certain individual diseases
Sprain	:	To wrench or tear a ligament or muscle of a joint without dislocating joint or fracture of the bones
Sternutatory	:	Errhine; which causes sneezing
Stimulant	:	Increases or augments normal functional activity or specific portions of body; as intestinal, cardiac and respiratory
Stomachic	:	A drug used for improving digestion
Styptic	:	Blood purifier
Sudorific/Diaphoretic	:	Induces profuse sweating
Synergist	:	Aids the action of another drug in one way or another
Syphilis	:	A venereal disease caused by <i>Treponema pallidum</i>
Taeniicide	:	Drug that kills tapeworms
Tetanus	:	An infectious disease caused by the <i>Bacillus clostridium tetani</i>
Thermogenic	:	Producing heat offer metabolism

Thrombosis	:	A blockage preventing the flow of blood in the body caused by clot
Tonic	:	Improves or increase general bodily tone and vitality; restoring strength and energy
Tonsillitis	:	Inflammation of the tonsils
Tranquilizer	:	A drug used to calm a person and reduce mental activity
Tuberculosis	:	An infectious disease caused by the <i>Tuberculi bacillus</i>
Tumor	:	An abnormal swelling of the body
Tympanitis	:	Swelling in tympanum
Typhoid	:	Infectious disease caused by bacteria, it causes fever and intestinal disorders
Ulcer	:	Any open sore other than a wound
Urticaria	:	Nettle rashes on skin
Uterine sedative	:	Reduces hypermotility of uterus, hence prevents or tends to prevent miscarriage
Vaso-constrictor	:	Medicine that causes diminution or constriction of lumen of small blood vessels
Vaso-dilators	:	Produces dilatation of the peripheral vessels, and the arterioles, lowers the blood pressure, and thus relieves the heart, increase circulation and equalize blood pressure; used to relieve internal congestion
Venereal	:	Sexual diseases
Vermicide	:	Agent the kills intestinal worms
Vermifuge	:	Expelling or destroying intestinal worms
Vertigo	:	Dizziness, a feeling of spinning
Vesicant	:	Irritates skin sufficiently to cause watery blisters or vesicles to form
Vulnerary	:	A healing agent for wounds
Whooping cough	:	Cough with a peculiar whooping sound
Zomotherapy	:	Involves treatment of disease by administration of raw meat diet, muscle plasma, meat juice <i>etc.</i>

Traceability of raw materials to their source is one of the biggest quality concerns impacting herbal products. This coupled with the need for reducing pressure on wild sources of medicinal plants, has prompted the need for cultivation of medicinal plants outside wild habitats. The first step for this to become a reality on a big scale, is to develop and disseminate suitable agricultural practices for each species which currently is a big gap.

The present publication is an attempt to bridge this gap as it lays down agro-techniques for 32 important species. The work is a result of painstaking efforts of scientists from various R&D institutions and universities who have dedicated their time and effort towards standardizing these techniques.

It is hoped that farmers, students, teachers, R&D institutions and the general public will find this publication useful.



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