



सत्यमेव जयते

Agro - Techniques of Selected Medicinal Plants

Volume III



NATIONAL MEDICINAL PLANTS BOARD

Ministry of AYUSH, Government of India

Agro - techniques of Selected Medicinal Plants

Volume III



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Ministry of AYUSH, Government of India
AYUSH Bhawan, B-Block, 3rd Floor, G.P.O. Complex, I.N.A.,
New Delhi – 110023

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CONTENTS

I.	Message	v
ii.	Forward	vii
iii.	Acknowledgement	ix
iv.	Abbreviations	xii
v.	Introduction	xiv
1.	<i>Asparagus adscendens</i> Roxb.	1
2.	<i>Boswellia serrata</i> Roxb.	4
3.	<i>Callicarpa macrophylla</i> Vahl.	7
4.	<i>Coscinium fenestratum</i> (Gaertn.) Colebr.	10
5.	<i>Crataegus oxyacantha</i> Linn.	13
6.	<i>Dactylorhiza hatagirea</i> (D. Don) Soo.	18
7.	<i>Elaeocarpus sphaericus</i> (Gaertn.) K. Schum	22
8.	<i>Gmelina arborea</i> Roxb.	27
9.	<i>Juniperus communis</i> Linn.	32
10.	<i>Lycopodium clavatum</i> Linn.	35
11.	<i>Mesua ferrea</i> Linn.	40
12.	<i>Pistacia integerrima</i> Stew. Ex Brandis	43
13.	<i>Podophyllum hexandrum</i> Royle	46
14.	<i>Prosopis cineraria</i> (Linn.) Druce	49
15.	<i>Prunus cerasoides</i> D. Don	52
16.	<i>Pueraria tuberosa</i> (Roxb. ex Willd) DC.	56

CONTENTS

17.	<i>Sarcostemma acidum</i> (Roxb) Voigt	59
18.	<i>Semecarpus anacardium</i> Linn. f.	61
19.	<i>Sphaeranthus indicus</i> Linn.	64
20.	<i>Streblus asper</i> Lour.	66
21.	<i>Stereospermum colais</i> (Dillw.) Mabb.	69
22.	<i>Vateria indica</i> Linn.	72

Glossary

Glossary of Botanical Terms	75
Glossary of Medical Terms	84



सत्यमेव जयते

श्रीपाद नाईक
SHRIPAD NAIK

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आयुर्वेद, योग व प्राकृतिक चिकित्सा, यूनानी, सिद्ध एवं
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भारत सरकार

MINISTER OF STATE (INDEPENDENT CHARGE) FOR
AYURVEDA, YOGA & NATUROPATHY
UNANI, SIDDHA AND HOMOEOPATHY (AYUSH)
AND MINISTER OF STATE FOR HEALTH & FAMILY WELFARE
GOVERNMENT OF INDIA

22nd February 2016/345


MESSAGE

It gives me immense pleasure to make available the 3rd volume of Agro-techniques of selected medicinal plant species published by National Medicinal Plants Board to all stakeholders in the field of medicinal plants particularly farmers and cultivators.

Medicinal plants are now gaining importance among the people to use in drug preparations for its effective curative power for various ailments. There is a global awakening about its potential in controlling and eradicating communicable diseases, malnutrition as well as life-style related disorders of body and mind.

India has rich diversity of medicinal plants (MPs) resources. The natural resources are gradually getting depleted due to various developmental activities in its habitats. At the same time the demand for raw materials from flourishing ASU (Ayurveda, Siddha, Unani) industries is on the rise. To conserve the diversity in the wild as well as to supply quality raw materials in required quantity to the ever growing need of industries, the cultivation of MPs species are of prime importance. Therefore, the 3rd volume of Agro-techniques describing various stages of cultivation will definitely give farmers an opportunity for crop diversification and an alternative option for livelihood.

I deeply appreciate the much needed efforts of the NMPB to bring out the publication for welfare of the community at large.


(Shripad Naik)



सत्यमेव जयते

अजीत मोहन शरण
AJIT M. SHARAN

सचिव

भारत सरकार

आयुर्वेद, योग व प्राकृतिक चिकित्सा
यूनानी, सिद्ध एवं होम्योपैथी (आयुष) मंत्रालय
आयुष भवन, 'बी' ब्लॉक, जी.पी.ओ. कॉम्प्लेक्स,
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FOREWORD

Health seeking behaviour is changing across the globe as more and more people are seeking remedies through medicinal plant based traditional systems of medicines. We in India have rich heritage of plant based healthcare systems e.g. Ayurveda, Unani, Siddha etc. with a very high degree of social acceptance. Though forests continue to be the main source of these plants, used in manufacture of medicines of Ayurveda, Siddha and Unani (ASU) systems, the unsustainable collection from the wild not only pushes many species towards the risk of extinction, but also affects the quality and safety of plant based medicines. Therefore, the National Medicinal Plants Board (NMPB) has been mandated *inter-alia* the promotion of cultivation of medicinal plants. The cultivation can also ensure production of raw-material of standardized content and quality, thereby enhancing the quality of the ASU medicines.

2. According to a study, conducted by NMPB, about 6000 plants are used in the folk and documented systems of medicine in India. However, less than 50 species of medicinal plants are cultivated to any sizeable extent. Non-availability of agro-techniques is one of the main constraints in popularizing cultivation of medicinal plants. Therefore, developments of agro-techniques of medicinal plants are at the centre stage for development of medicinal plants sector in India. NMPB has already published agro-techniques of 50 Medicinal Plant Species in the Volume I and 32 Species in the Volume II of "Agro-techniques of Selected Medicinal Plants". Moreover, the present Volume III of agro-techniques compiled by NMPB contains information about 22 Medicinal Plant species. The present work on agro-techniques, developed through various universities and R&D institutions, will go a long way in disseminating scientific information to the farmers and other stakeholders who are keen to take up cultivation of medicinal plants.

3. I hope that this book will fill this critical void in the programme for promoting cultivation of medicinal plants. I am confident that these agro-techniques, once disseminated and adopted, will go a long way in improving the quality of the products that we manufacture and thereby help in improving health of people. This will also contribute in the acceptance of Indian Systems of Medicines within and outside the country.

4. The formulation, implementation and monitoring of the programme and its outcome in the form of this book are the result of untiring efforts of officers and staff of National Medicinal Plants Board. I would like to compliment them for their initiative, particularly because the cultivation of medicinal plants would get much needed boost through these agro-techniques.

(Ajit M. Sharan)

NEW DELHI
19.02.2016

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Acknowledgement

Cultivation of medicinal plants offers opportunities for crop diversification and income generation to the farmers. However, development of sound agro-techniques for plants that have traditionally been collected from forests has been a major challenge in promoting 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, the Department of AYUSH decided to support studies for development of agro-techniques under the 'Central sector scheme for development of agro-techniques and cultivation of medicinal plants', specifically for those plants that are used in AYUSH systems of medicine.

Projects were, therefore, allocated to develop agro technologies for 115 allocated plants to 33 esteemed organizations consisting of agriculture/horticulture universities and the R&D institutions of CSIR (Council of Scientific and Industrial Research), ICAR (Indian Council of Agricultural Research), and ICFRE (Indian Council of Forestry Research and Education), which had necessary infrastructure and expertise to undertake studies. Under the scheme the organizations were required to undertake experimental cultivation of allocated plants, specifically for development of agro-techniques through projects that were normally executed for three to four years. Performance and progress of these projects were monitored by the PEC (Project Evaluation Committee) set up by the Department.

Out of 115 allocated plants, 50 medicinal plants were published as 1st Volume of "Agro-techniques for selected medicinal plants" and 32 medicinal plants have been published as its 2nd Volume. Agro-techniques of medicinal plants selected for Volume-IIIrd is based on the reports & results received from different organizations/institutions. NMPB's attempt for development of Agro-techniques is considered foremost step towards promoting medicinal plants' cultivation through standardized Agro-techniques and thereby to make available to the industries raw material of quality. This would not have been possible without the efforts of Principal Investigators (PIs) and Project Staffs in respective organizations that were assigned the projects for development of Agro-techniques. This publication is primarily based

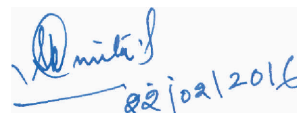


on reports provided by the Project Investigators from allocated organizations. National Medicinal Plants Board immensely acknowledges valuable contribution of all the PIs, Co-PIs and their organizations for their sincere efforts. Some information on plants regarding their morphological/ taxonomical/ therapeutical characters and chemical constituents have also been adopted from the published literature, formularies/pharmacopeias (API, HPI, UPI, IP, Wealth of India) *etc.*

The agro-technique developed by a particular Institution located in a particular geographical area is the outcome of its best efforts. The findings cited therefore are only indicative and most suited for the agro-climatic conditions of locations where studies were conducted. Thus anyone seeking to enter into cultivation as a commercial activity is advised to consult R&D institution/university located in the region where cultivation is sought to be done. NMPB has supported for setting up 23 Facilitation Centres for medicinal plants in different states, which may also be approached for seeking guidance for agro-techniques for a particular agro-climatic region.

The work allocated under the agro-techniques projects were guided and evaluated by the Project Evaluation Committee (PEC) consisting of members Dr. Rajender Gupta (Retd. Agricultural Scientist of NBPGR) and Dr. Mayaram Unniyal, Ayurvedic Expert, Govt. of Uttarakhand, Dehradun. Their contribution is duly acknowledged. NMPB is also grateful to Dr. S.K. Pareek and Dr. Rajender Gupta, who tirelessly went through the draft and gave their valuable technical inputs. Initial editing of the text and preparation of final document for publication in a uniform pattern was a phenomenal assignment. Dr. V.K. Singh, Deputy Director, CCRUM, is responsible for the initial editing of this document. The present publication is product of an untiring efforts of Officers/Staff of NMPB, Ministry of AYUSH. In particular, contribution of Dr. R.B.S. Rawat, Sh B.S. Sajwan and Sh. Bala Prasad former CEOs, NMPB needs special mention. My sincere thanks goes to Sh. Jitendra Sharma, former CEO, NMPB and Joint Secretary, Ministry of AYUSH, Govt. of India, and ex-Dy. CEO, Smt. Meenakshi Negi, NMPB for their tremendous contributions to NMPB. I would particularly grateful to Deputy CEO, Smt. Padmapriya

Balakrishnan, NMPB for her sincere efforts in this publication. This publication would not have been possible without the active involvement and untiring efforts of Dr. Lalit Narayan, Deputy Director (Medicinal Plants), NMPB and Dr. Kavita Tyagi, Consultant (NAM). I would also like to thank Sh. Sunil Dutt, Research Officer (MPs/ Agro), Dr. M.S. Rawat, Research Officer (Botany) and Dr. Shahidul Khair , ARO (Phcg) for their sincere efforts and help received during the course of this publication. Contributions received at various level by Sh. T.U. Haqqi, former Assistant Adviser (Botany), Dr. Sanjiv Kumar, AD(Ay), Sh. Ashok Kumar, F&AO, Dr. N. Padmakumar, Research Officer (Botany), Dr. Dr. Pawan Kumar, Research Officer (CP), Dr. Kunal Sajwan, Research Officer (Chem.), Dr. Lalit Tiwari, SRA, Dr. Lily Mitra, Sr. Consultant (NAM),|Dr. Santosh Kumar, Consultant (JFMC), Sh. Fayaz Ahmad Tantray, consultant (Geonformatics) and all other Officers/Staff of NMPB and Department of AYUSH is gratefully acknowledged. The Board extends its gratitude to everyone who has been directly or indirectly involved in bringing out this publication.



(Shomita Biswas)
Chief Executive Officer

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 = 10 000 sqm.
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
P	Phosphorous
P ₂ O ₅	Phosphate
pH	Measure of acidity & alkalinity 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

Medicines are substances capable of regulating the normal flow and sequences of physiological process in any organism. It can be obtained from the nature around us i.e. plants, animals, minerals etc.

Saints and seers of ancient era had unleashed the potentiality of plant species as a major component to set rights the physical and mental disorders in human. The search for the finest remedy for all sorts of ailment starting from mental, physical and psychological syndrome was the result of their boundless passion, mission and pursuit for the larger welfare of mankind. They practiced and recorded their observations and preserved the wealth of knowledge for the posterity. The wisdom of remedy for common ailments had gradually been inherited through the generations and today that could be traced in many remote places as well as in tribal areas as an effective & reliable home remedy, in a few cases in its effectiveness even superior than that of best modern medical care. Acceptance of traditional system of treatment among the masses is not significant because of strong prevalence of modern system of medical treatment which provides fast and visible relief from the disease or symptoms.

The temptation and fascination of modern drugs are gradually on decline because of its incapability of restoring holistic health. People of the world has now turned its attention to the age old traditional methods of medication for holistic and complete health and rejuvenation leading to longevity.

Plants are the only major source bank down for finding solution for our afflictions and infirmities. As per a study that had been commissioned by NMB through FRLHT, there are around 7500 medicinal plants species exist in india. Of which 758 are normally traded and 178 are highly traded in quantity of more than 100MT. With the increasing awareness about Indian Medicine System and people finding no solution and enduring side effects in modern medicine system especially for communicable diseases, the demand for nature based drugs (ASU drugs) is increasing day by day and pushing the source material {Medicinal Plants (MPs)/



species} towards extinction.

If the supply chain is studied, more than 80% of MPs species by volume and variety are sourced from wild. The collection from wild is generally unsustainable leading to degradation of natural resources hence to have a sustained supply of quality raw material to meet the ever increasing demand of ASU drugs we need to bring these wild species under cultivation.

In an effort towards this NMPB has taken an initiative to develop agrotechnology of highly in demand species. With the help of various Research Organisations and Universities already for 82 medicinal plants species Agrotechnology has been published in Vol.I and Vol.II. At present vol III. which contains Agrotechnology for 22 species is being published to disseminate the knowledge of technology to interested stakeholders i.e. cultivators and farmers.

The agronomic package of practices would make aware of the stakeholders on points underlined below:

- Suitability of the region-climatic conditions
- Soil and land preparation
- Seed treatment and nursery techniques
- Spacing and lay-out in the planting site
- Cultivation practices
- Cultural practices
- Harvesting practices
- Post Harvest Management

The knowledge assimilated in this book will surely guide farmers to adopt package of practices in their farming to ensure quality and assured quantity production from unit area. It would also allow them a choice in diversification of crops, which serve as an alternative livelihood option. The purpose of assured supply of quality raw material to the ASU industries from arable land also ensure conservation of natural bio-resources in its habitat in the wild for generations to come.

Agro-techniques of Selected Medicinal Plants

Asparagus adscendens Roxb.

Ayurvedic name	Satavari
Unani name	Shaqgul Misri, Musli Siyah, Shaqaq-ul-Hindi
Hindi name	Pili Satawar
English name	Asparagus
Trade name	Pili Satawar
Parts used	Tuberous Roots

Fam : Asparagaceae



Asparagus adscendens in early stage

Morphological Characteristics

Asparagus adscendens is a sub erect or curved prickly shrub. It produces white tuberous roots. Stem is tall, sub erect, terete, smooth, white and much branched. Branchlets are ascending, ashy-white, grooved and angled. The angles are minutely scabrid. The spines are 1-2 cm long, stout and straight. The cladodes are in dense, slender, filiform & soft.

Floral Characteristics

Flowers are usually bisexual, small in many fid and inflorescence racemes. Pedicels are jointed above or up to the middle. Bracts are minute. Perianth segments are spreading. Ovules are many in each cell. Fruit is a globose pulpy berry.

Distribution

Plant is distributed in Punjab, Himachal Pradesh, Jammu and Kashmir, Uttar

Pradesh, Bihar, West Bengal, Orissa, Madhya Pradesh, Gujarat and Lower Himalayan hills up to an altitude of 2000 msl.

Climate and Soil

Asparagus grows best under sunny condition, but elongation occurs when day temperature during growing season ranges between 20-30°C and night temperature 15-22°C and humidity ranges between 70-80%. The plant can be grown in a wide range of soils, but it is most productive over deep well drained sandy-loam fertile soil containing pH ranges from 6.0-7.5. It appears less-vigorous and susceptible to root rot in poorly drained soils.

Propagation Material

Seeds proved to be the best planting material for raising under cultivation. Freshly collected seeds remain viable for four months. For raising nursery, the freshly collected seeds should be used.

Agro-techniques¹

Nursery Technique

- **Raising Propagules and Pretreatment:**

Broadcast the seeds on a well prepared nursery beds in the month of June when weather is dry and temperature is high (35°C). Seeds are treated with Bio fungicide before sowing to protect against fungal attack.

- **Propagule Rate and Optimum Spacing:**

The seedlings are to be transplanted at spacing of 0.6 m X 0.6m for raising a pure crop and 0.6m X 1.5m spacing in shallow soil for short duration. Herbaceous crops are planned to be raised in the intercropping pattern. Nearly 12,000 seedlings are required for planting in one hectare area as a pure crop.

Planting in the Field

- **Land Preparation and Manure Application:**

The crop remains in the field for 10 years, or more. The soil should be thoroughly prepared up to fine tilth by ploughing, hoeing and planking and made free from weeds. About 20 t of Farm Yard Manure (FYM)/ha is to be added as basal dose during land

preparation, mixed with thoroughly. A total of 4-5 harrowing is done followed by planking and layout.

- **Interculture and Maintenance Practices:**

NPK at 60:120:80 kg/ha be given as basal dose. The Nitrogen should be applied in two equal split doses, one in March and another after six months in September.

- **Irrigation Practices:**

The plant can tolerate drought up to a certain extent depending upon type of soils and atmospheric humidity. It should be irrigated once in a month except in rainy season. It requires about eight irrigations in a year.

- **Weed Control:**

This plant is affected adversely in presence of weed. A pre-emergence application of bio weedicide should be given before transplantation of seedlings in the field to control seasonal weeds. At least 2-3 manual weeding are required at an interval of one month during early growth stage; however, more weeding may be required during monsoon season from July to September.

- **Disease and Pest Control:**

In dried parts of western India, plants remain relatively free from pests and

¹Agro-technique study carried out by National Institute of Pharm. Education and Research, SAS Nagar, Mohali, Punjab.

diseases. But several fungal diseases affecting *Asparagus* like Asparagus rust, Fusarium root rot and Crown rot are reported. These are controlled by bio-pesticides.

Harvest Management

- **Crop Maturity and Harvesting:**

Flowering starts in October followed by fruiting in March. The plant attains full maturity after 3rd year of planting, but it starts bearing flowers and fruits after one year of planting. Crop is ready for harvesting after 3rd year of planting. Spears can be harvested in the last week of April annually after 3rd year of planting. The content of steroidal glycosides increases with the age of spears.

- **Post-harvest Management:**

Spears can be harvested from underground part without disturbing the aerial portion. Sun dried tubers can

be stored in clean gunny bags. Long storage be avoided as the storage can deteriorate the quality of the product.

- **Chemical Constituents:**

Asparosides A, B, C and D, Adscendosides A and B, Asparanins A, B, C, D and Adscendins A and B are the main chemical constituents isolated from tubers of *Asparagus adscendens*.

- **Yield:**

650 kg /ha in pure crop after 3rd year annually, in intercropping pattern 350-500 kg /ha as a dry matter.

Therapeutic Uses

Root is demulcent and used as tonic. It is also useful in diarrhoea, galactagogue, dysentery, and general debility. The tubers are rich in protein and specially credited with nutritive and aphrodisiac properties. It also increase sperm count.

Boswellia serrata Roxb.

Fam : Burseraceae

Ayurvedic name	Shallaki
Unani name	Kundur
Hindi name	Salai
English name	Indian Frankincense, Indian Olibanum
Trade name	Salai gugal
Parts used	Gum - oleoresin



Plant of *Boswellia serrata*

Morphological Characteristics

The plant is medium to large-sized tree deciduous and balsamiferous, upto 18 m in height and 2.4 m in girth. Bark is greenish grey, yellow or reddish, fairly thick, smooth, exfoliating in thin, papery flakes and resinous inside. Leaves are long up to 30-45 cm, opposite, sessile, variable in shape. The leaflets are 2.5-6.3 cm X 1.3-3.0 cm ovate-lanceolate.

Floral Characteristics

Flower is small, white, in auxiliary racemes or panicles. Petals are long and ovate. Fruit is trigonous, 12 mm long drupe, splitting along 3 valves.

Distribution

Tree is common at the foot of the Western Himalayas, Rajasthan, Gujarat, Maharashtra, Madhya Pradesh, Bihar, Orissa, Andhra Pradesh and also found in dry forests from all over North-West India

upto West Bengal and peninsular India.

Climate and Soil

It prefers dry, hot exposures of rocky hills, with 50-125 cm rainfall. Usually Plant is gregarious, comparatively in open forests. In central and peninsular India. It occupies the hotter slopes and ridges. In its natural habitat, the absolute maximum shade temperature varies from 38-49°C and the absolute minimum from 1 to 7°C and the normal rainfall ranges from 50-125 cm. Plant produces root-suckers, coppices and pollards. It can be grown in red, lateritic to rocky soils of dry deciduous forests and on dry sand stone ridges. It is also grown on drier ridges of metamorphic rocks and easily planted in shelter-belts, windbreaks and hedges too.

Planting Material

It is propagated by seeds as well as cutting. Seeds are germinated immediately after collection. The rate of germination was

found to be 25-30%. About two months old seedlings of 15-20 cm height is ready for planting in the field. A cutting of 1.0-2.0 cm thickness recorded 26% success but has poor survival in the field.

Agro-technique²

Nursery Technique

- **Raising Propagules and Transplanting:**

Seeds obtained during May-June from selected plus trees. Seeds are sown during July-August and about two months old seedlings are planted in the field at a spacing of 5m x 5m. Thus, about 400 plants per hectare are required for raising plantation.

Planting in the Field

- **Land Preparation and Manure**

Application:

Cross ploughing is done early in April followed by furrowing till a good tilth of soil is obtained and field is made free of weeds. Well decomposed Farm Yard Manure (FYM) is added @ 20 t/ha during land preparation. It should be spread well and thoroughly mixed the soil.

- **Intercropping System:**

During initial 5-6 years, crops like ginger, turmeric, aloe, pine apple etc. can be grown as catch crops in between the trees.

- **Irrigation Practices:**

Crop requires irrigation at 15 days interval during dry season beginning from December to June.

- **Weed Control:**

Hoing and weeding is done during first few years of growth.

- **Disease and Pest Control:**

No disease or pests or any other physiological disorder was observed in its cultivation. However, it would be advisable to dust pesticide against white-ants.

Harvest Management

- **Crop Maturity and Harvesting:**

Its flower occurs during January-April and seeds mature in May-June. Experimental cultivation recorded growth of 2.75 m in height in 3 years. It may require 8-10 years to get the bark and yield gum.

- **Post-harvest Management:**

Tapping for the oleoresin is done after

²Agro-technique study carried out by RRL, Bhubaneswar

plants reach a sizeable girth which is attained after 8 to 10 years.

- **Chemical Constituents:**

Boswellia oil is very similar to turpentine oil. The hydrolysis of the pure gum of *Boswellia serrata* yields mainly pentose (65% as arabinose) and small quantities of Galactose and Xylose. The gum also contains oxidizing and diastatic enzymes, and 3.03% of total nitrogen.

Therapeutic Uses

It has astringent & antiseptic properties and is useful in diarrhea, dysentery, piles, ulcers, tumor, skin diseases, and in genitourinary affections. The oleo-gum-resin contains α , β and γ boswellic acid having antitumor, analgesic and sedative properties. It contains marked anti-inflammatory and anti-arthritis activity. It

Callicarpa macrophylla Vahl.

Syn. *C. lanata* Linn.

Fam : Verbenaceae

Ayurvedic name	Priyangu, Priyaka
Unani name	Habb-ul-Mihlb
Hindi name	Dahiya
English name	Perfumed Cherry
Trade name	Dahiya & Sumali
Parts used	Leaves, fruits and roots



Callicarpa macrophylla

Morphological Characteristics

It is an erect bushy shrub, 2.0-2.5 m tall, branches virgate, usually shaggy as well as with tomentose tips. The leaves are 15-25 cm long and 5.0-7.0 cm broad, ovate-lanceolate, acuminate, base cuneate or rounded. The upper surface of leaf is wrinkled, glabrate when mature, white tomentose beneath with compound stellate hairs. The main lateral nerves are 12-16 pairs. Petiole is 0.5-1.2 cm long.

Floral Characteristics

Flowers appear in July-November are small, 0.5 cm long, pink in colour and crowded in axillary peduncled globose cymes, solitary, pedunculate or sessile. Flowers are bisexual, actinomorphic and fragrant. Calyx 4 or rarely 5 toothed, pubescent, corolla infundibular, 4 or rarely 5 lobed. Stamens are 4, exserted, anthers oblong 2 loculed, dorsifixed. Ovary is superior, 4 lobed, 4 loculed, 1 ovule in each locule, style short, stigma 2 lobed. Fruit is drupe and white

containing one seeded nutlets.

Distribution

The plant is distributed throughout North-Eastern India upto 1000 m msl

Climate and Soil

The plant grows in dry tropical forests including shaded places of ravines and scrub forests.

Propagation Material

The planting material is seed.

Agro-technique³

Nursery Technique

• Raising Propagules:

At the onset of monsoon from June-July, seeds are sown at the rate of 5-10 kg/ha. Germination is approximately 50%. Propagules are also raised through stem-cuttings. Row to row

³Agro-technique study carried out by NBPGR, Regional Station Bhowali, Uttaranchal

distance should be of 50 cm and plant to plant is 25 cm. Seeds germinate after 30-45 days and stem cuttings sprout after 8-10 days.

Planting in the Field

- **Land Preparation and Manure Application:**

The field should be ploughed two or three times to have the fine tilth to facilitate planting and sprouting of stem cuttings. FYM @ 20-25 t/ha is mixed with the soil. NPK at 40:20:10 kg/ha is given as basal dressing and equal quantity as a top dressing after establishment of plant population.

- **Intercropping:**

Crop can be raised as sole crop for commercial purpose and mixed crop with vegetable and other medicinal plants *i.e.* rosemary, garden sage etc.

- **Intercultural Operations:**

It is done after 30-45 days and second at 60-80 days.

- **Irrigation:**

It is a rainfed crop.

- **Weed Control:**

The initial growth of the crop may be hampered because of increased infestation of weeds. Therefore, weeding and hoeing should be done

whenever needed.

- **Disease and Pest Control:**

No visible symptoms of any pest and diseases have been recorded.

Harvest Management

- **Crop Maturity and Harvesting:**

Crop matures after 10 months. The mature fruits are plucked during second year in November-December. The yield increases subsequently compared to first year.

- **Post-harvest Management:**

After plucking of fruits, these are dried in shade and kept in air tight vessels.

- **Chemical Constituents:**

Leaves contain ursolic acid, oleanolic acid; bark contains methyl betulinate and baurenol. Heart wood contains oleanolic acid and B-sitosterol.

- **Yield:**

One hectare plantation gives yield of dried-fruits 630 kg and 1660-1680 kg of dry roots.

Therapeutic Uses

In Ayurvedic literature, Priyangu is described as cooling, refrigerant, deodorant and antipyretic, tones up the digestive system, checks excessive perspiration, disinfects intestines, controls

diarrhoea and allays burning sensation during fevers. Leaves are applied in

rheumatic joints. Oil from root is aromatic and stomachic.

Coscinium fenestratum (Gaertn.) Colebr.

Menispermum fenestratum Gaertn.

Fam : Menispermaceae

Ayurvedic name	Harichandan, Pitassara, Pitasandan
Unani name	-----
Hindi name	Jhar-haldi, Daruharidra
English name	False Calumba
Trade name	Pitchandan
Parts used	Wood, root



Fruits of *Coscinium fenestratum*

Morphological Characteristics

It is a climbing shrub. Young shoots are hairy-tomentose. Leaves are oblong deltoid, obscurely peltate, acuminate, glabrous above, hairy and reticulate beneath. Petiole is long. Plant is listed as endangered species in India

Floral Characteristics

It is a dioecious plant and comes to bloom from August to October. Flowers are green, borne in dense globose heads. Sepals are 6 in number with a bract, orbicular persistent. Petals are 3 in number, large, spreading and elliptic. Fruit is a drupe globose, villous and bony endocarp. Seed is globose.

Distribution

Plant is a native of India. It has also been reported in Vietnam. Within India, the species is restricted to the Western Ghats of Karnataka (Coorg, Udupi, Dakshin and

Uttar Kannada districts), Kerala (Thiruvananthapuram, Wynaad, Thrissur, Idukki and Palakkad) and Tamil Nadu (Kanyakumari, Tirunelveli and Nilgiri districts) up to an altitude of 1000 m msl. The species is seen confined to the semi-evergreen and wet evergreen forests.

Climate and Soil

This plant is an endemic species of Western Ghats, wherein it prefers rain forest climate and high humidity throughout with a temperature ranging from 15-25°C. Plant occurs in partial shade in humid location in association with many shrubs and large trees. The soil is acidic (pH of 5.2) with very high organic matter (2.3%) content.

Propagation Material

The planting material is seed.

Agro-technique⁴

Nursery Technique

- **Raising Propagules:**

The plant is propagated through seeds. Matured fruits occur in bunches from May to October. Fruit pulp could be removed by rubbing against rough surface. Black seeds may be soaked in 3000ppm GA for 20 hours to hasten germination up to 90%.

Seed should be immediately put for germination since they lose viability within two weeks. Seeds germinate very slowly, beginning after 4 months and may take even 8-10 months. Germination percentage of fresh seed is approx. 60%.

The plants from nursery bed are carefully shifted to polybags filled with mixture of sand, soil and FYM @ 2 kg/polybag. Plants are watered on alternate days and kept in shade in mist chamber. They are maintained for nearly 6-9 months and then shifted to main field after it has attained 60 cm in height.

Planting in the Field

- **Land Preparation and manure Application:**

Plant is raised over FYM. In all 20 kg FYM is applied in a pit and seedling is

planted over the manure and nurtured well by watering regularly. The plant is given a bamboo pole to support for better plant growth.

- **Transplanting and Optimum Spacing:**

Well-grown plants are planted with minimum disturbance in main field along with soil attached to the roots in poly bags. Plant to plant spacing is 2m X 2m. Care is taken to put plant underneath a shrub or tree having 50-60 percent shade for quick establishment of crop.

- **Irrigation Practices:**

Plant needs frequent irrigation and daily in summer months.

Harvest Management

- **Crop Maturity and Harvesting:**

Crop matures at about 15 years. The economic part is root. It is expected to give about 3-4 kg of fresh root/plant depending on the growth of plant and its environment.

- **Post-harvest Management:**

The root is dried in shade and stored in air-tight gunny bags.

- **Chemical Constituents:**

Roots contain alkaloids such as berlambine, dihydroberlambine and

⁴Agro-technique study carried out by Indian Institute of Horticulture Research, Hessaraghatta Lake Post, Bangalore-560089

noroxyhydrastinine, oxo-berberine, berberine, tetrahydro-berberine, cytosterol, stigmasterol and jatrorrhizine. Stem contains protoberberine alkaloids and jatrorrhizine.

- **Yield:**

The plant yields about 3-5 kg fresh root and reduced to half on drying. Thus, about 4 t dry roots can be expected from 2500 plants/ha.

Therapeutic Uses

Root of Harichandan is used in the form of powder and decoction to treat indigestion, flatulence, diseases of liver and fever. Decoction of bark is used in intermittent fevers.

Crataegus oxyacantha Linn.

Fam : Rosaceae

Hindi name	Bansangli
English name	European Hawthorn, Thornapple
Trade name	Hawthorn
Parts used	Fruit, leaf, and flowers



Plant of *Crataegus oxyacantha*

Morphological Characteristics

It is deciduous small tree growing up to nine m in ht. Branches are grayish and spine scent. Leaves are 3.0-3.5 cm long, broadly ovate or rhombic, cuneate at base, deeply and sharply cut to two-thirds their width, coarsely-toothed, pubescent or glabrescent beneath. Petioles are almost equal to blade.



Flowers of *Crataegus oxyacantha*

Floral Characteristics

- Flowers are 5.0-5.7 mm long, white,

terminal corymbose cymes. Calyx is woolly-hairy at base having 5-lobbed. Lobes are sub-acute. Petals are 5 in number and orbicular. Stamens are many. Carpels are adnate to the calyx tube, tips pubescent. Styles are 1 or 2 in number, slender and globose. Fruits are glabrous, scarlet red and fleshy.

Distribution

It is a temperate shrub or a small tree of forests, scrubs, foothills, wastelands *etc.* of north-west Himalaya from Indus to Ravi, at an altitude of 2000-3000 m msl.

Climate and Soil

It prefers sandy clay-loam soil and sub-humid, temperate climate. It can grow well in low rainfall areas.

Propagation Material

Planting material is seed. It has two years dormancy. Seed germination is difficult

and time consuming. Therefore vegetative propagation by stem cutting is preferred for raising saplings of *C. oxyacantha*. Further, vegetatively propagated plants produce better growth than that of raised from seeds.

Agro-technique⁵

Nursery Technique



Rooted stem cutting of *Crataegus oxyacantha*

- **Raising Propagules:** Appropriate time to collect its seeds is September, when the fruits are just ripe on tree. Rate of success in raising plants from seed by deploying different scarification and stratification treatments is not satisfactory (less than 20%). Hence, vegetative propagation is more effective. Stem-cuttings of 2-8 mm diameter are raised in nursery

during May should be planted at 10cm X 10cm spacing. Soil mixed with equal quantity of sand is more suitable for raising its nursery. Stem cutting be given treatment with Indole Butyric Acid (IBA) at 4000 ppm for promoting callus. Shoot-cutting derived from the plant acclimatise in vicinity, so that the success in rooting is around 60%. Normally, the stem-cuttings take 70-90 days for rooting. The rooted stem-cuttings should be hardened at least for 2 months before transplanting in field.



Sprouting kernels of *Crataegus oxyacantha*

- **Propagule Rate and Pre-treatment:** 2,500 saplings/ha are required for plantation.

⁵Agro-technique study carried out by Institute of Himalayan Bioresource Technology (Council of Scientific and Industrial

Planting in the Field

- **Land Preparation and Manure Application:**

Primary tillage of entire field is not necessary for this crop. Only planting spots marked at desired spacing should be cleaned and pits of 45cm X 45cm X 45cm dimension should be dug out at a distance of 2m X 2m in the field, which is filled with equal proportion of soil and sand. July-August is the suitable period for planting of rooted stem-cuttings in field. The saplings should be planted at the centre of pits and the soil should be gently compressed after planting. The transplants should be given light irrigation after the planting. Farm Yard Manure (FYM) @ 15 t/ha should be applied as basal dose at the time of transplanting in field. In subsequent years, FYM should be applied @ 22.5 t/ha at the time of bud-break, after winter dormancy i.e. March-April.

- **Transplanting and Optimum Spacing:**

Rooted stem-cuttings, after proper hardening in nursery, can be directly planted in main field. Plant spacing of 2m x 2m is optimum in terms of vertical growth of the tree and yield of fruit.

- **Irrigation Practices:**

Irrigation at weekly interval is

essential for about a month, during dry period after transplanting.

- **Weed Control:**

Two hand-weeding at monthly interval during July to September provides effective weed control in the initial 2-3 years of the plantation.

- **Disease and Pest Control:**

Disease or insect-pest has not been observed in this crop.

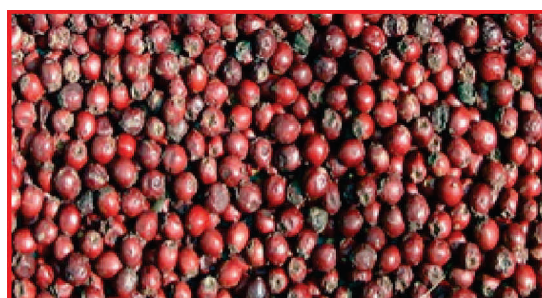
Harvest Management

- **Crop Maturity and Harvesting:**

C. oxyacantha comes to bearing after 5-6 years from planting in the field. Flowering and fruiting occur during April-May and fruits ripen during July-August. Fruits are harvested when it is fully ripe.

- **Post-harvest Management:**

Fruits should be dried under shade and stored at room temperature in a dry place.



Ripe fruits of *Crataegus*



Mature fruit of *Crataegus oxyacantha*

- **Chemical Constituents:**

Plant contains total flavonoid content in leaf, flower, fruit, pulp and bark range from 0.48 to 1.65% and total phenolic content vary from 3.31 to 5.46%. The flavonoid content is maximum in leaf while phenolic content is maximum in bark. The antioxidant potential (percent inhibition of DPPH free radical by 1 mg/ml of plant material) was maximum in bark (81.5%) followed by flower, leaf, pulp and fruit (14%).

It also contains saponins, glycosides, flavonoids, ascorbic acid, condensed tannins and amines. The therapeutic properties of *C. oxyacantha* are attributed to the flavonoids, triterpenic acids and biogenic amines in it. Its

flower yields positive inotropic amines viz, phenethylamine, o-methoxyphenethyl - amine and tyramine. Active principles also include pocyandins and alkylamines.

- **Yield:**

Production of fresh fruits after nine years after planting is about 600 kg/ha.

Therapeutic Uses

Traditionally, fruit is used as home remedy for arteriosclerosis, hypertension, and sore throat in folk medicine. It is considered useful in congestive heart failure, coronary circulation problems, angina, and arrhythmias. It is used to increase cardiac output reduced by pulmonary disease and to treat hypo- and hyper-tension, atherosclerosis, hyperlipidemia, and Buerger's disease. It is also used as a sedative, anxiolytic, antispasmodic, astringent, and diuretic. Hawthorn preparations are used as a wash for sores, itching, and frost-bite. Fresh fruit is effective in treatment of cardiac disorders of nervine origin. Extract of *C. oxyacantha* shoot possesses strong negative chronotropic, positive inotropic and coronary dilatory effects. Leaf is used to treat hypertension. *C. oxyacantha* also possesses antioxidant properties. Phenolic extract of its flower has antioxidative properties.



Seeds of *Crataegus oxyacantha*



Kernels of *Crataegus oxyacantha*

Dactylorhiza hatagirea (D. Don) Soo

Syn. *Orchis latifolia* var. *indica* Lindl.

Fam : Orchidaceae

Ayurvedic name	Salampunja
Unani name	Buzidan, Salab Misri
Hindi name	Salampanja
English name	Himalayan Marsh Orchid
Trade name	Salampanja
Parts used	Tubers, roots



Dactylorhiza hatagirea

Morphological Characteristics

Plant is terrestrial glabrous herb attains height of 20-25 cm. Tubers slightly flattened, palmately divided into 3-5, finger like lobes. Flower stalk upto 90 cm Long, erect, hollow, leafy throughout or the lower portion bear few sheathing scales. Leaves are 4-6, cauline, leaf blade oblong to linear-lanceolate, 8.0-15.0cm x 1.5-3.0 cm in size, base sheathing, apex obtuse or acuminate.

Floral Characteristics

Inflorescence is raceme, 5.0-15.0 cm long, crowded with many flowers. Flowers are purple and the bracts green, narrowly lance-shaped, lower bract longer than the flowers, upper slightly shorter. Flowers are about 1.8 cm long, including the curved spur. Sepals and petals are nearly equal. Three of them form a hood and the two sides spread outwards. The lip is rounded and shallowly 3-lobed, spotted dark purple. Spur straight,

cylindrical, nearly as long as the ovary; column very short; anther adnate to its face, cells diverging; pollinia 2, caudicles attached to 2 small globose, viscid glands enclosed in a minute pouch overhanging the broad, 2-lobed stigma.

Distribution

This attractive terrestrial orchid grows in damp pastures of Himalayas from Kashmir to Nepal at the altitude of 2500-5000 m msl.

Climate and Soil

Plants grow in the alpine climate of Central and Western Himalayas where average summer temperature ranges between 15-18°C and winters are very harsh generally below the freezing point. Plants grow best in moist meadow soils. These soils are usually dark grey, granular, sandy loam, micaceous sandy soils at greater depth.

Propagation Material

The materials for propagation are seeds and tuber cuttings. Plants can be grown by splitting the sprouting tubers. Collected seeds did not show germination at controlled temperature and moisture (temp. 10-15°C; humidity 90+5%) conditions. It probably requires thawing under the snow for about 4-5 months and mycorrhizal association for germination. It is reported to be an inherently slow-growing and poorly regenerating species because of pollinator specificity.

Agro-technique⁶

Nursery Propagules



Acclimatization of collected saplings in the glass house

- **Raising Propagules:**

Vegetative propagation through tuber cutting is quite successful in this plant. Small slices of tuber of 4.0 mm size, with meristematic tissues are reported to develop plantlets when transplanted

⁶Agro-technique study carried out by Institute of Himalayan Bioresource Technology (Council of Scientific and Industrial

at 5.0cm -7.0cm depth at a spacing of 15cm X 15cm. Plant raised from tuber cutting develops tubers and roots after one year and it becomes about 4. 0-8.0 cm tall.

- **Propagule Rate and Pretreatment:**

Multiplication through seeds is very low and no fruitful results have been obtained so far. In natural habitat, seed germination was found to be between 20 to 30%. Seed sowing in soil collected from its natural habitat at lower altitudes gives better results. Collection of immature and fresh seeds from nature enhanced germination percentage. Approximately 1,11,150 tubers or tuber segments are required for one hectare of land and are transplanted at spacing of 30 cm apart.

- **Land Preparation and Manure Application:**

Land should be ploughed and cross ploughed to have a fine tilth. The field should be well prepared and made free from weeds before transplanting. Livestock manure and forest litter treatment increase survival, growth and yield. Approximately 5 t manure is required for one hectare of land. Manure requirement increases at lower altitudes and at 1800-2000 m approximately 10.0 - 15.0 t/ha manure

is required depending upon soil fertility.

- **Transplanting and Optimum Spacing:**

Small slices of tuber of 4.0 mm size with meristematic tissues are reported to develop plantlets when transplanted at 5.0 -7.0 cm depth at spacing of 15cm X 15cm.

- **Intercropping System:**

Intercropping with *A. heterophyllum* Wall. ex Royle is found suitable because of similar edaphic conditions for good growth and yield. Intercropping with *Swertia chirayita* Roxb. ex Fleming is also recommended for subsidiary income from the cultivation of medicinal plants.

- **Intercultural and Maintenance Practices:**

Frequent weeding at every seven to ten days especially during the rainy season favour optimal growth.

- **Irrigation Practices:**

At the early stage, 80-90% humidity is required for plant development of rooting and leaf initiation. Irrigation at every twelve hours is needed, especially at lower altitude during this stage.

- **Crop Maturity and Harvesting:**

Tubers are usually harvested after five years to fetch a good yield. Sometimes it is harvested after two or three years of

transplantation. Tubers should be collected after seed maturity at late September.

- **Post-harvest Management:**

Old tubers are separated from young and then steeped in hot water for one hour. Outer membranes of tubers are removed through this process, and tubers turn light yellow in colour. These are sun dried and can be preserved for a long time. In Garhwal, tubers are boiled with buffalo milk before drying in the sun, which is considered to keep its contents active for long time.

- **Chemical Constituents:**

Tubers contain 45% mucilage, 2.7% starch, 1% sugar, 2% phosphate and chloride. Tubers also contain glucoside-loroglossin.

- **Yield:**

Its approximate yield is 1.8 t/ha in natural conditions. Under greenhouse and cultivated conditions, productivity may increase up to 1.8-2.0 t/ha if appropriate techniques are used.

Therapeutic Uses

It is used as a farinaceous food, nervine tonic, used as an aphrodisiac, and in diarrhoea, dysentery, chronic fever and in

leucorrhoea. It is also considered a very good tonic, especially for women after delivery, with suitable drugs in liquid form.

The tubers are used as food, nervine tonic and aphrodisiac.

Elaeocarpus sphaericus (Gaertn.) K. Schum

Syn. E. ganitrus Roxb.

Fam : Elaeocarpaceae

Ayurvedic name	Rudraksha
Unani name	-----
Hindi name	Rudraki
English name	Utrasum Bead tree
Trade name	Rudraksh
Parts used	Fruit, seeds



Plant of *Elaeocarpus sphaericus*

Morphological Characteristics

An evergreen medium sized tree, up to 15 meter tall. The main trunk is cylindrical and circular. Bark is grayish -white and rough in texture with small vertical lenticels and narrow horizontal furrows. Leaves are shining green above and dull coriaceous below. These are simple, alternate, 10-15cm long and 2.0-5.0cm broad, oblong-lanceolate, apex acuminate, margins serrulate, nearly glabrous. Old leaves become red in colour.

Floral Characteristics

Flower are hermaphrodite, white, tinted purple in bud, upto 1.25cm in diameter, fragrant borne in axillary pendulous racemes arising mostly from the axils of old leaves. Fruits are drupe, deep or bluish purple, globose or ovoid (1.5-2.5cm in diameter) enclosing a hard, longitudinally grooved and tubercled seed that is commonly called as stone or bead. Fruits are kept in water for many days then stones

are taken out after peeling off the pulp. It is then cleaned, polished or stained and used as rosaries or malas. The sculpturing of the bead surface is associated with the locules of the ovary. Normally there are five locules but few or more locules may also occur. Almost 99% beads are five loculed and are called as panch mukhi. Abnormal or freak beads may possess 1-8 locules, which are much valued because of belief that it possesses magical property and fetch higher price.

Distribution

Tree is mostly distributed in the islands of South East Asia, Indonesia and Myanmar. The plant has restricted distribution in India and due to much demand and over exploitations; the trees have become rare in nature. The plant is confined to North-eastern regions particularly in Assam and adjoining state of Arunachal Pradesh. However, some trees are reported to occur in Bihar, Bengal, Madhya Pradesh,

Maharashtra and Uttarakhand. The plant is also grown in some gardens as ornamental tree and those have been adapted to follow the normal life cycle of the plant.

Climate and Soil

Plant grows well in tropical humid climate. It also grows in different types of soils particularly in alluvial, laterite, red and black soils containing sufficient organic matter. However, it has been observed that in the hot conditions of sub-tropics, the plants do not produce fruits.

Propagation Material



Seeds

Plants can be propagated both by seeds and air layering. However, air layering / mossing method was very successful and several small plants were produced through this method. In nature *E. sphaericus* plants reported to regenerate from seeds. Seeds improve germination

after soaking in sulfuric acid for 15 minutes and then washed in lukewarm water for nearly 24 hours.

Agro-technique⁷

Nursery Technique

- **Raising Propagules:**



Air layered Saplings

Propagation of plant by air layering was found to be most successful method for raising plants. Air layering is usually done during the onset of rainy season and these rooted branches become ready during late rainy season for planting in the field.

- **Propagule Rate and Pretreatment:**

Since *E. sphaericus* is a tree, saplings obtained through air layering should be planted in pits at a distance of 5m X 5m in field. Thus, about 380 plants are needed for planting in a ha of land.

⁷Agro-technique study carried out by (a) Central Institute of Medicinal & Aromatic Plants (CIMAP), Lucknow, (b) Indian Council

Planting in the Field.

- **Land Preparation and Manure Application:**

Before putting the saplings developed through air layering in the field, the land should be levelled and made free of weeds. Saplings are planted in pits at a distance of 5m X 5m and the pits are filled with well decomposed Farm Yard Manure or vermi-compost.



Saplings raised from cutting

- **Transplanting and Optimum Spacing:**

Saplings obtained from air layering should be planted in pits at sufficient depth with a distance of 5 m from all sides to avoid falling of large tree by wind due to absence of tap root. Where sufficient land is not available for planting trees, saplings may also be planted along the boundaries, fences or road sides in the gardens or orchards at the distance of 5m from each other.

- **Intercropping System:**

E. sphaericus is a medium sized tree and there is ample space below the trees. It allows the growth of herbaceous medicinal plants both annual and perennial as catch crop or intercrop.

- **Interculture and Maintenance Practices:**

The fields should be kept free from weeds.

- **Irrigation Practices:**

Watering should be done regularly during the first month for the establishment of the plants. Thereafter, watering should be done depending upon the weather conditions. After one year, plants do not require regular watering.

- **Disease and Pest Control:**

At the sub-tropical conditions *E. ganitrus* plants generally do not show any disease, insect or nematode attack.

Harvest Management

- **Crop Maturity and Harvesting:**

Plants take about five years to bear flower after planting. In its natural environment, it flowers during summers *i.e.* in May and June. The fruits ripen in November - December.

- **Post-harvest Management:**

Stony seeds of Rudraksh are used as beads for rosaries and necklace. For separating seeds, fruits are kept in water for few days. Then fruit pulps are removed and seeds are taken out. Cleaned seeds are dried and boiled in oil and polished. This protects the seeds / beads from spoiling.

- **Chemical Constituents:**

Fruits contain alkaloids, glycosides, steroids, flavonoides and fatty acids. The main alkaloids are rudrakin and cucurbitacin. Leaves contain quercetin, gallic and ellagic acids, (\pm) elaeocarpine, (\pm) iso-elaecarpine and rudrakine.

- **Yield:**

5 year old plants gives an yield of 5-7 kg fresh fruits per plant (0.7-1.0 kg dry seed per plant). At 10 years and above, trees give yield of 15-25 kg fresh fruits per plant 2-3.5 kg dry seeds per plant. Estimated yield from 10 years old tree is 10 t/ha fresh fruits.

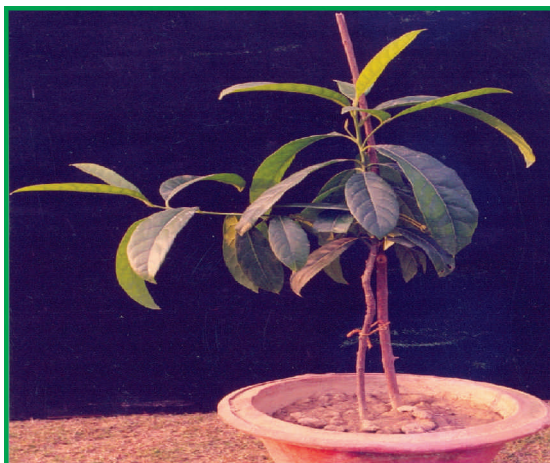
Therapeutic Uses

Fruits have properties such as sedative, hypnotic, tranquillizing, anti-convulsive, anti-epileptic and anti-hypertensive properties, used in the treatment of epilepsy and heart problems. Fruits also show significant anti-inflammatory, analgesic

activities and protection against bronchospasm. It is mentioned in ancient literature that the beads of Rudraksh have amazing powers to relieve people from stress, pain and sufferings and provide tranquility.



Air-layering



Sapling obtained from air layering



Young plant in the field,



Three year old tree



Six year old tree



Close-up of the flowering branch



Fruits

Cultivation of Elaeocarpus sphaericus (Rudraksh)

Gmelina arborea Roxb.

Syn. *Premna arborea* Roth

Fam : Verbenaceae

Ayurvedic name	Gambhari
Unani name	
Hindi name	Gamhar, Khamer, Gambhari, Sewan
English name	Candahar tree, White Teak
Trade name	Gamhar, Gambhari
Parts used	Root, leaves, bark and fruit



Plant of *Gmelina arborea*

Morphological Characteristics

It is a moderately deciduous tree with straight trunk and numerous spreading branches, which form large shady crown with whitish grey corky lenticellate bark, exfoliating in thin flakes. It has a clear bole of 6.0-9.0 meter, and a girth 1.5-2.5m. Branchlets and young parts are clothed with fine white mealy pubescence. Leaves are simple, opposite, broadly ovate, cordate, glandular, glabrous above when mature and fulvous-tomentose beneath. It attains its largest dimension in the mixed forests of moist region as in the eastern sub Himalayan track, Assam and elsewhere in south India.

Floral Characteristics

Flowers are 2.5-5.0 cm in diameter, brownish yellow in terminal panicle. Calyx is campanulate, pubescent outside and with 5 lobes. Corolla is showy, brownish yellow with short tube and

oblique limbs. Stamens are 4 in number and didynamous. Ovary is 4 chambered with one ovule each; style slender ending in a bifid stigma. Fruits are drupe and obovoid in shape, 1.8-2.5 cm long, pericarp leathery, shining yellow outside when dry; endocarp bony, embedded in an aromatic sweetish pulp. Seeds are 1 or 2, hard and oblong ex-albuminous. The panicles of flowers appear from February to April.

Distribution

Plant is found wild throughout India from the foot of Himalayas to Kerala and Andaman, in moist, semi-deciduous and open forests up to an altitude of 1500m msl. It is generally found scattered in mixed forests of moist regions of the country extending up to comparatively dry regions of central India. Occasionally it occurs in evergreen as well as in the Sal forests. In the natural forest, the species is usually found scattered and in association

with other species. It is found in dry mixed deciduous forest types in Central India.

Climate and Soil

It thrives well in shade in the temperature range of 30°C – 47°C, 60-100% humidity and the annual rainfall between 750 mm to 4500 mm. Its choice of site is wide, but it shows a preference for moist fertile valleys with sandy loam soil. It does not thrive in waterlogged conditions and remains stunted on dry, sandy or otherwise poor soil. It also does not thrive on heavy clay soils.

Propagation material

Planting material is seed.

Agro-technique⁸

Nursery Technique

It is a light demanding tree. It does not tolerate drought but it withstand in light frost condition. Seed formation occurs in May-June. Seeds are dried well before germination.

- **Raising Propagules:**

Seeds are dibbled at spacing of 7.5 cm X 7.5 cm, 1 to 2.5 cm deep in unshaded nursery beds. The bed should be slightly raised to ensure good drainage. Seeds germinate in 20-25 days. During this period, weeding and watering is done according to the requirement.



Seedlings of *Gmelina arborea*

- **Propagule Rate and Pretreatment:**

Dried seeds are soaked in water for 1-2 days to accelerate germination. Considerable amount of heat and moisture is needed to stimulate the germination and so the beds are covered with a layer of hay. The average number of seeds/kg is 2000-2500. The germination percentage of seed recorded is 13-90%.

Planting in the Field

- **Land Preparation and Manure Application:**

The land is prepared before plantation by way of removing the unwanted herbs, shrubs and trees. It is better to do deep ploughing to loose the land mass and allow to dry the unwanted weeds. Pits of 45 cm X 45 cm X 45 cm of size are dug during the month of May at a

⁸Agro-technique study carried out by (a) JNKV, Jabalpur, (b) TFRI, Jabalpur

spacing of 4m X 4m. The pits are filled with well matured Farm Yard Manure (FYM), sand and soil in the ratio of 1:1:1 and allowed to cure before undertaking plantations in the month of June-July after onset of the rainy season. The choice of site is wide, but it shows a preference for moist fertile valleys with sandy loam soil.



Gmelina arborea in Field

- **Transplanting and Optimum Spacing:**

About 10-15 cm tall seedlings are transplanted in pits at the beginning of rainy season. The optimum spacing recommended between plant to plant is 4m X 4m.

- **Interculture and Maintenance Practices:**

Plants raised in the field require two weeding around the pits especially in rainy season. Plantation done in the black cotton soil require four weeding

at monthly intervals. The unwanted weeds between the rows are removed by sword or sickle. Cultivator ploughing through tractor is beneficial to remove the weeds as well as loosening the soil especially in the black cotton soil. This operation not only conditions the soil but also avoids cracking associated with the black cotton soil during the summer months. It is advisable to run the cultivator before the start of active summer months to avoid cracking of soil to save water and damage of roots. Under natural conditions germination takes place in the rainy season soon after the fall of fruits. Heat and moisture stimulate germination. The hard coat of seeds takes time to rot and germination takes place only in the next rainy season.

Crop can be raised through direct sowing and transplanting. Seeds are sown in lines at a distance of 3.0mX3.5m. Saplings are thinned in the third year. Dibbling and broadcasting on prepared sites also gives satisfactory results. Weeding hoeing, soil working and manuring is essential in the first year. Though the artificial regeneration mainly depends on seedling raised from seeds, cutting also strikes roots well. Growth is faster in case of vegetative propagation usually done through stumps and cuttings.

- **Irrigation Practices:**

Weekly irrigation is required in summer season and irrigation at fortnightly interval is preferred in winter. Irrigation is required in the initial two years of the establishment of plants.

- **Weed Control:**

One or two weeding in the month of July and September is enough for establishing the plantation.

- **Disease and Pest Control:**

The common nursery disease reported is sooty mould caused by *Corticium salmonicolor* which can be controlled by applying a suitable fungicide. The trees are often attacked and completely defoliated by the beetle (*Calopepla leayana*). It feeds on the leaf and also eats young buds and shoots. Defoliation is first noticed at the beginning of the rains and continues till October. No biological or mechanical control measures have been developed. Larvae of other several insects are known to bore in the wood and to defoliate, but the damage caused is usually not appreciable.

Among fungi which are known to cause damage to this tree are *Poria rhizomerpha*, commonly a saprophyte but becomes pathogenic when

G. arborea is raised in clayey soils which become water logged periodically, causing brown cuboidal rot in the roots resulting in die-back and death of affected plants. Trees are also liable to severe attack by Loranthus (*Loranthus scurrula*) as the tree has a thin bark, it readily becomes a victim to phanerogamic parasite.

Harvest Management

- **Crop Maturity and Harvesting:**

Tree grows fast and may be ready for harvesting of bark after 7 years. This plant is coppiced and traded. The roots are also harvested for medicinal purposes. The tree may stand up to 25 years. The medicinally important part of this species is stem bark which is extracted from 7-10 years old tree. Since, this is destructive harvesting method; it is suggested that from one tree partial debarking should be done by removing bark in patches of 15cm X 15cm with a distance of 60 cm. For getting roots, from the young plant it is desirable that the root should have good thick bark so as to get maximum active principle. Since, harvesting of roots and bark would be destructive, it is recommended to collect the bark from the clear felled crop as secondary product to avoid destruction of the plants growing in nature. Yellowish green fruits are collected from April-

June from the ground duly rejecting the green and black ones. Fruits are heaped under or buried in a pit for 4-5 days and then washed to remove the pulp.

- **Post-harvest Management:**

Properly dried bark with less than 10% moisture content can be stored in gunny bags in well ventilated room. Bark having moisture is susceptible to fungi infestation which turns it black in colour and becomes useless for medicinal use. Dried seeds can be stored in air tight container for one year and with this viability is decreased to a great extent.

- **Chemical Constituents:**

Drupe contain butyric acid, tartaric acid and traces of resinous and saccharine substances. Arboreol is the major active constituents present in the plant. The roots contain thick yellow coloured oil. It also contains alkaloids, sugars, resins and some astringent compounds.

Therapeutic uses

Root of *Gmelina arborea* is an ingredient of the “**Dasamula**”. It promotes digestive power and improves memory. Roots are useful in fever, dyspepsia, haemorrhoids, stomachalgia, heart diseases, nervous disorders, piles and burning sensation. Bark is used in fever and dyspepsia.

Juniperus communis Linn.

Fam : Cupressaceae

Ayurvedic name	Vapusha, Hapusa
Unani name	Abhal
Hindi name	Aaraar, haubera, abhal
English name	Common Juniper
Trade name	Hauber
Parts used	Berries, leaf, bark and wood



Juniperus communis

Morphological Characteristics

It is a dense sub-erect or prostrate perennial shrub growing up to 1.5 m height. Leaves are 5-13 mm long, in whorls, linear, sharply pointed, spreading nearly at right-angles from the branchlets, convex on the back, concave and glaucous bluish white on the upper surface, jointed at base and continued down the stem with a large gland on the decurrent portion.

Floral Characteristics

Flowers are dioecious, axillary, supported by small imbricating bracts. The male cones ovoid, yellow; antheriferous, scales broad ovate and acuminate. Stamens are decussate or in three, connective enlarged ovate or peltate at the apex bearing 2-6 globose pollen sacs near the base. Female flowers are in cones, composed of 2-6 opposite or ternate scales, usually not all fertile. Ovules are 1-2 to each fertile scale.

Fruit are 7.5-10.0 mm long, sub-globose, blue-black, glaucous berries tips of the scales visible at apex. Seeds are 1-3 with a thick hard testa and often connate into a hard several-celled mass.

Distribution

Juniperus is a temperate species, which occurs in forests throughout Western Himalaya from Srinagar to Kumaon at 1700-4200 m msl.

Climate and Soil

Sandy clay loam soil rich in humus is more suitable for this crop. It prefers temperate climate.

Propagation Material

Plant can be multiplied through stem cuttings and seeds, however, meristems and stem-cuttings are ideal material as plants propagated from stem-cuttings grow faster than that of seedlings.

Agro-technique⁹

Nursery Technique

- **Raising Propagules:**

The right time for collection of seeds is October for raising seedlings of *J. communis*. Moreover, the rate of success of nursery using seeds is very poor. Hence, to multiply the plant through vegetative propagation is preferable. Stem cutting is suitable in May. Apical shoot (15cm) performs better root formation than the older part of the stem. Sand is most suitable medium for planting. In propagation chamber or polytunnel, the success rate of rooting is 40 to 57%. IBA 2500 ppm promotes rooting in maximum cuttings (80%) followed by IBA 3000 ppm (60%). Peeling of bark at the lower end of the cuttings improves the rate of success as compared to round or normal cut and crushing at the lower end. Normally, stem-cuttings take 60-70 days for rooting. The rooted stem-cuttings should be hardened at least for 6 months before transplanting in field. In nursery, the stem-cuttings should be planted at 10cm X10cm spacing.

- **Propagule Rate and Pre-Treatment:**

About 10,000 saplings are required for one hectare land.

Planting in the Field

- **Land Preparation and Manure Application:**

July-August is the suitable period for planting rooted stem-cuttings or seedlings of plant in main field. It is not necessary to plough entire field for planting crop. The planting spots marked at desired space should be made weed free before making planting pits of dimension 45cm X 45cm X 45cm. Pits are filled with equal proportion of soil and sand. About 15 t/ha of Farm Yard Manure (FYM) should be applied as basal dose at the time of transplanting in main the field. In subsequent years, FYM @ 15 t/ha should be applied at the time of bud-break in March-April, after winter dormancy.

- **Transplanting and Optimum Spacing:**

Sapling is planted at the centre of the pit and the soil is gently compressed after planting. The pits are made at a spacing of 1m x 1m accommodating 10,000 plants/ha. Plants should be watered lightly after the planting.

- **Intercropping System:**

Intercropping is not suitable for the crop.

⁹Agro-technique study carried out by Institute of Himalayan Bioresource Technology (Council of Scientific and Industrial

- **Irrigation Practices:**

In the absence of rainfall, irrigation at weekly interval is essential for about a month after transplanting to ensure establishment of the saplings in field.

- **Weed Control:**

Hand weeding twice at monthly intervals during July-September provides effective weed control in the initial 2-3 years of the crop.

- **Disease and Pest Control:**

No disease or insect-pest has so far been noticed in this crop.

Harvest Management

- **Crop Maturity and Harvesting:**

J. communis bears flowers / fruits after attaining the age of about five years. Fruits rip during September-October, hence it is the right time to harvest the fruits. Bark and leaf can also be collected during October.

- **Post-harvest Management:**

Bark, leaf and fruits can be air dried and stored at room temperature in a dry place.

- **Chemical Constituents:**

Plant contains 4-terpineol (18.14%), marpol (7.96%), α -pinene (6.96%), γ -terpinene (4.46%), β -fenchyl alcohol (1.53%) and oplophenone (0.69%) are major constituents. As per literature, sabinene (48.8%), α -pinene (6.2%) and endofenchyl acetate (5.8%) are major components of the essential oil from needles of *J. communis* growing in nature. Fruit yields 0.8 – 1.2% essential oil and 8% resin. It also contains the bitter substance juniperin.

- **Yield:**

Yield could not be recorded because of destructive methods for extracting leaf, bark and wood.

Therapeutic Uses

Berries, wood and oil are used in folk remedies for cancer, indurations, polyps, swellings, tumors and warts. Its fruit and essential oil possess carminative, stimulant, deobstruent, diaphoretic, digestive and diuretic properties. They are useful in different forms of dropsies, either administered alone, or in combination with other diuretics. They are also used to treat mucous discharges in gonorrhoea, gleet and leucorrhoea; and some cutaneous diseases. The wood is sudorific in action.

Lycopodium clavatum Linn.

Fam : Lycopodiaceae
(Pteridophyta)

Ayurvedic name	Nabbeli
Unani name	-----
Hindi name	Nagbeli
English name	Common Club Moss
Trade name	Lycopodium, Common Club moss
Parts used	Spores and herb



Lycopodium clavatum Linn.

Morphological characteristics

The plant has creeping stem with erect tips. Stems are dichotomously branched, one of the branches remains small and the other grows to a greater length. Smaller and erect branches bear cone or strobili at the tips containing spores. The old main axis or the rhizome remains completely or partially subterranean. Stems are densely covered with small moss like leaves that are spirally arranged and 4.0-6.0 mm long. Leaves are simple, sessile, with serrate margins, pointed tip and single median vein. Leaves are also called microphylls. Fertile or strobilus bearing branches bear scale like yellowish green leaves while the sterile branches bear linear green leaves. Basal surface of creeping stems bear dichotomously branched and thin adventitious roots abounds all along its length.

Floral Characteristics

This plant belongs to a lower group under phylum Pteridophyta and does not bear

flowers. It has two phases in the life cycle i.e. sporophytic and gametophytic phases. The plant bearing strobilus is the sporophytic phase of the life cycle. Strobilus bears spirally arranged sporophylls with sporangium which produces numerous spores. The spores come out from the sporangium and germinate in the soil to form a small top shaped prothallus. This is the gametophytic phase of the life cycle.

Strobilus:

These are distinct, yellowish to cream in color when mature, 2.5-5.0 cm long, compact and are borne at the tips of special erect shoots. The sporophylls possess a small flange on ventral side. It protects the sporangium. Sporangium arises on the dorsal (adaxial) surface of the sporophylls (foliar or epiphyllous condition). Sporangia are yellowish orange in colour and about 2.0 mm long. When spores become mature, central axis of strobili

elongates. As a result the sporophylls spread out exposing the sporangia. The exposed sporangia become dry. Later on sporangial wall splits and disseminate the spores.

Spores:

These are light yellow in color, homosporous, unicellular with single nucleus, filled with oil and fat, 0.03 mm in diameter, tetrahedral in shape with a rounded or semicircular base, spores possess triradiate ridges and reticulate ornamentation on the surface.

Germination of Spores:

Spores take about 3-8 years to germinate. They germinate under moist conditions to form prothallus with the help of specific endophytic fungus. In the absence of this fungus, prothallus does not develop and die.

Prothallus:

It is top shaped, tuberous, yellowish brown in colour and about 15 mm long. It has two distinct zones (i) lower conical region bearing numerous rhizoids and (ii) upper broad generative region several archegonia on the margins and antheridia on the center. Antheridia produce biflagellate spermatozoites, which in presence of water droplets, swim and reach the archegonial neck. Only one spermatozoid reaches the egg and effect

fertilization forming oospore. Oospore is converted into embryo by cell division which later becomes young plant. This development is very slow and the young plant (sporophyte) depends for years together on the subterranean prothallus (gametophyte) for nutrition. It takes many years to come above ground and become independent.

Distribution

Plant is usually found in the temperate regions, particularly in Himalayas in the moist shaded woodlands, open thickets, rocky slopes, pine forests and mixed woods between 2000-3000 m msl.

Climate and Soil

Plants grow well in cold, moist and shady areas, where the soil is loose, acidic with good depth of humus.

Propagation Material

Plant may be grown from spores or vegetatively propagated by rhizomes. Spores take long time (3-8 years) to germinate into prothallus and few years to form a new plant while through rooted rhizome cuttings plants may be multiplied quickly.

Agro-technique¹⁰

Nursery Technique

¹⁰Agro-technique study carried out by Central Institute of Medicinal & Aromatic Plants (CIMAP), Lucknow

Raising Propagules:

The plant is moisture-loving, so rhizome cuttings should be planted during rainy season for their better survival. Rhizome pieces should be of 15 cm long with several roots. They should be just buried (< 1 cm deep) under the soil.

Propagule Rate:

Plants are prostrate and slow growing. However, enough space should be provided between the plants for their proper growth. Rooted rhizomes of 15 cm long should be planted at 45cm apart from each other in rows and the rows should be at least 45 cm apart. Approximately 1,20,000 rhizomes could be accommodated in one ha of land. For planting the crop in one hectare of land approximately 50 kg of rooted rhizomes is required. This has to be collected from the wild (temperate hills).

Planting in the Field

Land Preparation and Manure Application:

Loose, humus rich soils are best suited for good growth of this plant. They take longer time to establish in freshly prepared fields. Therefore, before putting the rhizome cuttings, soil of the fields should be properly loosened and mixed well with decomposed Farm Yard Manure @ 25 t/ha for their proper growth. Rhizome cuttings perish quickly if proper moisture

conditions are not provided immediately after planting. Therefore, during and after planting, field should have good amount of moisture. However, water logging has been found to be harmful for the plants. The plants of *Lycopodium* do not survive in subtropical conditions even in glass house. Therefore, plants should be grown in high altitudes, in shades where natural moisture is available in plenty.

- **Transplanting and Optimum Spacing:**

Rooted rhizomes of approximately 125 cm in length are suitable for planting. There should be at least 45 cm space both between the rhizome cuttings and between the rows for their optimum growth.



Plant established in the field.

- **Intercropping System:**

Plants are prostrate, perennial, slow growing and require cool, moist and shady conditions. Therefore, it should

be grown under the orchards of small temperate fruit trees (e.g. Apple, Pear, Apricot, Peach, Cherry etc.)

- **Interculture and Maintenance Practices:**

Plants are slow growing, prostrate, require organic manure and do not tolerate dryness, therefore, regular watering and weeding is required. Well decomposed powdered Farm Yard Manure or vermi-compost should also be added to the soil time to time.

- **Irrigation Practices:**

Plants grow profusely in cool, moist and shady conditions of high altitudes. Therefore, they should be grown in such conditions for their better survival and good growth. In relatively dry places, plants require irrigation almost daily. Irrigation with sprinkler was found to be most useful. However, flooding or water logging in the field during irrigation should be avoided. Care must be taken so that the fields remain always moist.

- **Weed Control:**

Initially after planting, hand weeding is required at every 15-20 days. Later as the plant proliferates and forms a dense mat, hand weeding may be reduced after 30-45 days depending upon the weed conditions.

- **Disease and Pest Control:**

Diseases are generally not observed field condition. However, it has been observed that, Plant growing in soils having less organic matter, becomes yellowish in colour.

Harvest Management

- **Crop Maturity and Harvesting:**

Plants grown from rhizome cuttings remain vegetative for long time. It produces strobili, the spore producing organ, after 4-6 years of planting.

- **Post-harvest Management:**

The most efficient and least destructive way to harvest is by clipping the mature aerial part of the plant near the base of the stem with some sharp instruments preferably with secateurs. Plants should not be pulled from the ground. Rhizomes should be allowed to remain undisturbed in its position on the ground for future growth and harvesting. Strobili should be separated carefully from the plant without dispersing the spores. Strobili and aerial parts are dried separately in shade. Strobili should be dried in paper bags; it takes about one week to dry properly. However, vegetative parts take about two weeks for drying.

- **Chemical Constituents:**

It contains fatty oil (40-50%), a complex high polymeric carbohydrate sporonin, sucrose, a protamine, hydrocaffeic acid and alkaloids (0.12%) of which lycopodine is major constituent and the other alkaloids are clavatin and clavatoxine.

- **Yield:**

In suitable conditions plants yield about 2.4-2.9 t/ha fresh herb.

Therapeutic Uses

Spores are used as dusting powder and absorbent in excoriations of skin; also as a base for medicated snuff and covering for pills to prevent adhesion.

In homoeopathy, the herb is used in the disorders of chest and urinary passage, in rheumatism, cramps and varices, antiseptic, in diseases of lungs and kidneys.



Lycopodium clavatum in Pot

Mesua ferrea Linn.

Syn. *M. nagassarium* (Burm. F.) Kosterm

Fam : Colophyllaceae

Ayurvedic name	Naagakeshar, Naagapushpa
Unani name	Naaremushk
Hindi name	Nagkesar
English name	Iron-wood, Indian rose chestnut
Trade name	Nagkeshar
Parts used	Stamens & flowers



Flower of *Mesua ferrea*

Morphological characteristics

This is an evergreen, large and glabrous tree. Trunk is straight and erect. Bark is smooth and ash reddish brown in colour. Wood is red, hard and heavy. Leaves are 8.0-15.0 cm long, oblong-lanceolate, acute, red when young, afterwards shining above, glaucous, rounded at the base and with close inconspicuous veins. Petioles are short.

Floral Characteristics

Flowers are white, hermaphrodite or polygamous, fragrant, 2 to 10 cm across axillary, solitary or sometimes in pairs. Both sepals and petals are 4 in number, stamens indefinite, golden yellow, much shorter than the petals. Style is twice as long as the stamens. Stigma is peltate. Fruits are ovoid, 2.5 – 6.4 cm long with a conical point, woody, greenish in colour surrounded by enlarged sepals. Seeds are 1 – 4 in number, chestnut-brown and flattened on one side.

Distribution

Plant is commonly distributed in mid-hills of Eastern Himalayas and rain forests of Konkan and Karnataka in Western Ghat. Plant is also distributed in Nepal eastwards, in north-eastern India, Deccan Peninsula and in the Andaman Islands.

Climate and Soil

The plant requires well drained and deep fertile soil, stiff clay soil. Low-lying areas are unsuitable. It is a strong shade bearer, particularly when young and this makes it a valuable component of the middle storied tree in forests. It is susceptible to frost and drought.

Propagation Material

One year old seedlings raised from seeds. Seedlings are of 45-50 cm in height at the time of planting.

Agro-technique¹¹

Nursery Technique

- **Raising Propagules**

(1) **Natural regeneration:** In natural regeneration abundant seedlings are found. Artificial propagation is done by direct sowing or by transplanting nursery raised seedlings.

(2) **Vegetative propagation:** This tree takes 12 or more years to flower. So vegetative propagation (both stem and root cuttings) is more relevant especially when flower and fruit are economically important for medicinal used.

Propagule Rate and Pretreatment:

Freshly collected seeds with dark brown colour give about 100% germination. Seeds soaked in cold water for 24 hours hasten germination. Approximately 400 plants are required per hectare for planting at a spacing of 5m x 5m. No particular treatment is given to the propagules before planting.

Planting in the field

- **Land Preparation and Manure Application:**

The land is ploughed, harrowed and planked, mixed thoroughly with Farm Yard Manure (FYM)@ 15-20 ton/ha. The field is made weed-free through hoeing.

¹¹Agro-technique study carried out by (a) Regional Research Laboratory (RRL), Bhubaneswar, (b) Tropical Botanic Gardens &

- **Transplanting and Optimum Spacing:**

Seedlings of 45-50 cm height of about one year old are planted at a spacing of 5m X 5m during autumn rains. The plants are provided with partial shade by growing Arhar (*Cajanus cajan*) around the plants during early stage of establishment.

- **Intercropping System:**

Annuals crops viz. Ginger, Turmeric, Aloe, Pineapple etc. can be grown as intercrops during first 3 to 4 years of growth.

- **Interculture and Maintenance Practices:**

Initially NPK fertilizers @ 0.05-0.10 kg/plant is recommended once during the rainy season in the first year. Its doses may be enhanced in subsequent years depending upon the age of the plants. Usually additional Nitrogen may be applied after six months to boost growth. Hoeing and weeding is required during first ten years of growth.

- **Irrigation Practices:**

Crop requires irrigation at 15 days interval during dry seasons mainly from December to May in early stage.

- **Disease and Pest Control:**

No disease or pests or any other physiological disorder was noted. However, being a tree species, bio-pesticide is advisable against white-ants.

Harvest Management

- **Crop Maturity and Harvesting:**

Tree begins bearing flowers after 4 years of planting. It bears flowers in April- June (Eastern Himalayas) and fruiting during July- Sept. Most of fruits bear 2 seeds. Dark brown seeds just after the fruit dehiscence are found to be most viable. The yield is sizable after 10 years and over.

- **Post-harvest Management:**

Stamens or flower buds are picked up early and dried fast in shade. The dried stamens are packed in moisture proof-bags in dark and ventilated stores. Stamens may be consumed early.

- **Chemical Constituents:**

Stamens possess essential oil and gave α - β -amyrin, β -sitosterol, biflavonoids. Seed oil gave 4-phenyl comarin

analogues – mesuol, mammeign, mesuagin, mammeisin and mesuone. Seed oil is rich in oleic, stearic and palmitic acids.

Therapeutic Uses

Nagkesar is a well-known medicinal plant widely used in indigenous system of medicine. Stamens is the main constituent. The genuine Ayurvedic drug Nagesar, which is considered astringent, stomachic, cooling, carminative, expectorant and purgative. It hastens fermentation and imparts fragrance to Ashava and Aristas used in Ayurveda preparations. Flowers are astringent, stomachic, expectorant, made into paste with butter and used in bleeding piles and burning feet. Powdered flower bud is mixed with honey is given in blood dysentery, piles and leucorrhea. Bark acts as tonic after childbirth and also useful in anemia. Bark and unripe fruit are sudorific. Leaf and flower are antidysenteric. Flower acts as stomachic, expectorant and used in piles & burning of the feet. Seed oil is antirheumatic and used in skin diseases.

Pistacia integerrima Stew. ex Brandis

Fam : Anacardiaceae

Ayurvedic name	Karkarashringi, Shringi
Unani name	Kaakarasingi
Hindi name	Kakrashinghi
English name	Pistanchio tree or Zebra wood
Trade name	Kakrashinghi
Parts used	Galls, kernels, foliage, bark



Fruits of *Pistacia integerrima*

Morphological Characteristics

It is a moderate sized deciduous tree with rough grey bark. Leaves are 15-23 cm long with or without a terminal leaflet. Petiole is terete, puberulous. Leaflet is stalked, 4-5 sub-opposite pairs, lanceolate, coriaceous, entire and arched.

Floral Characteristics

Flowers are greenish – yellow or brownish in colour, dioecious, 0.2 cm diameter, reddish in lateral, puberulous panicles, appearing with or just before the young leaves. The male flowers are in compact panicles, pubescent, 5-15 cm long. Stamens are 5-7 in number. Female flowers lack panicles, 15-26 cm long, elongate, sepals 4, linear and bracts deciduous. Fruit is a drupe, broader than long, glabrous, rugose, grey. Seeds are collected during May-June.

Distribution

This plant is distributed over dry scrub forests in North - Western Himalayas between 300 and 2400m msl. Plant is also cultivated in Punjab.

Climate and Soil

- Plant grows well in open rocky grounds and over limestone soil with good amount of organic matter.

Propagation Material

- Healthy seeds after careful scarification.

Agro-technique¹²

Nursery Technique

- **Raising Propagules:**

Seeds are raised in nursery during June-July. About 80-100 kg of seeds is required for one hectare area. Seed germination is

¹²Agro-technique study carried out by National Bureau of Plant Genetic Resources (NBPGR), Bhowali, Uttaranchal

only 50%. Seeds are germinated in about 30 days after sowing.

- **Propagule Rate and Pretreatment:**

80-100 kg seeds/ha at a spacing of 1m X 1m is required. No pretreatment is required.

Planting in the Field

- **Land Preparation and Manure Application:**

Land is ploughed once with harrowing and 2-3 ploughing to have a fine tilth. Organic compost (FYM) @ 25 to 30 t/ha is thoroughly mixed with the soil during land preparation.

- **Transplanting and Optimum Spacing:**

- Seedlings are transplanted with the onset of monsoon rains during July-August. An optimum spacing of 1m X 1m is given for accommodating 10,000 trees/ha.

- **Intercropping System:**

The plant can be grown as a pure crop or herbaceous medicinal plants can be grown as filler crop with it.

- **Interculture and Maintenance Practices:**

Regular weeding and hoeing operations are required after 30 to 60 days of

transplantation. Weeding is required for 2-3 years in early stages.

- **Irrigation Practices:**

It requires irrigation in first year depending upon soil and climatic conditions. Afterwards 2-3 irrigations are required during summer upto 3 years old crop.

Harvest Management

- **Crop Maturity and Harvesting:**

The tree has a long span of life, that is 30-40 years. It takes about 9-10 years to bear flowers and fruits in July-August and insect galls are formed in natural habitat after 15-20 years during December-February.

- **Post-harvest Management:**

Mature galls are hand picked and stored in air-dried places.

- **Chemical Constituents:**

Essential oil from galls contains α -pinene, camphene, dl-limonene, 1,8-cineole, α -terpineol, aromadendrene and caprylic acid. Other constituents of galls are β -sitosterol and triterpene acids, pistacienoic acids A and B;

- **Yield:**

An average tree of 15-20 years old produce 0.40 kg of galls. It is a natural

phenomenon and no efforts have been made to introduce gall formation to increase yield or its size under plantation. A yield of 25 kg gall may be estimated per ha of plantation.

Therapeutic Uses

Galls possess antiasthmatic, astringent and expectorant properties. Essential oil from galls is antibacterial, antiprotozoal, anthelmintic and antimicrobial in action.



Close view of plant *Pistacia integerrima*

Podophyllum hexandrum Royle

Syn. *P. emodi* Wall ex. Hk f & Thoms.

Fam : Podophyllaceae

Ayurvedic name	Vanyakarkati
Unani name	-----
Hindi name	Papra, Bankakri
English name	Indian Podophyllum
Trade name	Bankakri
Parts used	Rootstocks



Plant of *Podophyllum hexandrum*

Morphological Characteristics

Podophyllum hexandrum is succulent erect herb, glabrous, up to 30 cm tall with creeping long knotty rhizomes. Stem one or two, simple, leafy without top. Leaves alternate, palmate, up to 25 cm in diameter, deeply divided in 3-5 lobes, toothed, purple spotted.

Floral Characteristics

Flowers are white to pinkish in colour, 4 cm across, appear in the fork of the stem. Sepals are 3 in number and petaloid. Stamens are usually 6. Fruits are ovoid, pulpy 5 cm long and scarlet when ripe.

Distribution

It is a native to Himalayan region (Uttarkashi) in India.

Climate and Soil

The species thrives best as undergrowth as

well as in forests in well drained humus rich soil in temperate and subalpine zones.

Propagation Material

The plant is propagated by seeds and rootstocks.

Agro-technique¹³

Nursery Technique

• Raising Propagules:

It is propagated from seeds or by division of rootstock. Seed germination is poor. Seeds are to be sown before the onset of winter *i.e.* in spring season. The germination percentage of seeds ranges from 41-45%. Seedlings exhibit extremely slow growth rate and even after two seasons of growth. They could attain a height of 6.5-7.2 cm. The survival rate of this plants ranges from 85.0-92.6% by this method.

¹³Agro-technique study carried out by SK University of Agricultural Science & Tech, Srinagar, J&K

- **Propagule Rate and Pretreatment:**

7.0-8.0 kg seeds are required for an area of one hectare land. No pretreatment of seed is required. A density of 9 plants sqm is optimum for first two years.

Planting in the Field

- **Land Preparation and Manure Application:**

Land should be ploughed and planked to have a fine tilth and make it weed free. Well-decomposed Farm Yard Manure (FYM) @ of 10 t/ha is to be mixed thoroughly with the soil as basal dose.

- **Transplanting and Optimum Spacing:**

Seedlings of 10-12 cm height are transplanted at a spacing of 9m X 9m. It takes about 15 days for establishment.

- **Interculture Operations:**

Weeding-cum-hoeing may be carried out regularly after 4 weeks interval. Crop normally prefers cool, shady environments and light irrigation during hot season in June-August.

- **Weed Control:**

Regular weeding, hoeing operations are required during the months from March to May when the crop is grown at lower altitude.

- **Disease and Pest Control:**

No disease or pests are noticed in this crop.

Harvest Management

- **Crop Maturity and Harvesting:**

It is a perennial crop. The plants remain in vegetative stage during the first year and flowering start from 2nd and 3rd year onwards. Rootstocks are harvested in spring season. Rootstocks are found to be rich in resin contents during this season.

- **Post-harvest Management:**

Roots and rhizomes are harvested after drying of above ground parts. Roots and rhizomes are then cut into pieces of 15 to 20 cm long, washed and dried in shade. The dried material should be stored in clean containers or gunny bags.

- **Chemical Constituents:**

Rhizomes and root contain resinous mixture called podophyllum resin or podophyllin. The primary constituents are lignin glycosides, podophyllotoxin, podophyllic acid and picropodophyllin, α -peltalin and β -peltalin. The rhizomes also contain gum, starch, albumin, gallic acid, calcium oxalate, lignin flavones.

- **Yield:**

The crop gives yield of 3.0 - 4.0 t of dried rootstock and 10 kg of seeds from one hectare after 5 years.

Therapeutic Uses

Rhizomes are used for typhoid fever, jaundice, dysentery, chronic hepatitis, scofula, rheumatism, skin diseases,

tumerous growth, kidney & bladder problems. Plant is also used for gonorrhoea, and syphilis. The podophyllum is used as a purgative and also for treatment of vaginal warts. Two derivatives of podophyllotoxin, called eloposide and teniposide are employed for treatment of cancers. Root paste is applied on ulcers, cuts and wounds.

Prosopis cineraria (Linn.) Druce

Syn. *P. spicigera* L.

Fam : Mimosaceae

Ayurvedic name	Sami
Unani name	Sual, Safed Kikar
Hindi name	Khejri, Khejra, Jand, Thand
English name	Sponge tree
Trade name	Khejri
Parts used	Bark



Plant of *Prosopis cineraria*

Morphological Characteristics

The plant is much branched shrub or small tree. Branches are slender, glabrous, with compressed, straight and scattered prickles. Leaves are pinnate, glabrous or puberulous. Pinnae are usually 2-pairs and opposite. leaflets are sub sessile, oblong, obliquely rounded, mucronate at apex, base rounded and very oblique. The plant has deep root system and has low requirements for water and nitrogen. Shoots grow to produce new leaves, which appear twice in a year in March-April and July-October and thereafter these leaves develop slowly. Flowering starts in January, reaches in full bloom during February-March. Fruit setting starts from April onwards which attains maturity in May.

Floral Characteristics

Flowers are small, yellow, in slender spikes, arranged in short peduncled axillary panicles. Pod is 12-25 cm long, pendulous, torulose. Seeds are many,

immersed in sweetish mealy pulp, oblong and brown.

Distribution

It is an important leguminous multipurpose tree species of the Indian Thar desert. In nature, it reproduces by seeds only. However, this tree can be raised through air-layering and sprouting of vegetative buds on the mature stem and roots. The tree grows abundantly throughout the Rajasthan in different agro-climatic regions.

Climate and Soil

It has ability to grow in semi-arid and arid marginal environments receiving low rain fall of 250-500 mm/annum and yet it produces profuse flowering and fruiting. The soil with 2:2:1 ratio of sand : clay : FYM is best for plant growth and increasing biomass. Soil mixture with 50% clay is preferred.

Propagation Material

Propagation material is seeds collected during May-June from plus trees.

Agro-technique¹⁴

Nursery Technique

- **Raising Propagules:**

Plants raised through seeds show 90.0% survival under field conditions. About 20 gm seeds/ha are required. Seeds are pretreated with concentrated H₂SO₄ for 15-20 minutes and sown in polybag at 2.0 cm depth during May and subsequently one month old seedling is transplanted in the field during July-August at 5m X 5m spacing in field.

- **Planting in the Field**

Land Preparation and Manure Application: The land is prepared by ploughing 3-4 times with disc plough and the soil is brought to a fine tilth. The land is divided into plots of convenient size. The main and sub-irrigation channels are laid out. Pits of 45cm X 45cm X 45cm size are dug at a spacing of 5m X 5m and should be filled with top soil and well decomposed FYM in the ratio of 1:1.

- **Transplanting and Optimum Spacing:**

One month old seedlings is

transplanted in field conditions.

- **Intercropping System:**

Intercropping of crops like pearl millet and cluster bean could be grown.

- **Irrigation Practices:**

The crop requires monthly irrigation for achieving maximum growth of above and below ground biomass and bark yield.

- **Weed Control:**

Weeding and hoeing is done manually after every 15-20 days in rainy season and after rains, at same intervals upto 3-4 years of age.

- **Disease and Pest Control:**

No serious insects and pests were observed in this plant in the early stage except termite attack.

Harvest Management

- **Crop Maturity and Harvesting:**

It is a perennial slow growing tree. It takes about 7 to 8 years for flowering, fruiting and bark production.

- **Post-harvest Management:**

Scrapping of bark from the older branches is done in the month of November by knife and stored in dry shady and ventilated place in gunny bags for marketing.

¹⁴Agro-technique study carried out by (a) Jai Narain Vyas University, Jodhpur, (b) State Forest Research Institute, (SFRI),

- **Chemical Constituents:**

The flowers contain a flavone prosogerin A and a chalcone – prosogerin B; seeds contain flavones – prosogerin C, prosogerin D and prosogerin E and polyphenolics – gallic acid, patuletin, luteolin and related glycosides; seeds also gave an alkaloid specigerin. Heart wood contains n-decanol, β -sitosterol, flavanones.

- **Yield:**

After 2 years of plantation,

approximately 500 kg of bark is obtained from one hectare plantation.

Therapeutic Uses

The bark is used for medicine. Bark is dry, acrid, bitter with sharp taste. It has anthelmintic property and prescribed in treatment of bronchitis, asthma, piles etc. The pods are rich source of protein and carbohydrate and eaten by animals as fodder. It is also eaten as vegetable and pickle by local people. The leaves are palatable and nutritious feed for livestock in desert.

Prunus cerasoides D. Don

Syn. *P.puddum* (Wall.) Roxb. ex Brandis non Miq

Fam : Rosaceae

Ayurvedic name	Padmak
Unani name	-----
Hindi name	Padam
English name	Wild Himalayan Cherry, Bird Cheery
Trade name	Padam
Parts used	Bark and seed



Tree of *Prunus cerasoides* with fruits

Morphological Characteristics

Prunus cerasoides is a medium size deciduous tree and known as Himalayan wild cherry. Its bark is brownish-grey, smooth and peels off in a thin shining horizontal stripes exposing a shining copper coloured surface. Its leaves are ovate, acuminate, doubly serrate and glabrous. The petiole has 2-4 glands at its base. The stipules are feathery. Flowering takes place in the months of October-November.

Floral Characteristics

Flowers are bisexual and occur in fascicles of rose-red colour, gradually fading nearly to white. Pollination is mainly through insects. The fruits are produced in abundance having scanty pulp and are scarcely eaten, but are famous for making well-known cherry brandy.

Distribution

Plant is distributed in temperate Himalayan region extending from Kashmir to Bhutan, Aka and Khasi hills in Assam and Manipur at an altitude of 900-2300 m msl. It prefers a fair amount of shade and may be found flourishing under the moderate shade of other trees. It requires moderate light conditions and grows in shady locations of hills and along the fields. The plant prefers temperate and moist.

Climate and Soil

The plant prefers light sandy, medium loamy and heavy clay soils and requires well drained condition. The tree grows in temperate regions on the hilly slopes.

Propagation Material

Propagation material is seed. It can also vegetatively be propagated through air-layering and stem cutting.



Plant raised from Cutting



Air layering

Agro-technique¹⁵

Nursery Technique

- **Raising Propagules:**

Plant is usually propagated through seeds. Seeds mature in the month of

¹⁵ Agro-technique study carried out by Indian Council of Forestry Research & Education (ICFRE), Dehradun, Uttaranchal.

March-April. Fully ripened fruits are picked up from tree or fallen ones are collected from the ground. The seeds are removed from the fruits, washed free of pulp and sown. The seeds may be sown immediately after collection in April to middle of May. Seeds remain viable for 2-4 months, but germination percentage is more in freshly collected seeds. The seeds should be sown in well prepared nursery beds or polythene bags containing mixture of sand, soil and farmyard manure (1:1:1). The seeds start germinating within 25 days and germination is completed within 15 days



Seeds

- **Propagule Rate and Pretreatment:**

Pre-sowing treatments like soaking the seeds in water or giving hot water treatment do have favourable effect on germination. Ripened and de-pulped

seeds treated with hot water for 10 minutes have a high germination rate.

Planting in the Field

- **Land Preparation and Manure Application:**

Land for plantation is prepared well in advance before onset of monsoon in May. Harrowing of the field is done mechanically. Pits of 45cm X 45cm X 45cm are dug and dry farmyard manure is added to the pits.

- **Transplanting and Optimum**

Spacing:

Seedlings of 4 leaf stage are transferred from the nursery beds to the polybags. The seedlings of about 65 cm height are transplanted into the field. Approximately 1100 plants/ha at a spacing of 3m X 3m in open field and around 620 plants/ha at a spacing of 4m x 4m in intercropping system is found to be appropriate.

- **Interculture and Maintenance Practices:**

Seedlings are transplanted into the pits during monsoon in July. Weeding is carried out at a monthly interval in monsoon season. Plants require manuring in its initial stage of growth. Well rotten cattle manure or compost @ about 750 kg /ha is given in

September-October. Watering at an interval of 10-15 days is favourable during summer. The lower branches are pruned in the second year in winter to avoid crowding.

- **Irrigation Practices:**

Irrigation on alternate days is necessary at the seedling stage to promote favourable growth to take place. Irrigation of saplings at an interval of 10-15 days is done during summer months to overcome dry spell until the onset of monsoon is recommended.

- **Weed Control:**

The frequency of weeding varies depending on weed growth. Monthly weeding is carried out during monsoon months.

- **Disease and Pest Control:**

No serious incidence of any insect pests or disease has been noticed in this crop.

Harvest Management

- **Crop Maturity and Harvesting:**

The tree flowers in autumn or early winter October-December. Fruiting occurs between December and February. Fruits ripen from March-April. *Prunus cerasoides* being a tree species, the harvesting of its bark and

fruits from the plantation can only be done when tree matures.

- **Chemical Constituents:**

Stem bark contains flavones and isoflavones. Stem sapwood gave flavone glucoside. The leaves, twigs, bark and kernels contain a cyanogenetic substance. Kernels contain oil similar to that of bitter almonds with a strong flavor of prussic acid.

Therapeutic Uses

The kernel is used as a remedy for stone and gravel in urinary bladder. The leaves, twigs and bark contain a cyanogenetic substance. The bark is used for plastering fractured bones. The smaller branches are crushed and soaked in water and taken internally to stop abortion. Its stem is antipyretic, refrigerant and useful in treating vomiting, leprosy and leucoderma.

Pueraria tuberosa (Roxb. ex Willd) DC.

Syn. *Hedysarum tuberosum* Willd.

Fam : Fabaceae

Ayurvedic name	Vidarikand
Unani name	Vidari
Hindi name	Vidarikand, Bilaikand
English name	Indian Kudzu
Trade name	Vidari, Kudzu
Parts used	Tubers



Pueraria tuberosa

Morphological Characteristics

It is a large spreading tuberous, deciduous climber or twining shrub with very large tuberous roots. Leaves are pinnately compound, three foliolate with long petioles. Leaflets are broadly ovate or rhomboid, sub-coriaceous, glabrescent above and densely clothed with silky hairs.

Floral Characteristics

Flowers appear in April. It is blue or purplish blue in colour. It is leafless 15-27 cm long racemes. Calyx is 0.4-0.6 cm long densely silky. Corolla is bluish, larger and papilionaceous. Fruits are membranous. Pods are of 5.0-7.5 cm long, flat and jointed. It contains 2-3 seeds clothed with long, silky bristly brown hairs.

Distribution

It is common in Central India and ascending up to 1300 m msl and also found in hills of western Himalayan region.

Climate and Soil

The plant prefers sub-tropical climate, shade and warm humid conditions. It grows well in loam to sandy loam soil, rich in organic matter.

Propagation Material

It is generally propagated by seeds, but seed germination is low. Tubers and layering is also used for raising plants. Ground layering of stem is very successful for propagation.

Agro-technique¹⁶

Nursery Technique

• Raising Propagules:

The seeds are soaked in water overnight and sown in nursery in month of May. Seedlings are planted in field at the end of July. The plants can be raised vegetatively in June-July and shifted to main field in August-September.

¹⁶ Agro-technique study carried out by National Botanical Research Institute (NBRI), Lucknow

- **Propagule Rate and Development:**

Ground layering may be done with the help of rooting hormones. Stem cuttings also require treatment of rooting hormone.

Planting in the Field

- **Land Preparation and Manure Application:**

About 15-20 t of FYM should be mixed in soil at the time of field preparation. The field should be levelled well after one cross ploughing and harrowing.

- **Transplanting and Optimum Spacing:**

The seedlings or cuttings are planted at spacing of 75cm X 75cm in 30cm deep pits filled with 1:1:1 mixture of soil, sand and manure. About 18,000 plants are required for planting in one hectare land.

- **Intercropping System:**

This is widely spaced crop and allows inter-cropping of narrow spaced, erect plants like *Desmodium* (Shalparni) and *Plumbago* (Chitrak) during the first season. It can also be grown as inter-crop under large tree plantation or orchards. In fact, upto 50% shade provide ideal conditions for its growth and development.

- **Interculture and Maintenance Practices:**

Pueraria is perennial crop and requires three hand weedings in the first year at 30, 60 and 180 days after transplanting, corresponding with end of August, September and early February months.

- **Irrigation Practices:**

One irrigation is required at the time of transplanting, and two during establishment stage at 15 and 45 days after transplanting. The plant becomes dormant during winter. Generally, 3 to 4 irrigations are required during April-June in the following year.

- **Weed Control:**

Mechanical and cultural method are used to control weeds.

- **Disease and Pest Control:**

The leaves are damaged by sucking and chewing type of insects during and after rainy season. This can be controlled by applying Neem cake in the soil and repeated spray of its solution in July-August to control this menace.

Harvest Management

- **Crop Maturity and Harvesting:**

The large tuberous roots take 4-5 years to develop. Occasionally the tubers may develop up to 20 kg in weight.

Medium sized tubers are considered better.

- **Post-harvest Management:**

The tubers are cut into thin slices, dried in shade and stored.

- **Chemical Constituents:**

The tubers contain approximately 65% carbohydrates, 11% protein and glucosides.

Therapeutic Uses

The tubers are aphrodisiac, cardio-tonic, galactagogue and diuretic. The tubers are used for the treatment of dysuria, emancipation and spermatorrhea and given in malarial fever.

Sarcostemma acidum (Roxb.) Voigt.

Syn. *Sarcostemma brevistigma* Wt. & Arn.

Fam : Asclepiadaceae

Ayurvedic name	Soma
Unani name	-----
Hindi name	Somlata
English name	Moon Plant, Soma Plant
Trade name	Somlata
Parts used	Entire plant



Flower twig of *Sarcostemma acidum*

Morphological Characteristics

This plant is almost leafless, straggling, jointed shrub with many branches. Stem is cylindrical and 3.0-6.0 mm in diameter. It is green, pubescent in young stage and gradually turns glabrous. Internodes are 1.0-3.0 cm long. Leaves are very minute, caducous, adpressed and opposite.

Floral Characteristics

Flowers are white on sessile umbels at the end of branches. Pedicels are 6.0-8.0 mm long, slender and pubescent. Bracts are 1.5-2.0 mm long, lanceolate. Calyx is divided at the base, sub-actue and margins are revolute. Outer corona is crenately 10 lobed on the margins, inner corona lobes thick, fleshy, obtuse and longer than the stamina column, almost concealing the anthers. Staminal column is very short and pollen masses are waxy, compressed, falcately flavate. Caudicles are short and orange in colour. Ovary is glabrous with many ovules and the style apex is

shortly conical at the apex.

Distribution

Plant found in dry places of West Bengal, Rajasthan, Bihar and Peninsular India.

Climate and Soil

Plant grows in open sun light on rocky-sandy soil in arid and semi-arid areas with low rainfall. The conditions of shade and high moisture is preferable.

Propagation Material

Stem cuttings with nodes.

Agro-technique¹⁷

Nursery Technique

• Raising Propagules:

During July-September, stem cuttings with nodes are directly planted in the nursery beds. Rootex hormone is used for early rooting of cuttings.

¹⁷ Agro-technique study carried out by Jamia Hamdard, New Delhi

Planting in the Field

- **Land Preparation and Manure Application:**

Pits are dug at a distance of 1m X 1m and Farm Yard Manure is given @ of 10 kg/plant at the time of plantation as basal dose.

- **Transplanting and Optimum Spacing:**

Seedlings or stem cuttings are transplanted at a spacing of 1m X 1m between plant to plant and row to row with an optimum crop stand of approximately 100 plants/ha.

- **Irrigation Practices:**

It is a rainfed crop, irrigation is rarely required.

- **Weed Control:**

Manual weeding is required to keep the plantation weed-free.

- **Disease and Pest Control:**

No disease noticed.

Harvest Management

- **Crop Maturity and Harvesting:**

Matured plant can be harvested during November-December with the appearance of matured seeds.

- **Post-harvest Management:**

Whole plants is dried in shade and stored in gunny bags in cool-airy rooms.

- **Chemical Constituents:**

Twigs contain luprol acetate α and β -amyrin acetate and β -sitosterol.

- **Yield:**

The estimated yield of whole plant is about 9 kg fresh wt.

Therapeutic Uses

Stem is emetic and hypothermic. Root acts as antidote for snake-bite and rabid dog bites, mental diseases, sinusitis and rhinitis.

Semecarpus anacardium Linn. f.

Fam : Anacardiaceae

Ayurvedic name	Bhallataka, Arushkar
Unani name	Bhilavan, Balodur
Hindi name	Bhilawa, Bhela
English name	Marking-Nut
Trade name	Bhilawa, Marking nut tree
Parts used	Fruits, Pericarp



Plant of *Semecarpus anacardium*

Morphological Characteristics

Semecarpus anacardium is a moderately sized deciduous tree, reaching up to a height of 12-15 meter and girth of 1.25 meter. Bark is rough, dark brown in colour. Leaves are large, simple, obvate-oblong and 9.0-30.0 cm long, curvaceous covered with five pale pubescence.

Floral Characteristics

The flowers are small, dull greenish yellow, dioeciously borne in December-January. Inflorescence is terminal panicles. Flowers are 0.6 - 0.8cm in diameter, sub-sessile, fascicled. Petals are oblong, greenish-white filaments subulate. Fruit is a drupe of 2 to 2.5 cm long, obliquely ovoid, smooth and shining, black when ripe, borne on orange coloured receptacle. It remains on tree from February to June.

Distribution

Plant is distributed at the outer Himalayas from Sutlej to Sikkim and fairly at hotter parts of India as far as east of Assam. The tree is not found under cultivation but is common in forests often found occurring with Sal.

Climate and Soil

Marking nut tree is common throughout the hotter parts of India. Semi-arid climatic conditions and light to medium gravelly soils with good drainage are most suitable for raising the plantation.

Propagation Material

Plant is propagated by seeds. The seed viability is 6 months.

Agro-technique¹⁸

Nursery Technique

- **Raising Propagules:**

The seedlings are to be raised in

¹⁸ Agro-technique study carried out by DPDKV, Akola, Maharashtra

nursery during March to April. Normally, 30 days are required for seed germination. Transplanting of seedlings is done in rainy season. Seedlings are frost sensitive but have good power of recovery. They are found prone to damping off disease at a tender stage.

- **Propagule Rate and Pre treatment:**

Alternate days soaking of seeds and drying in cow dung for 15 days hasten seed germination. Seed treatment in concentrated H_2SO_4 for 5 minutes followed by washing in running water induces 60-65% germination.

Planting in the Field

- **Land Preparation and Manure Application:**

The field should be ploughed thoroughly followed by harrowing and planking to bring from soils to a fine tilth and free from weeds. The land is mixed with 20 t/ha FYM at planting.

- **Transplanting and Optimum Spacing:**

Marking nut seedlings are planted at 6m X 6m spacing. Pits of 60cm X 60cm X 60cm size are dug out in the month of April-May and exposed to the sun for drying. Each pit is filled with soil mixed with 15-20 kg FYM. The transplanting of seedlings raised

in the nursery is done in rainy season in July. About 277 saplings are required for one hectare land.

- **Intercropping System:**

Intercropping with any short duration crop can be done from early stage of planting till 3-4 years age.

- **Intercultural and Maintenance Practices:**

The intercultural operation like weeding and hoeing is carried out periodically.

- **Irrigation Practices**

Protective irrigation is to be provided in initial years.

- **Weed Control:**

Manual weeding is to be done to keep the plantation free of weed.

- **Disease and Pest Control:**

No major insect pest is noted, however in case of severe infestation bio-control measures are to be adopted.

Harvest Management

- **Crop Maturity and Harvesting:**

Economic yield of seed production takes place after 10 years of plantation. The flowering begins in the monsoon during June-July and the fruits start ripening during November - January. The economic life of the tree is about

25 to 30 years.

- **Chemical Constituents:**

Nut-shells contain biflavonoids – biflavones A, C, A1 & A2. Oil from nuts called Bhilavinol contains a mixture of phenolic compounds. Crystal of Calcium oxalate and oil is present in the mesocarp parenchyma.

- **Yield:**

25-45 kg fruits/tree/annum are

obtained from a full grown tree.

Therapeutic Uses

The fruits and its oil (28-36%) have medicinal property. The fruits are traditionally used for astringent, rubifacient, counter irritant and aphrodisiac properties. Juice of the fruit pericarp is used for marking cotton clothes.

Noticeable impact observed in heart related illness, cancer, etc.

Sphaeranthus indicus Linn.

Fam : Asteraceae

Ayurvedic name	Mundi, Mahamundi, Hapusa
Unani name	Mundi
Hindi name	Gorakhmundi
English name	East Indian Globe Thistle
Trade name	Gorkhmundi
Parts used	Whole plant



Plant of *Sphaeranthus indicus*

Morphological Characteristics

It is an aromatic annual spreading herb with branches, 30cm to 60cm tall. Stems and branches have toothed wings, more or less covered with glandular hairs. Leaves are sessile, decurrent, obovate-oblong, glandular, dentate and narrowed at the base.

Floral Characteristics

Flowers are in compound heads, globose, ovoid in shape, ebracteate, borne on solitary glandular peduncles with toothed wings. Flowers are purple in colour. Involucre of bracts is linear in shape, acuminate apex, pubescent and ciliate near the ends. Fruit is achenes are glabrous and stalked.

Distribution

Plant is found throughout India, at an altitude of 1500 m msl.

Climate and Soil

It grows as a weed in paddy fields and thrives well after harvest of paddy over medium clayey soils.

Propagation Material

Plant is propagated by seeds.

Agro-technique¹⁹

Nursery Technique

- **Raising Propagules:**

Seed are sown in August in well prepared nursery beds. It takes about 10-12 days for germination. Seedlings are ready within one month attaining the height of 5.0 - 6.0 cm. It is then ready for field planting.

Planting in the Field

- **Land Preparation and Manure Application:**

The field is ploughed, harrowed and

¹⁹ Agro-technique study carried out by MPKV, Rahuri, Maharashtra

planked to have a fine tilth. About 5-10 t of FYM along with N:P:K 20:30:30 kg/ha is mixed with soil before transplanting seedlings at a distance of 30cm X 15cm. Irrigation is given immediately. Rest of Nitrogen is given at 30 and 70 days after planting.

- **Intercropping System:**

It can be grown as intercrop in paddy fields.

- **Interculture and Maintenance Practices:**

Two weeding and hoeing are given at 20 and 45 days after planting.

- **Irrigation Practices:**

About 4 to 5 irrigation at an interval of 15 days is required after monsoon rain is over.

- **Disease and Pest Control:**

Leaf eating caterpillar has been observed and can be controlled through bio-pesticide.

Harvest Management

- **Crop Maturity and Harvesting:**

Flowering starts in November and

continues upto March. Seed can be collected from March to April.

- **Post-harvest Management:**

Plant should be dried in shade.

- **Chemical Constituents:**

It has an essential oil, containing methyl chavicol, α -ionone, d-cadinene, p-methoxycinnamadehyde as major constituents and a-terpinene, citral, geraniol, geranyl acetate, β -ionone, shaerene, indicusene and sphaeranthol are minor constituents. Leaves contain some alkaloids.

- **Yield:**

Yield of dry herbage is around 1000-1200 kg/ha.

Therapeutic Uses

The whole plant is used for formulation of medicine. It is pungent, bitter and stomachic and stimulant. It is a remedy for glandular swelling in the neck, urethral discharge and jaundice. The juice of plant is styptic and useful in liver and gastric disorder. A decoction of the root is used for chest pain, cough and bowel complaints. Bark powder mixed with whey is useful in piles. Leaf juice boiled with milk and sugar candy used for cough.

Streblus asper Lour.

Fam : Moraceae

Ayurvedic name	Shakhotaka, Sihor
Unani name	Sihor
Hindi name	Daheya
English name	Siamee Rough Bush or toothbrush tree
Trade name	Sihora
Parts used	Leaves, fruits, roots



Twig of *Streblus asper*

Morphological characteristics

It is a small, rigid, evergreen tree with latex and grows upto 15 meter in height. Twigs are hairy and interwoven. Bark is rough grey to greenish in colour. Leaves are simple, alternate, rhomboid, elliptic, acute or acuminate more or less crenate-scabrid on both surfaces.

Floral Characteristics

It flowers from January to March. Flowers are dioecious. Males heads are globose, minute and yellowish-green in colour. Female flowers are very small, solitary or 2-4 together. Dioecious plants are to be planted in 3:1 female and male ratio for higher fruit yield. Tree produces succulent large drupes during April to May, Drupes have fleshy base. The fruits are yellow when ripe and single seeded. Seeds are smooth, round, greenish-white in colour and light in weight.

Distribution

It is distributed throughout drier parts of India usually along the river banks. In Karnataka, it is found in rain forests of North Canara and Banavasi region.

Climate and Soil

Red loamy lateritic soils and clayey - loam soils are suitable for plantation. It grows wild in dry areas up to 600 m msl.

Propagation Material

Hard wood rooted cuttings of one year old are used for planting in the field.

Agro-technique²⁰

Nursery Technique

- **Raising Propagules and Pretreatment:**
- The hardwood cuttings having 3-4 nodes are to be treated with 200 ppm,

²⁰ Agro-technique study carried out by University of Agricultural Sciences, GKVK Campus, Bangalore

IBA for 18 hours and planted in polythene bags. These are kept in intermittent mist chamber for better rooting and field establishment.

Planting in the Field

- **Land Preparation and Manure Application:**

The soil should be ploughed and harrowed thoroughly to have a fine tilth. Pits of 45 cm cube in size are dug at a spacing of 4 meter. These are filled with top soil mixed with FYM or forest mulch. Application of 6-8 kg FYM along with NPK 50:30:40 gm per plant is ideal in the first year. In the second year, application of 75:40:40 gm NPK per plant and 100:50:70 gm NPK per plant from third year onward is recommended. The entire dose of P, K and 1/3 N should be applied during September and remaining N should be given in two split doses during February and June. The nutrients are applied in rings around the tree at a distance of 30 cm.

- **Transplanting and Optimum Spacing:**

One year old rooted hard wood cuttings are planted in the main field at a spacing of 4m x 4m.

- **Intercropping System:**

Annual or small perennial herbs like Ashwagandha, Sarpagandha,

Periwinkle, Kalmegh, Coleus *etc.* can well be accommodated. Other medicinal trees like Amla and fruit trees like Guava, Sitaphal can also be intercropped.

- **Irrigation Practices:**

Irrigation has to be provided till the establishment of plants. Well established plants are hardy and withstand drought. *Streblus* can easily be grown as a rainfed plantation crop under Bangalore conditions.

- **Weed Control:**

Manual weeding is recommended in between the rows during the months of December and May.

- **Disease and Pest Control:**

The plant is hardy and only powdery mildew disease is noticed in water logged conditions.

Harvest Management

- **Crop Maturity and Harvesting:**

Useful parts such as leaves, fruit and bark can be harvested after 5 year old trees onwards.

- **Post-Harvest Management:**

Transverse incisions are made with a small axe and thin strips of outer bark are torn off. Initial blaze of 15cm X 10 cm X 2.5 cm to 3 cm is made and

number of blazes depend on girth. Trees of girth around 25-45 cm are best suited. The bark is dried and stored.

- **Chemical Constituents:**

Plant contains tri-terpenoids, friedelin, epifriedelinol, taraxasteryl acetate. Root bark contains cardiac glycoside, cardenolide, kamalosite, asperoside, indroside, lucknoside, and strophalloside, glucogito dimethoside, strophanolloside, glucokamalosite, sarmethoside and glucostraboside, stem bark contains cardiac glycoside strebloside mansonin.

- **Yield:**

Five year old tree is estimated to yield 1 kg fresh bark.

Therapeutic Uses

The root is prescribed as a cure for elephantiasis. Roots are astringent, bitter, acrid, anti-inflammatory, healing, haemostatic, febrifuge and antiseptic. They are useful against vitiated conditions of kapha, ulcers, sinusitis, elephantiasis, boils, haemorrhage, bronchitis, diarrhoea, dysentery, syphilis and hemorrhoids. The bark is used for constipation and ulcers.

Stereospermum colais (Dillw.) Mabb.

Syn. *Bignonia caudata* DC.

Fam : Bignoniaceae

Ayurvedic name	Patala, Patali,
Unani name	-----
Hindi name	Patala
English name	Trumpet Flower, Yellow Snake tree
Trade name	Pardi, Podhel, Utapali
Parts used	Root



Tree of *Stereospermum colais*

Morphological Characteristics

It is a large deciduous tree, often buttressed upto 20 m in height. Leaves are 30-45 cm long, imparipinnate, opposite. Leaflets are 5-11 in number, purple when young. Petiole is short.

Floral Characteristics

Flowers are bisexual, drooping, large, glabrous panicles, yellow or dark purple with red coloured veins. Fruit is capsule 30-45cm X 0.5-1.3cm, spirally twisted, 4 angled. Seed is 3.0 X 0.6cm in size, deeply notched at the middle, winged and many in numbers.

Distribution

It is distributed throughout the moist parts of India and widely distributed in the deciduous forests of Kerala.

Climate and Soil

The plant prefers hot and humid climate with temperature ranging from 20°C to 33°C and humidity 40-50%. It grows over sandy black and lateritic loamy soils.

Propagation Material

Propagation material is seed.

Agro-technique²¹

Nursery Technique

- **Raising Propagules:**

The whole capsule is collected from the mother plant and dried for one week under shade. The seeds are liberated from the dry capsule and the wings are removed and graded by seed blower. The viability of seed remains for two months and declines gradually and lost after 5th month of harvest. Seeds are sown immediately after removing the wings. Seeds are rolled on paper towel and placed inside seed

²¹ Agro-technique study carried out by Tropical Botanic Garden & Research Institute (TBGRI), Thiruvananthapuram

germinator at 32°C or in nursery condition at room temperature under mist house which are ideal conditions for germination. The seed germination takes place from 6 to 20 days and the germination is completed within 8-15 days. The vegetative propagation are also developed through stem cutting .

- **Planting of Seedlings:**

Seedlings having two pair of leaves of four cm in height can be transplanted in polybags containing growth medium (sand +cow dung @ 2:1). Plants remain in polybags for about 8 months before planting in field in next rainy season. Light irrigation and shade facilitate establishment of plants.

Planting in the Field

- **Land Preparation and Manure Application:**

About one year old seedling of 70-80 cm in height is ideal for field planting. Best time for field planting is rainy season at end of May.

- **Transplanting and Optimum Spacing:**

Pits of 30cm X 30cm X 30cm are dug at a distance of 10 m between rows. About 330 seedlings are planted in one hectare. It attains a height of 15-20 meter and branches spread up to 10-15 meter in next six years.

- **Interculture and Maintenance:**

Tree saplings in the field are provided with regular weeding and mulching twice in a year. The plants are given moderate watering in summer season. In the early developmental stages, usually a number of branches arise, but only one leader branch is allowed to grow and supported with good stake. Rest of the branches is pruned out.

- **Weeding:**

Weed removal and mulching is necessary at the basal portion at a diameter of 1.5 meter.

- **Disease and Pest Control:**

In the seedling stage no serious attack of pest or fungal infection are noticed. Parasitic nematodes infest the foliage and eat chlorophyllous tissue during the summer. It can be controlled effectively by using systemic bio-pesticides applied as a foliar spray.

Harvest Management

- **Crop maturity and Harvesting:**

Root can be harvested after five years.

- **Post Harvest Management:**

Roots are dried in shed and stored in gunny bags.

- **Chemical Constituents:**

Leaves contain a flavone named

stereolensin and has been characterized as 5, 7, 3, 4-tetrahydroxy 6-O- β -D-glucopyranosyl flavones.

- **Yield:**
27-32 t/ha fresh root is obtained.

Therapeutic Uses

Root is used in medicine. Root bark is one of the constituents of “**Dashmula**” preparation used as tonic, diuretic. Root is anti-inflammatory, anti-asthmatic, anti-emetic and febrifuge. It is biliary, stimulant, of cardiogenic, diuretic and used in piles and nervous disorders.

Vateria indica Linn.

Syn. *Vateria malabarica* Bl.

Ayurvedic name	Sarja
Unani name	Raal Safed
Hindi name	Kahruba, Dammar
English name	White Damar, Indian Copal-Tree
Trade name	Vellapine, White Dhup, White Damar, Piney resin
Parts used	Resin of trunk

Fam : Dipterocarpaceae



Fruits of *Vateria indica* along with foliage.

Morphological Characteristics

Plant is a large magnificent evergreen resinous tree, reaching up to 25 meter tall. Trunk is about 3 m in girth. Bark is smooth, about 1 cm thick, whitish grey blotched with green, bitter and acrid in taste, peeling off into round flakes. Blaze is dull brown. Wood is white and hard. Young branchlets are drooping, with minute stellate trichomes. Leaves are alternate, elliptic, oblong, 10-25cm X 5-10cm in size, heart-shaped or rounded, apex acuminate, margin entire, leathery. Lateral veins are 12-14 pairs, stout and parallel. Stipules are prominent.

Floral Characteristics

Flowers are bisexual, about 2 cm across, white, slightly fragrant, arranged in panicles. Panicle is robust, multi-branched, up to 15 cm long and drooping. Fruit is capsules, 4-6 cm X 2-4 cm in size, pale-

brown, fleshy, hard when dry, splitting by 3 valves when ripe.



Fruits of *Vateria indica* on the plant

Distribution

It is also endemic to Western Ghats in Maharashtra, Karnataka, Kerala and Tamil Nadu.

Climate and Soil

It is a large resinous tree. Normally used as an avenue tree. It is found in moist deciduous to evergreen forests, especially along watercourse. It is found at an altitude

up to 1200 m msl.

Propagation Material

Propagation material is seed.

Agro-technique²²

Nursery Technique

- **Raising Propagules:**

Seeds are collected from fully ripened fruits. The normal practice is to collect the fallen fruits. Seeds are sown in raised nursery bed of 10mX1.0m. Seeds germinate in about 30-45 days after sowing. The nursery bed is prepared by mixing sand, soil and Farm Yard Manure in 1:1:1 ratio.

- **Transplanting the Seedlings to Poly Bags:**

Seedlings of 45 days old are transplanted into poly bags having 10 kg of soil mixture containing sand, soil and FYM. Seedlings are maintained for about six months for proper root establishment in the poly bags.

- **Transplanting the Seedlings to Main Field and Optimum Spacing:**

Trees are huge and can survive in the field about 80-100 years. The well-established seedlings are planted in the field in rainy season. Spacing of 15m X 15m from plant to plant and row to

row is recommended and accommodating 45 trees per hectare only.

Planting in the Field

- **Land Preparation and Manure**

Application:

Seedlings of polybags are planted in the field. The trenches measuring by 60cm X 60cm X 60cm are opened and filled with 20 kg of FYM, covered with sand and seedlings are planted at the center of the trench. FYM @ of 25-30 kg per tree is applied in a circular ring at a distance of 1m from the trunk for first three years.

- **Green Manuring:**

To sustain the productivity, green manuring crop like Mucuna, Dhaincha, Arhar etc is recommended which yields 40-50 tons of green manure in about 70 days after sowing. It is recommended that the seeds of velvet bean about 12.5 kg/ha are dibbled at spacing of 1m X 1m. The farmers may plough back the debris in-situ to enrich the soil fertility or the plant residues can be harvested and taken elsewhere to prepare vermi-compost manure to apply afterwards.

- **Irrigation and Intercultural Operations:**

²² Agro-technique study carried out by Indian Institute of Horticulture Research, Hesaraghatta Lake Post, Bangalore-560089

Watering in summer month is provided as per requirement.

- **Intercropping System:**

The space in between the plants may be utilized for cultivating intercrops. Field crops such as maize, wheat, rabi, jowar and vegetable crops may be cultivated. Fruit crops such, as papaya, pineapple and guava, may be cultivated to increase the crop productivity as well as to get the subsidiary income.

- **Pests and Diseases:**

Leaf webber affect this crop during October-December. It can be controlled by spraying Neem soap at 5 gm/l or neem seed kernel oil at 5 ml /l. To ward off infestation by termites Neem cake @ of 5 kg per plant may be applied to soil during November-June.

- **Special advise:**

It could be planted in the boundary of homestead organization

Harvest Management

Trees are cultivated for resinous gum. It is collected by incision in the bark. The plants are expected to yield gum after 15 years of planting. Yield of gum ranges from 0.5 kg in the initial harvesting to about 2.5 kg/tree at 40-50 years of age. Sustainable

harvesting is obtained by removing 1/3rd of the bark of the plant to exude resin.

- **Crop Maturity and Harvesting:**

The tree becomes ready to yield resin after 20 years of age.

- **Chemical Constituents:**

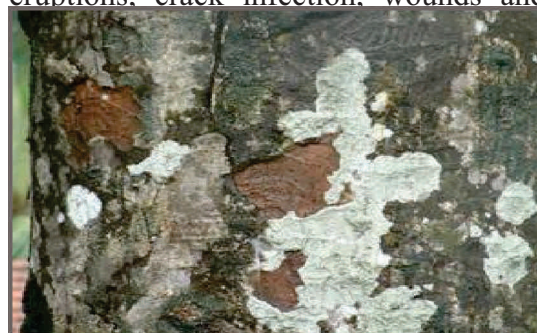
The tree yields a resin, which is complex mixture of triterpenes. Seeds yield, a semi solid fat known as piney tallow of Malabar. Gum yield lipids namely Vateriaphenol A, Vateriaphenol B, Vateriaphenol C and Vaticanol C and have been found active against tumours.

- **Yield:**

Yield not estimated under plantation.

Therapeutic Uses

The dammar resin obtained from bark of the tree is used in chronic bronchitis and throat troubles. The resin is used for the treatment of cough, asthma, leprosy, skin eruptions, crack infection, wounds and



Vateria indica (trunk portion-note the white bark)

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 plant
Bark	: Outer covering of trunk, branches and roots of trees
Berry	: Small juicy, fleshy, stoneless fruit that contains one or many seeds
Biennial	: Plant takes two years to complete the full life cycle
Bilateral	: Two sides

Birch	: These are broad-leaved, 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 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 (as in <i>Dioscorea bulbifera</i>)
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
Cork	: It is the soft, light weight bark of the cork oak tree.
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
Discoid	: Disc-shaped
Dispersal	: It is a process in which an organism spreads out geographically
Dominant	: It is the most abundant species 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
Gynoecium	: 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 region and were not introduced there by man
Inferior ovary	: An ovary located below the flower parts
Inflorescence	: A cluster of flowers
Lanceolate	: Shape of convex lens
Lateral	: Near or from the side of an organism
Latex	: Oozing milky sap
Leaflet	: In a compound leaf the individual blades are known as leaflets
Lemma	: A bract in a grass spikelet 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 atoms 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 needs 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 completely decomposed plant material that is waterlogged and low in oxygen
Pedicel	: 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, sometimes 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 whorles 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
Variiegated	: 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	: Asymmetrical 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 (e.g. 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
Anhydrotics	: Which decrease perspiration

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; Used against malarial fever
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 etc.
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	: Dminishes functional activities of any cell, tissue, organ and system
Depurant	: Purifier
Derivativities	: 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

Flatulence	: 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 genito-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
Hypnic or Hypnotic	: 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	: Smoothing rectal wall and loosening the stool
Lenient or Lentitive	: Allays irritation and eases pain; also acts as demulcent and mild purgative
Leprosy	: Chronic contagious diseases due to infection with Lepra bacillus
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, Plasmodium, 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
Odontalgics/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

Pectoral	: 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
Respiratory sedative	: Respiratory depressant- Decreases force or slows rate of respiration
Respiratory stimulant	: 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 vit. 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 Treponema pallidum
Taeniicide	: Drug that kills tapeworms
Tetanus	: An infectious disease caused by the bacillus Clostridium tetani
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
Tonsilitis	: Inflammation of the tonsils
Tranquilizer	: A drug used to calm a person and reduce mental activity
Tuberculosis	: An infectious disease caused by the Tuberculi bacillus
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 bloodpressure, 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 etc

Publications of National Medicinal Plants Board (NMPB)

- 1. Agro-techniques of Selected Medicinal Plants -Volume I**
- 2. Agro-techniques of Selected Medicinal Plants -Volume II**
- 3. High Yielding Varieties of Some MAPs with General Guidelines for Seed Production and Certification**
- 4. Good Agricultural Practices (GAPs)**
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