



# PRACTICAL MANUAL



## Medicinal & Aromatic Crops

B.Sc. (Hons.) Horticulture

Semester : V<sup>th</sup> (New)

Course No.: H/MAP-351

Credits : 3 (2+1)



### College of Horticulture

Vasant Rao Naik Marathwada Krishi Vidyapeeth  
Parbhani-431 402

**VASANTRAO NAIK MARATHWADA KRISHI VIDYAPEETH,  
PARBHANI-431 402**

---

# **PRACTICAL MANUAL**



**PREPARED AND COMPILED BY**

**Dr. A.S. Lohakare,**

Assistant Professor,

College of Horticulture, VNMKV, Parbhani.

**PUBLISHED BY**

**Dr. G.M. Waghmare**

Associate Dean and Principal

College of Horticulture, VNMKV, Parbhani.

---

**College of Horticulture,  
VNMKV, Parbhani**



**COLLEGE OF HORTICULTURE,  
VASANTRAO NAIK MARATHWADA KRISHI VIDYAPEETH,  
PARBHANI**

**Certificate**

Certified that Mr./Miss. \_\_\_\_\_

Registration No. \_\_\_\_\_ has completed all practical exercises  
for the course Medicinal and Aromatic Crops (Course No. H/MAP-351)  
during academic session \_\_\_\_\_

**Place : Parbhani**

**Date :**

**Remarks :**

**Signature of course teacher**

**Course Title** : Medicinal and Aromatic Crops  
**Course No** : H/MAP-351  
**Credits** : 3 (2+1)  
**Semester** : V (New)  
**Degree** : B.Sc. (Hons.) Horticulture

## INDEX

SN	Particulars	Page No.	Date	Signature
1	Collection of medicinal and aromatic plants from their natural habitat.	01		
2	Identification of medicinal and aromatic plants.	02		
3	Study of morphological description of medicinal plants (Withania, Periwinkle, Safed Musli, Arjun, Behada, Rauvolfia, Dioscorea).	09		
4	Study of morphological description of medicinal plants (Isabgol, Opium Poppy, Panpimpali, Ammi Majus, Belladonna, Wild Brinjal, Cinchona, Pyrethrum and Hirda).	11		
5	Study of morphological description of aromatic plants (Flag, Lavender, Geranium, Patchouli, Mentha, Musk, Ocimum, Lemon grass, Tikhadi).	13		
6	Nursery techniques in medicinal and aromatic plants.	15		
7	Harvesting of medicinal plants (Withania, Periwinkle, Safed Musli, Arjun, Behada, Rauvolfia, Dioscorea, Aloe-vera).	20		
8	Harvesting of medicinal plants (Isabgol, Opium Poppy, Panpimpali, Ammi majus, Belladonna).	22		
9	Harvesting of medicinal plants (Wild Brinjal, Cinchona, Pyrethrum and Hirda).	23		
10 - 11	Harvesting of aromatic plants (Citronella grass, Khus grass, Flag (baje), Lavender, Geranium, Patchouli, Bursera, Mentha, Musk, Ocimum, Lemon grass, Tikhadi).	24		
12 - 13	Curing and processing techniques of medicinal plants.	27		
14	Curing and processing techniques of aromatic plants.	30		
15 - 16	Extraction of essential oils in medicinal and aromatic plants	32		

# COLLECTION OF MEDICINAL AND AROMATIC PLANTS FROM THEIR NATURAL HABITAT

### Introduction

Plant known as medicinal or officinal, are rich in secondary metabolites which are potential source of drugs and essential oil. The biosynthesis of the secondary metabolites although controlled genetically is affected strongly by environmental influences (Milca, 1962). Survey of medicinal and aromatic plants in arid zones as it is their natural habitat.

There are few medicinal plants which are considered as desert plants, native of the arid zones of the world (Paris and Dillemann, 1960). There are not enough data to answer the question whether these ecological conditions are optional to the formation of the secondary metabolites usable in medicine. Since the arid zone climate consists of not only drought but also high temperature and lack of rains that could wash out the secondary metabolites the interaction of the two factors affects the plants' adaptability to its environment in this case.

Plants rich in essential oils are much more abundant in dry than in humid habitats. The plants rich in mucilage, especially in their vegetative organs, are also abundant in the arid regions (Fluck, 1955).

### A) Medicinal plants

Medicinal plants are those plants rich in secondary metabolites and are potential source of drugs. These secondary metabolites include alkaloids, glycosides, coumarins, flavonoids, steroids. These plants form main base for the manufacture of drugs of Indian systems of medicine (Ayurveda, Unani, Siddha) and Homeopathy. These plants are found in various parts of the country in different environmental and climatic conditions. Plants which grow wild in forest region, classified as minor forest produce, supply a substantial amount of raw material required for the indigenous drug industry.

### B) Aromatic plants

Aromatic plants are defined as those plants which process **essential oil**. These essential oils are the odoriferous steam volatile constituents of the aromatic plants. They are mainly a complex mixture of acyclic and or cyclic mono terpenoids. These terpenoids are basically secondary metabolites and they have no apparent function in the plants primary metabolism. These essential oils are used in perfumery, cosmetic and pharmaceutical industries where as the essential oils obtained from spices and condiments. Which impart the flavour and improve the taste of the food is used in several flavour industries.

**Assignments:** Collect the medicinal and aromatic plants from their natural habitat.



### IDENTIFICATION OF MEDICINAL AND AROMATIC PLANTS



**MEDICINAL YAM**  
*Dioscorea floribunda*



**ASHWAGANDHA**  
*Withania somnifera*



**PERIWINKLE**  
*Catharanthus roseus* (G.) DON



**SAFED MUSLI**  
*Chlorophytum borivillianum*



**ARJUN**  
*Terminalia arjuna*



**BEHADA**  
*Terminalia bellirica*



**SARPAGANDHA**  
*Rauvolfia serpentina* Benth.



**ALOEVERA**  
*Aloe barbadensis* Mill.



**ISABGOL**  
*Plantago ovata* Forsk.





OPIUM POPPY  
*Papaver somniferum*



PANPIMPLI  
*Piper longum* Linn.



Beshop's weed  
*Ammi majus*



BELLADONNA  
*Atropa belladonna* L.



WILD BRINJAL  
*Solanum khasianum*



CINCHONA  
*Cinchona* sp.



PYRETHRUM  
*Chrysanthemum cinerariaefolium*



HIRDA  
*Terminalia chebula*



Sweet Flag  
*Acorus calamus*



BURSERA  
*Bursera microphylla*



AMBRETTE  
*Abelmoshus moschatus*



SHATAVARI  
*Asparagus racemosus*





BETEL VINE  
*Piper betel*



STEVIA  
*Stevia rebaudiana*



ADULSA  
*Adhatoda* sp.



CITRONELLA GRASS  
*Citronella winterianus*.



VETIVER  
*Vetiveria zizanioides* L.



LEMON GRASS  
*Cymbopogon* sp.



PALMAROSA  
*Cymbopogon martinii*



LAVENDER  
*Lavendula* sp.



GERANIUM  
*Pelargonium graveolens* (L.)



PATCHOULI  
*Pogestemon patchouli*



JAPANESE MINT  
*Mentha arvensis* L.



SACRED BASIL  
*Ocimum sanctum*

SN	Name of crop	Botanical name	Family	Origin	Plant parts used	Varieties	Propagation	Seed rate and spacing	Yield/ha
1	ASHWAGANDHA / WINTER CHERRY	<i>Withania somnifera</i>	Solanaceae	Africa	Roots and fruits	Jawahar Aswagandh (WS-20), Poshita, Nagori	Seed	1-2 kg 60 x 30 cm	Seed yield- 1-1.5 q/ha  Dried roots - 10-15 q/ha.
2	PERIWINKLE / SADAPHULI / SADABAHAR	<i>Catharanthus roseus</i> (G.) DON	Apocynaceae	Southern Switzerland	Leaves and roots	Alba, Roseus, Nimal, M-153, IC-49581, Selection-1	Seed	500 g/ha seed 45x30 cm	Leaves- 2-3 t/ha Roots- 1-1.5 t/ha Stems- 1-1.5 t / ha.
3	SAFED MUSLI	<i>Chlorophytum borivilianum</i>	Asparagaceae	India	Roots	RC2, RC16, RC20, RC36, RC37, Jawahar Safed Musli 405	Roots or Seed	3.33 lakh roots 30x10 cm.	Fresh root 18-20 q/ha  Dry roots 3-4 q/ha.
4	ARJUN	<i>Terminalia arjuna</i>	Combretaceae	Central India	Bark	--	Seed	6x6 m	10-45 kg bark/plant
5	BEHADA	<i>Terminalia bellerica</i>	Combretaceae	South Asia	Bark and fruits	--	Seed	6x6 m	40-50 kg dry fruits/tree/year
6	SARPAGANDHA	<i>Rauvolfia serpentina</i> Benth.	Apocynaceae	South East Asia	Dried roots	--	Seed, root and stem cuttings	5.5 kg seed/ha 45x30 cm	2000 kg/ha dried roots.
7	MEDICINAL YAM / DIOSCOREA	<i>Dioscorea sp.</i>	Dioscoreaceae	South East Asia	Tubers	FB (C)- 1, Arka Upkar	Pieces of tubers	60x30 or 60x45 cm	Tuber yield 50-60 t /ha



SN	Name of crop	Botanical name	Family	Origin	Plant parts used	Varieties	Propagation	Seed rate and spacing	Yield/ha
8	ALOEVERA	<i>Aloe barbadensis</i>	Liliaceae	Eastern and Southern Africa	Leaves	<i>A.veravar.chinensis</i> , <i>A.abysinnica</i> , <i>A.variegata</i>	Root suckers or rhizome cuttings	36300 suckers/ha 60x45 cm	Average leaf yield is 30-40 t/ha.
9	ISABGOL	<i>Plantago ovata</i>	Plantaginaceae	Iran	Seed and husk	Gujarat Isabgol-1, Gujarat Isabgol-2, Niharika, Jawahar-4, Trombay selection, Hissar-2 & 5.	Seed	8 - 10 kg/ha The seeds are sown by broadcast method	Average seed yield is about 1 t/ha.
10	OPIUM POPPY	<i>Papaver somniferum</i>	Papavaraceae.	Western Mediterranean Region	Seed and Capsules	Talia, Dhola Chota Gotia, MOP-16, Shweta, Ranghatak, Shama	Seed	2.5 to 3.5 kg/ha	25-30 kg/ha crude opium and 4-5 q/ha of seeds.
11	PANPIMPLI	<i>Piper longum</i> Linn	Piperaceae	India	Fruits and Roots	Viswam	Vine cuttings.	60X60 cm.	12-15 q/ha fresh fruits and 2.5-4.5 q/ha dry fruits
12	BELLADONNA	<i>Atropa belladonna</i> L.	Solanaceae	Europe	Leaves, stem, roots	–	Seed	60x60 or 60x45 cm	200 to 400 kg dried leaves/ha.
13	MEDICINAL SOLANUM / WILD BRINJAL	<i>Solanum khasianum viarum</i>	Solanaceae	India.	Berries (fruits)	RRL-20-2, RRL-SL-6, Arka Sanjeevani, Arka Mahima	Seed	1.25 kg/ha 50x50 cm	6-8 t/ha fresh berries and 1.8-2.0 t/ha dry fruits.

S N	Name of crop	Botanical name	Family	Origin	Plant parts used	Varieties	Propagation	Seed rate and spacing	Yield/ha
14	CINCHONA	<i>Cinchona</i> sp.	Rubiaceae	South America	Bark	--	Seeds, cutting, stooling, layering and patch budding.	2x2 m HDP- 1.25 x1.0 m.	The yield of bark at final stage of uprooting the tree, may be 6 t/ha.
15	PYRETHRUM	<i>Chrysanthemum cinerariaefolium</i>	Asteraceae.	Dalmatia, Herzegovina and Montenegro	Flowers	KKL-1, Hansa and Jhelum, Sel-2	Seeds and splits	45x25 or 60x45 cm	250 kg/ha
16	HIRDA	<i>Terminalia chebula</i>	Combretaceae	South Asia	Fruits	--	Seed	6x6 m	The yield of 40-50 kg dry fruits/tree/year is expected from full grown tree.
17	FLAG (BAJE)	<i>Acorus calamus</i>	Acoraceae	South Eastern USA	Rhizome, roots and leaves	--	Rhizomes	30x30 cm	Fresh rhizome- 10t/ha Dried rhizome- 4t/ha
18	MUSK/ AMBRETTE/ KASTUR	<i>Abelmoschus moschatus</i>	Malvaceae	India	Seed	--	Seed	12 kg/ha 45x30 cm	Seed yield is 5-8 q/ha
19	LEMON GRASS	<i>Cymbopogon</i> sp.	Graminae	India	Leaves	OD-19, SD-68 and CKP-25	Seed or splits from old clumps	15-20 kg/ha 15x10 cm	25 kg oil/ha - 1 <sup>st</sup> year plantation 80-100 kg oil/ha from 2 <sup>nd</sup> -6 <sup>th</sup> year plantation

S N	Name of crop	Botanical name	Family	Origin	Plant parts used	Varieties	Propagation	Seed rate and spacing	Yield/ha
20	CITRONELLA GRASS	<i>Citronella winterianus</i> . <i>Citronella nardus</i>	Graminae	Tropical Asia	Leaves	RRL - JOR-3, IW 31243, IW 31245, KS-CW- SI	Rooted slips	90 x 60 cm.	Oil yield 200-300 kg/ha
21	VETIVER	<i>Vetiveria zizanioides</i> L.	Graminae	India	Roots and leaves	Bhartapur, Akila, KS-2, Musanagar, HybridQDVI 3, Hybrid7&8	Tillers/slips	1,50,000 to 2,25,000 slips/ha 50x25 cm	Roots yield- 5 to 7 t/ha. Oil yield- 15 to 16 kg/ha.
22	PALMAROSA	<i>Cimnopogon martinivar</i>	Graminae	India	Leaves	IW-31244, RRL (B)-77, RRL (B)-71 and Trishna	Seed	2.5 kg/ha 90x60 cm	15 to 20 t/ha of herbage in a year with an oil yield of 50-60 kg/year.
23	LAVENDER	<i>Lavendula</i> sp.	Labiatae	Mediterranean region	Leaves	CIMAP/B-15	Seed or cuttings	150x75 cm 170x60 cm	Herbage yield 20 q/ha
24	GERANIUM	<i>Pelargonium graveolens</i> (L.) Hervitt.	Geraniaceae	South Africa	Leaves	Kodaikanal-I	Cuttings	60x60 cm	Herbage yield- 200 to 300 q /ha/year and it yields 25-30 kg oil.
25	PATCHOULI	<i>Pogestemon patchouli</i> Hook	Labiatae	Indonesia	Leaves and young shoots	java, Johore, Singapore	Stem cuttings	90x90 cm	Dry leaves 2 t/ha/annum 50-60 kg/ha oil yield
26	MINTS/ MENTHA /POODINA	<i>Japanese mint- Mentha arvensis</i> L. <i>Pepper mint- Mentha piperita</i> L.	Labiatae	Japanese mint is native to China.	Leaves	CIMAP/Hybrid -77, RRL 118/3. Black Mitechem, MSS-1 and Kiran	Suckers or rhizomes	5 q suckers/ha 75x10, 60x10 40x10 cm	Herbage yield is 10 t/ha/harvest and oil yield is 82-100 kg/ha



## PRACTICAL NO. 3

### STUDY OF MORPHOLOGICAL DESCRIPTION OF MEDICINAL PLANTS (*Withania*, *Periwinkle*, *Safed Musli*, *Arjun*, *Behada*, *Rauvolfia*, *Dioscorea*)

**Objective:** To get acquainted with medicinal and aromatic plants by studying their growth habit and specific medicinal use.

S N	Crop	Morphological description
1.	<b>Ashwagandha</b> <i>Withania somnifera</i> Solanaceae	The plant is a small to medium shrub, growing to a height of 1.5 m shoot and leaves covered with hairs. Flowers are pale green, small, born in axillary clusters. Fruit is globose, smooth, red colour enclosed in calyx. <b>PPU:</b> Dried roots. Alkaloids (0.1 to 0.03%) Somnine, somniferine and withasomnine. <b>Use:</b> The roots are regarded as tonic, aphrodisiac, useful in Asthma. Withanolides has remarkable antibacterial properties.
2.	<b>Periwinkle</b> <i>Catharanthus roseus</i> Syn. <i>Vincarosea</i> Apocynaceae	It is a perennial ornamental herb. Flowers are pink/ white bloom throughout the year. Leaves are simple opposite. Fruits are cylindrical follicle with many black seeds. <b>PPU:</b> Leaves, roots and stem. <b>Constituent:</b> Raubasin and serpentine (Roots) Vinblastine and vincristine (Leaves). Raubasin and serpentine have anti-fibrillic and hypertensive properties.
3.	<b>Safed Musli</b> <i>Chlorophytum borivilianum</i> Asparagaceae	It is a small root crop reaching a height of 45-60 cm. The fleshy roots, is a tuber or finger is valued for its medicinal property. The leaves are slightly yellowish and 20-25 white bisexual flowers appears on the flower stalk from the centre of the plant. The seeds are very small and light. The tubers are about 0.5 to 0.9 cm in thickness and 8-10 cm long. Tubers are white in colour and economic part. <b>Uses:</b> It is useful on <i>pitta</i> and <i>vaat</i> . It is effective on fatigueness and blood purification. It is lactating and makes

4.	<b>Arjun</b> <i>Terminalia arjuna</i> Combretaceae	A tall tree, 25-30 m high. It has greyish white trunk 3-6 m in girth. Tonic, astringent in heart diseases as cardiac tonic, scorpion sting and earache etc. Bark is astringent and used in fever. Bark powder mixed with butter (ghee) applied to wounds and injuries. It relieves diarrhoea and dysentery. When taken with goat milk increases sexual power. Gargle of bark decoction in swelling of gums.
5.	<b>Behada</b> <i>Terminalia bellirica</i> Combretaceae	A large tree, deciduous with bluish or ash grey bark, uneven with longitudinal furrows, leaves alternate petiole usually, glandular, flowers small pale green bad smelling, in simple spike. The dried fruits constitute the drug as astringent, tonic and laxative used in piles, diarrhoea and dropsy.
6.	<b>Rauvolfia</b> <i>Rauvolfia serpentina</i> Apocynaceae	An erect glabrous shrub 50 to 75 cm tall. Leaves whorled, flowers are white or pinkish, fruits small, round, dark purple. <b>PPU:</b> Dried roots <b>Constituents:</b> Alkaloids. Chief use is as a sedative and hypnotic and for reducing blood pressure. Mental illness.
7.	<b>Dioscoria (Medicinal Yam)</b> <i>Dioscorea floribunda</i> Dioscoreaceae	Medicinal yam is a twining herb; leaves are simple, prominent nerves. Bulbils in leaf axil. There are 15 spp. containing diosgenin. Medicinally valuable species <i>composita, deltoidea</i> <b>PPU:</b> Tuber roots (Diosgenin) <b>Use:</b> Source of steroidal drugs which are used as anti-inflammatory, anti-fertility properties. (contraceptive pills and cortisone)
8.	<b>Aloe vera</b> <i>Aloe barbadensis</i> Mill. Liliaceae	Aloe is a coarse looking, perennial, shallow rooted plant with a short stem, 30-60 cm high. The plants have multiple tuberous roots and many supporting roots penetrating into the soil. Aloe does not have a true stem but produces bloom stalks. The plants generally grow close to the ground in a typical rosette shape. The fleshy leaves are densely crowded and have a spiny margin with thin walled tubular cells. The flowers vary from yellow to rich orange in colour and are arranged in axillary spikes. The ovary is superior, trilocular with axial placentation. The plant does not produce many viable seeds.

## PRACTICAL NO. 4

### STUDY OF MORPHOLOGICAL DESCRIPTION OF MEDICINAL PLANTS

(Isabgol, Opium Poppy, Panpimpali, Ammi majus, Belladonna, Wild Brinjal, Cinchona, Pyrethrum and Hirda)

S N	Crop	Morphological description
1.	<b>Isabgol</b> <i>Plantago ovata</i> Forsk Plantaginaceae	Plant is an almost stemless, small herb, covered with soft hairy growth. Leaves are narrow. Flowers are minute in cylindrical spikes. Seeds are boat shaped. <b>PPU:</b> Seeds and Husk (the husk yields a colloidal mucilage consisting xylose, arabinose and galacturonic acid. The husk is used to cure inflammation of the gastro intestine and genitor-urinary tracts. Chronic constipation, piles.
2.	<b>Opium Poppy</b> <i>Papaver somniferum</i> L. Papaveraceae	The plant is an erect annual, rarely branched, growing to a height of 60 to 90 cm. The leaves are ovate, oblong or linear oblong. Flowers are pink bluish or white, purple or variegated. Fruits are globose about 2.5 cm. Seeds are very small white colour. <b>PPU:</b> Latex from capsule. (40 alkaloids opium and codeine). <b>Uses:</b> Opium is an addictive narcotic, used as sedative to relieve pains and cause sleep in addition to their use against cough.
3.	<b>Panpimpali</b> <i>Piper longum</i> Linn. Piperaceae	Long pepper is the fruit of <i>Piper longum</i> which is a slender, much branched, ascending herb and needs support for its proper growth. The leaves are 5-9 cm long and 5 cm wide. The young shoots are drooping type. Flowers are unisexual arranged in erect spikes. Female spikes are 1.25-2.00 cm long and stout. It gives rise to multiple fruit, which is shining dark green when immature and blackish-green when fully mature. <b>Uses:</b> Fruits and roots are useful in cold cough, chronic bronchitis, diarrhoea, indigestion, jaundice, asthma, piles, fever, flatulence, abdominal disorders, vomiting and worms. It is also used to treat rheumatic pains, paralysis, insomnia, epilepsy and leprosy.
4.	<b>Ammi majus</b> <i>Ammi majus</i> Apiaceae	An exotic (Egypt) biennial glabrous herb; requiring mild cool climate; fruit is the economic part. <b>Uses:</b> Fruits containing 0.4% Xanthotoxin used in the treatment of leucoderma and in the formulation of suntan lotion.



5.	<b>Belladonna</b> <i>Atropa belladonna</i> L. Solanaceae	The plant is an erect; branched perennial herb, growing to a height of 90 cm, leaves brownish green, flowers axillary, solitary or in pairs, bell shaped, yellow brown, fruit is purple black berry. <b>PPU:</b> Leaves, flowering tops and roots. Alkaloids-atropine, Hyosine (0.45%) <b>Use:</b> Anti-asthmatic, antispasmodic and anti-inflammatory. Used in the rheumatism and gout.
6.	<b>Wild Brinjal</b> <i>Solanum khasianum</i> Syn <i>Solanum viarum</i> Solanaceae	It is much branched undershrub, height up to 0.75 to 1.5 m. leaves are ovate, lobed, pinkly on both the surface. Flowers are white borne in racemes of 1 to 4 flowers. Fruits are globose, green, yellow coloured. <b>PPU:</b> Fruits. <b>Constituents:</b> Solasodine (1.0 to 1.75%) <b>Uses:</b> Source of steroidal raw material. Solasodine used as a substitute for diosgenin in the synthesis of steroidal hormones. The extract has nematocidal and bactericidal properties
7.	<b>Cinchona</b> <i>Cinchona officinalis</i> Rubiaceae	<i>Cinchona spp</i> (x=17) are evergreen shrubs or trees. The leaves are opposite, simple entire; the stipules are interpetiolar and deciduous. The inflorescence is a terminal panicle. The flowers are small and fragrant the calyx is small united and has pointed lobes; the corolla is tubular with 5 spreading lobes and a frill of hairs along the margins, it is heterostylous. The fruit is a capsule with seeds are flat and winged. <b>PPU:</b> Bark (alkaloids 6 to 8%) Quinine, Quinidine, Cinchonine are used in anti-malarial drugs. Quinine sulphate is used in heart trouble.
8.	<b>Pyrethrum</b> <i>Chrysanthemum cinerariaefolium</i> Asteraceae	<i>C. cinerariaefolium</i> (2n=18) is a glaucous, perennial herb which grows up to 60 cm tall. It has an unbranched stem with short, scattered hairs below the flower. The leaves are petiolate, long finely cut and silky beneath, with distinct segments. Numerous flower-heads are borne which measure 6-9 mm when closed, and 9-12 mm, when open. The cream-colored floret looks like that of the field daisy ( <i>C. leucanthemum</i> Linn.), but differs from the latter in having the central teeth of ray-floret shorter than the adjacent ones.
9.	<b>Hirda</b> <i>Terminalia chebula</i> Combretaceae	A large deciduous tree with dark brown bark. Young parts covered with rusty hairs leaves mostly such opposite, 6-12 on either side of the midrib petiole hardly exceeding 2 cm. often with 2 or more glands leaves are almost opposite pairs. Flowers dull white in spikes at the end of branch. <b>Uses:</b> The bark is useful as cardiac tonic, as it raises the blood pressure and is a effective diuretic. The fruits are an astringent and used as mild safe laxative in stomachic. The unripe fruit is used in dysentery and diarrhoea ripe fruits are safe purgative.

## PRACTICAL NO. 5

### STUDY OF MORPHOLOGICAL DESCRIPTION OF AROMATIC PLANTS (Flag, Lavender, Geranium, Patchouli, Mentha, Musk, Ocimum, Lemon grass, Tikhadi)

S N	Crop	Morphological description
1.	<b>Flag (baje)</b> <i>Acorus calamus</i> Araceae	It consists of tufts of basal leaves that rise from spreading rhizomes. The leaves are erect yellowish brown radical with pink sheathing at their bases. Sword shaped flat and narrow, tapering into a long, acute point and has parallel veins.
2.	<b>Lavender</b> <i>Lavendula</i> sp. Labiatae	Lavender is a shrub of 30 to 90 cm high with a short but irregular, crooked, much branched stem, covered with yellowish grey bark which come off in flakes and very numerous, erect, straight, broom like, slender, blunt opposite entire sessile and linear 3 cm flowers very shortly stalked 3-5 together in little opposite cymes in the axis of braces.
3.	<b>Geranium</b> <i>Pelargonium graveolens</i> Geraniaceae	There are about 600 species of the genus <i>Pelargonium</i> , many of which possess an agreeable odour. Other species like <i>P. radula</i> , <i>P. fragrance</i> are of lesser importance and have not attained any commercial significance. Geranium is a bushy, aromatic plant. The stem is cylindrical, woody at the base, pubescent, green when young and turning brown with age. The leaves are alternate, stipulate, simple, with 5 primary lobes and secondary lobes and densely pubescent. The leaves are highly aromatic in nature. The inflorescence is umbellate and hairy. The flower is bisexual, hypogenous, with a pink corolla.
4.	<b>Patchouli</b> <i>Pogestemon cablin</i> Labiatae	It is herbaceous perennial plant an erect, branched, pubescent herb, 0.5 to 1.0 m high and aromatic when crushed. The leaves are ovate to oblong-ovate, coarse, simple or doubly crenate-serrate, on both surfaces more or less densely tomentose. The petiole is 6-8 cm; the stem is densely tomentose and swollen on the nodes; the spikes are terminal and axillary, panicle, dense, sometime interrupted, 2.5-14 cm long. The oil extracted from leaves and twigs are used to scent shawls and other fabrics.
5.	<b>Mentha</b> <i>Mentha arvensis</i> Labiatae	Plants are aromatic herbs, growing to a height of 50 to 60 cm. leaf margin toothed, flowers are small, axillary.



6.	<b>Musk/Ambrette/ Kasturbhendi</b> <i>Abelmoschus moschatus</i> Malvaceae	It is an erect, hirsute, branching shrub, 0.5 to 1 m in height, with leaves of varying shape, usually palmate, with 5 to 7 lobes. The flowers are large, 7.5 to 10 cm in diameter and yellow color with a purple centre. The fruit is a capsule or pod, oblong, lanceolate, 5 to 7.5 cm long, containing a large number of seeds which are scented.
7.	<b>Ocimum</b> <i>Ocimum sp.</i> Lamiaceae	It is an erect, herbaceous, much-branched softly hairy, biennial or triennial plant, 30-75 cm tall. <b>Uses:</b> Used in perfumery and cosmetics industries. Used in indigenous system of medicine. The oil of certain species of ocimum has the antifungal, bactericidal and insecticidal properties too. <b>PPV:</b> The major constituents of ocimum oils include linalool, geraniol, citral, camphor, eugenol, methyl charcol, thymol.
8.	<b>Lemon grass</b> <i>Cymbopogon sp.</i> Gramineae	Plant is aromatic grass arising from woody rhizome, leaf sheath is glabrous hairy, leaf blade about 1 m in length. Cross pollinated. <b>Constituent:</b> Citral; Oil recovery: 1.2 to 1.5% <b>Use:</b> Perfumery and synthetic Vit. "A"
9.	<b>Tikhadi/ Palmarosa</b> <i>Cymbopogon martini</i> Poaceae	It is an aromatic, perennial grass, which attains a height of 3 m. The aerial parts die in the winter. Being very susceptible to frost, its leaves and shoots may dry up even in November when there is early frost, but usually withering starts in December, and by the end of January the plant dries up completely. <b>PPU-</b> Leaves and floral shoots <b>Oil recovery:</b> 0.4 to 0.6%; <b>Constitute:</b> geraniol 75 to 95%.
10.	<b>Vetiver or khus</b> <i>(Vetiveria zizanioides)</i> Poaceae	The underground part of the plant yellow or grey to reddish in colour, which contains a viscous essential oil with a pleasant and persistent odour. The commercial oil of vetiver is obtained by the distillation of the root. In India, the plant is known as khus. Khus meaning 'aromatic root'. The major constituents are vetivone, vetiverols, vetiverenyl, vetivernate, benzoic acid and palmitic acid. The root possesses a most agreeable aroma and is employed to scent clothes, either by itself or in the form of sachets. <b>PPU:</b> Roots.
11.	<b>Citronella grass</b> <i>Cymbopogon winterianus</i> Gramineae	Aromatic grass with superficial fibrous roots. Culm 2 m in height. Leaf blade about 1 m. leaf sheath glabrous yellow. Panicle 1 m in length. <b>PPU:</b> Leaves (Herbage) <b>Constituent :</b> Citronellol and Geraniol Used in soaps, cosmetics, deodorants and mosquito repellent creams.

### NURSERY TECHNIQUES IN MEDICINAL AND AROMATIC PLANTS

**Objective:** To study the different methods of propagation adapted in medicinal and aromatic plants.

**Methods of Propagation:** Plant can be propagated either from seed or from stem; root or leaf cuttings to be used for initial development preferably from high yielding strains/cultivars which have already been tested at research station. Knowledge on the quality of seed should be used for each experiment and the question of viability and germination should be studied at this stage. Simultaneously, experiment should be carried out on the problem of the best method of storage of seed, it is necessary over a long period in case to maintain a nursery for commercial cultivation. However, recent advancement of tissue culture techniques have made the task much easier for obtaining true to the type material of common medicinal and aromatic plants.

**Nursery:** It is defined as an area where plants are raised for eventual planting out. It comprises of nursery beds, paths, irrigated channels etc. Nursery bed is defined as prepared area in a nursery where seed is sown or into which seedlings or cutting are raised

**Seedling beds:** Are those nursery beds in which seedlings are raised either for transplanting in other beds or for planting out.

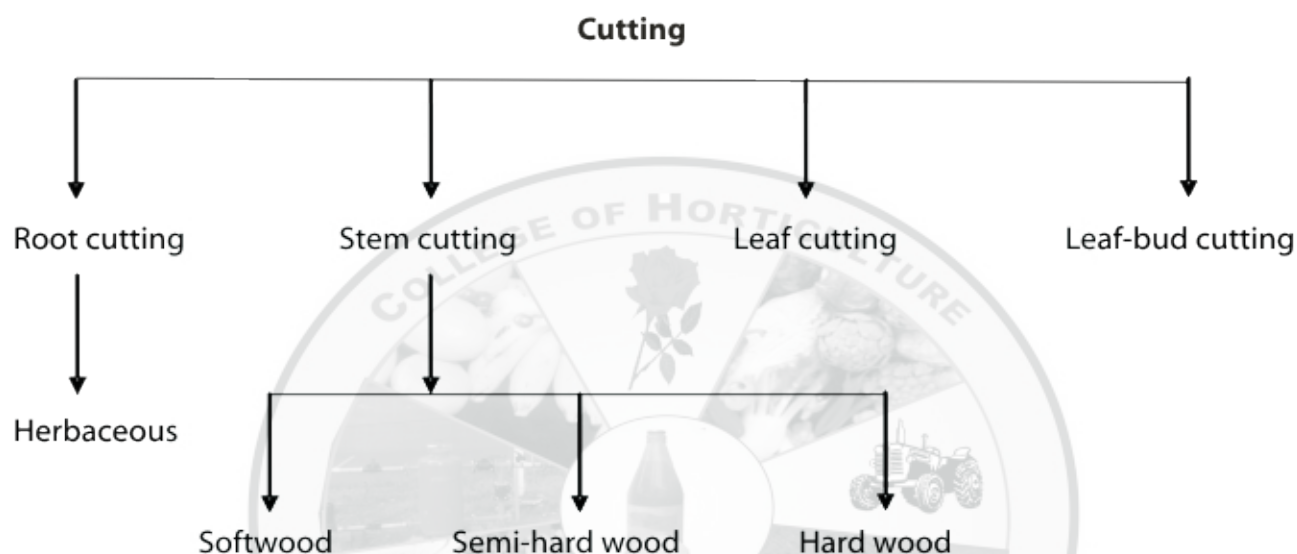
**Nursery beds:** Standard nursery beds of 3.0x 1.2 m and 10 to 15 cm height are formed and mixed thoroughly with well decomposed farm yard manure. Pre-treatment of seeds with cold water/hot water, etc. for a period of 6 to 12 hours results in good germination according to different species. After sowing the seeds are covered with thin layer of soil and pressed gently and a layer of grass 5 to 8 cm laid directly on the soil. The bed should be watered daily from a very fine rose can. After germination the grass cover should be removed. The young seedlings are highly susceptible to damping and if any sign of this observed before the germination complete, the grass cover should be removed and sun light allow falling directly on the seedling beds.

#### Types of cutting and layering

##### A) Methods of cutting

A cutting is a part of plant which will produce roots and eventually, a new plant quite true to the parent plant. A cutting may be a piece of stem, root, leaf or even the scale of bulb. Many horticultural plants are now propagated commercially by means of cuttings as this method has number advantages.

1. It is the easiest inexpensive, rapid and most convenient method of vegetative propagation.
2. Many new plants can be propagated in limited space from a few stock plants.
3. It doesn't require special techniques which are necessary in grafting and budding.
4. There is no problem of compatibility with the root stocks or of poor graft union.
5. Greater uniformity is obtained as there is no variation, which is sometime observed in the grafted plants due to viable seedling root stocks.
6. The cuttings are classified in various groups according to the plant parts used.



**1. Root Cutting:** Propagation by means root cutting is very simple and easy. The plants which freely produce suckers in nature can easily be propagated by root cuttings. Root cuttings are generally taken in winter or early spring when the roots are well supplied with stored food but before new growth starts. After the plants are well formed, these can be transferred in pots, beds or in nursery for further growth.

## **2. Stem Cutting:**

**Herbaceous cutting:** The herbaceous stem cuttings usually consist of the terminal leafy portion of the stem of herbaceous plants. Such cuttings are usually soft, tender and succulent. In general 7.5- 15 cm long terminal portion of moderately vigorous shoots are selected for making the cuttings and the leaves are removed from the basal portion of the cutting. The cuttings should be prepared just before they are placed in rooting medium

**Soft wood cutting:** The cuttings made from soft, succulent, new growth of some woody plants are known as softwood cuttings. In herbaceous cuttings, terminal portion of the shoots is used for making the cuttings, soft wood cuttings are usually made 10-15 cm long with terminal buds and at least 2-3 nodes as each cutting. The leaves are removed from the bottom node and the basal cut is made just below the node



**Semi hard wood cuttings:** Are those made from woody broad-leaved ever green species with partially mature wood.

**Hard wood cuttings:** Cuttings made from past season's growth or wood that has become mature are known as hard wood cuttings. Hard wood cuttings may be 10-30 cm or even more long and the diameter ranges from 1-2.5 cm or more depending upon the kind of plants.

**3. Leaf cutting:** Certain plants with thick and fleshy leaves can be reproduced themselves from leaf cuttings. For making leaf sections or the leaf with petiole is used. In all cases, adventitious roots and an adventitious shoot develop on leaf cutting e.g. Bryophyllum, In Bryophyllum well developed leaves are placed flat on rooting medium and partial covered with rooting medium.

**4. Leaf-bud cutting:** In general, a leaf-bud cutting consists of leaf blade, petiole and a small piece of stem containing a dormant vegetative bud at the leaf axil. Well developed leaves from current season's growth are generally used for making leaf-bud cuttings. In leaf-bud cutting about 1 to 1.5 cm of stem portion bearing an auxiliary bud is usually retain the auxiliary bud will sprout and develop quickly to form a new complete plant.

## **B) Methods of layering**

Layering is one of the oldest techniques used in propagating woody plants. Layering can be defined as development of roots on stem, when it is still attached to parent plant. After development of roots it is detached from parent plant and treated as a new young plant. Stem is induced to root. It is reliable and easy means of propagation especially in species, which are difficult to root on cuttings. It doesn't require any facilities necessary for cutting or grafting. Layering does not require close attention regarding control of watering, humidity and temperature or propagating fumes that cuttings often require. However the most important limitation of layering is that a large number of plants can't be produced by this method within short time form a limited number of stock plants. Layering involves an interruption of downward translocation of organic substances such as carbohydrates, auxins and other growth substances from the leaves and shoots tips. These organic substances accumulate in the stem portion, where layering has been done and ultimately facilitate rooting to occur. Root promoting substances are applied get profuse rooting within a short period eg. IBA.

### **There are different methods of layering**

1. Simple layering
2. Tip layering
3. Serpentine layering or compound layering
4. Trench or continuous layering
5. Mound or stool layering
6. Air layering

**1. Simple layering:** It is perhaps the easiest and the most efficient method of layering. For making simple layers, rapidly growing shoots are first trimmed off slice branches and leaves from 20 cm behind the tip. The shoot is then bent to ground level and covered with 5-7.5 cm of soil leaving the tip of the shoot exposed above the soil. The soil around the buried stem is kept reasonably moist, especially during the dry period. Sometimes a notch or a girdle or ring is made to the stem before burying it to the soil. In most plants rooting is complete within 4 - 8 week. The rooted layer is severed from the stock plant and kept in a pot for about a year before planting it in the final site.

**2. Tip layering:** Tip layering is practiced in such plants, which have got trailing type of shoots. Growing tips of such plant are bent down and buried in the soil to a depth 5-7.5 cm or they may be inserted in pots. The covered portion becomes etiolate and swollen and strikes root within 2-3 weeks. The root layer is then severed from the mother plant and transplanted either in a permanent place or in the nursery.

**3. Compound layering:** It is easy to perform in plants, which have long slender shoots, Stem of these plants are laid in the ground an alternately covered and exposed over their entire length. Sometime shoots are layered into pot sunk in the ground. A slanting cut of about 5 cm long is given at a point where the shoot is to be layered. Sometimes ringing or girdling is also done.

**4. Trench layering:** The branch is placed in a shallow trench and is covered for its entire length, leaving only the terminal portion exposed. Advantage of this method is that many numbers of plants are produced per branch.

**5. Mound layering:** It consist of cutting back to the ground the stem of the plant during the non-growing season and covering the basal portion of the newly developing young shoot in the spring with a mound of soil. Shoots get etiolated and encourage root formation. Mound should be done with moist soil. Sometime to encourage root development, ringing or girdling at the base of the young shoot and application of root promoting substance are practiced.

**6. Air layering:** This method is also known as Chinese layering, pot layering, mar cottage and gootee. It is very popular and practiced in a wide range of plants because the method is easy to perform, does not require any specialized equipment and does not disturb the plant. One or two year old shoots are selected. Leaves are removed from basal portion of shoots where layering is to be done. Ring of bark is removed about 2-3 cm wide. Root promoting hormone is applied at upper cut and to promote early and profuse root formation. Ringed or girdled area is covered with moist sphagnum moss and wrapped with a polythene sheet. The two ends are tied. The polythene film used for wrapping to retain moisture and allows gaseous exchange. It is done in monsoon or in spring. Rooting takes place within 4-8 weeks. The rooted layer is then separated in 2-3 stages to reduce the shock of sudden separation. The first cut, V-shaped and going in half way through the stem is given about 2.5 cm below the point of root emergence. The second cut is given to deeper the first one after a week later. After few days layer is separated and planted in pots or nursery beds in a shady place until they are fully established and show renewed growth.



## **Practicing different types of runner, offsets and other specialized plant organs for propagation:**

There are certain plant modifications, which are used for vegetative propagation of plants. These modified plant parts may be stem, root or leaf and are usually specialized for food storage. Two principle methods are used for propagation of plant by using these plant modifications.

- **Separation:** When naturally detachable structure, such as bulbs or corms are separated and planted individually.
- **Division:** When plant modifications such as rhizomes, tubers etc. are cut into sections too obtain new plants from each section.

**1. Bulb:** A bulb is specialized underground organ consisting of a short fleshy, usually vertical stem axis (basal plate). Bulbs are produced by monocotyledonous plants. There are two types of bulbs.

- **Tunicated bulb:** These bulbs have outer bulb scales, which are dry and membranous. This coverings or tunic, provides protection from drying and mechanical injury to the bulb.
- **Non tunicated (scaly) bulb:** These bulbs do not process the enveloping dry covering. The scales are separate and attached to the basal plate. In general, the non-tunicated bulbs are easily damaged and must be handled more carefully.

**2. Corm:** A corm is a solid underground base of stem having nodes and internodes and is enclosed by dry scale like leaves. After flowering one or more corms may develop just above the old one, which disintegrates. In addition, several new small corms called cormels develop below each new corm.

**3. Rhizome:** The horizontal, thick and fleshy or slender and elongated stems growing underground are known as rhizomes. Rhizomes have nodes and in ternodes and readily produce adventitious roots. Propagating plants with rhizome is easy.

**4. Tuber:** A tuber is a modified stem structure, which developed below ground as consequence of the swelling of the sub apical portion of a stolen and subsequent accumulation of reserve materials. A tuber has all the parts of typical stem. The 'eyes' present in regular order over the surface, represent nodes, each consisting of one or more small buds subtended by the leaf scar.

**5. Tuberous root:** Certain spectres of herbaceous perennials produce thickened underground structures which contain large amount of stored food. Each section must contain a bud.

**6. Runner:** Runner is a specialized aerial stem arising in the leaf axils of plants having rosette crowns. New plants arise from nodes at interval along these runners.

**7. Sucker:** Some plants produce adventitious shoos from the underground portion of the stem or from their horizontal root systems. These are known as suckers and when these strike roots. Developed suckers are dug out and separate from the mother plant and planted in then ursery for further growth.

**8. Offset:** Offset is a shoot or thick stem of rosette like appearance arising from the base of the main stem of certain plants. These are girdled and layered for about a year period to separation.

### HARVESTING OF MEDICINAL PLANTS

(*Withania*, *Periwinkle*, *Safed Musli*, *Arjun*, *Behada*, *Rauvolfia*, *Dioscorea*, *Aloe vera*)

**Withania-** The plants start flowering and bearing fruits from December onwards. The crop is ready for harvest in January- March at 150 to 180 days after sowing. The maturity of crop is judged by drying out of leaves and yellow red berries in the plant standing in the field. The entire plant is uprooted for roots which are separated from aerial parts by cutting the stem 1-2 cm above the crown. The roots are then either cut transversely into small pieces (7 to 10 cm) or dried as it is, in the sun. Berries should be hand plucked separately. They are dried and crushed to take out the seeds. The dried roots, entire or transversely cut into smaller pieces, have to be further cleaned, trimmed and graded.

**Periwinkle- Leaves :** Leaf stripping twice, first after 6 months and the second after 9 months of sowing can be taken. A third leaf stripping is also obtained when the whole plant is harvested. After the plant is harvested, it is dried in the shade.

**Roots:** The crop is harvested 12 months of sowing and plants are cut about 7.5 cm above the ground level and dried for the stem, leaves and seeds. The field is then copiously irrigated and when it reaches proper condition for digging, it is ploughed and the roots are collected.

**Seeds :** It has to be collected from matured pods 2 to 3 months before the harvest of the whole plant. The aerial part of the plant between 7.5 cm and about 25 cm above the ground level is taken as the stem for the purpose of marketing.

**Safed Musli-** It will be ready to harvest after 7-8 months of planting (Jan-Feb). Root bunches are washed and dried in shade for 2 days. The skin on the roots should be removed and peeled roots are again washed with water. Dry it completely and then marketed.

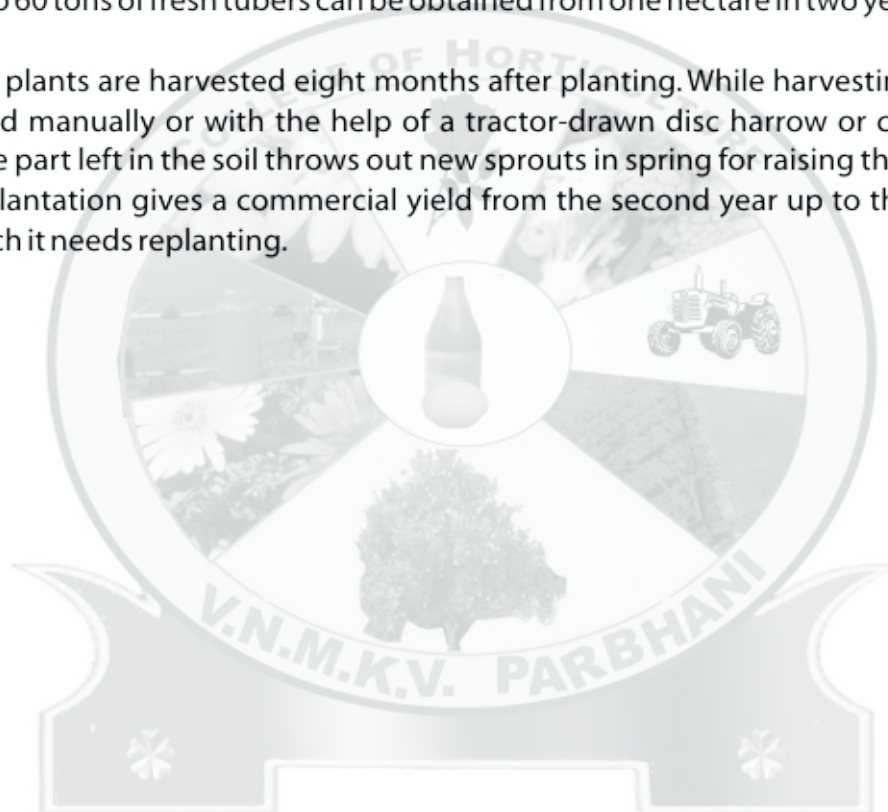
**Arjun-** The Arjun tree starts flowering from sixth year onwards. Lifespan of the tree is 50 years and above. Bark is repeatedly scrapped in winter season. The bark is removed from well-grown trees, preferably 10th year onwards, in spiral or vertical strips of not more than 5 cm width and 25 cm length.

**Behada-** The behda tree starts flowering from sixth year onwards. Lifespan of the tree is 50 years and above. Bark is repeatedly scrapped in winter season. The bark is removed from well-grown trees, preferably 10th year onwards, in spiral or vertical strips of not more than 5 cm width and 25 cm length.

**Rauvolfia-** The marketable roots are generally collected 2-3 years after plantation preferably after 30 months of planting. When transplanting is done during June-July harvesting period coincides with shedding of leaves during early autumn. At this stage root contains maximum concentration of total alkaloids. During harvest the roots may be found to go up to 40 cm deep in the soil. During root harvesting the thin roots are also collected. Care should be taken to keep the root bark intact as the bark constitutes 40-56 % of the whole root and has a higher alkaloid content. In general during winter months plants remain dormant, is considered ideal for harvesting. Application of a light irrigation if possible will make digging easier. After digging, the roots are cleaned, washed and cut into 12-15 cm pieces for drying and storage.

**Dioscorea-** The tubers grow to about 25 to 30 cm depth and hence harvesting is done by manual labour. The best season for harvesting is Feb- March, coinciding with the dry period. On an average 50 to 60 tons of fresh tubers can be obtained from one hectare in two years duration.

**Aloe vera-** The plants are harvested eight months after planting. While harvesting, the plants can be removed manually or with the help of a tractor-drawn disc harrow or cultivator. The broken rhizome part left in the soil throws out new sprouts in spring for raising the succeeding crop. An aloe plantation gives a commercial yield from the second year up to the age of five years, after which it needs replanting.





### HARVESTING OF MEDICINAL PLANTS (Isabgol, Opium Poppy, Panpimpali, Ammi majus, Belladonna)

**Isabgol-** The crop will be ready in about 110-130 days after sowing. When mature, the crop turns yellowish and the spike turns brownish. The seeds shed when the spikes are pressed even slightly. At the time of harvest the atmosphere must be dry and there should not be any moisture on the plant. The plants are normally cut at the ground level or uprooted if the soil is loose textured.

**Opium Poppy-** The crop is left for drying for about 20-25 days when the last lancing on the capsules stops exudation of latex. The capsules are then picked up and the plant is removed with sickles. Harvested capsules are dried in open yard and seeds are collected by beating with a wooden rod. The yield of raw opium varies from 50 to 60 kg/ha.

**Panpimpali-** The first harvest can be done after six months of planting. The spikes are ready for harvest 2 months after their formation on the plants. Spikes are picked when they are blackish green and most pungent. The harvested spikes are dried in the sun for 4 to 5 days until they are perfectly dry. The green/to dry spike ratio is around 10:1.5. The dried spikes are then stored in the moisture proof containers. During the first year, the dry spike yield is around 200 kg/ha. After three years, the productivity of the vines decreases and should be replanted. Besides the spike, the thick parts of stems and roots which have medicinal value may also be harvested from 18 months after planting. While harvesting the stems are cut close to ground, the roots are dug up, cleaned and heaped in shade for a day after which they are cut into 2.5 to 5 cm long pieces. The average yield of dried roots is 5 q/ha.

**Ammi majus-** Harvest when the first 2-3 small flowers open that make up the flower head will continue to open in floral preservative and water. Make your cut at the base of the stem.

**Belladonna-** The first harvest of the leaves is available three month after planting. Harvesting should be done as soon as the plants start flowering, as it is the period when alkaloid content is higher. The leaves are cut with the help of pruning scissors. The roots are also harvested after 3 years. During the first year an average of 10 q of dry herb is obtained and it will be increases to 15 q/ha during 2<sup>nd</sup> and 3<sup>rd</sup> year. The yield of dry roots will vary from 170 to 335 kg/ha.

### HARVESTING OF MEDICINAL PLANTS (Wild Brinjal, Cinchona, Pyrethrum and Hirda)

**Wild Brinjal-** The crop takes about 6 months to be ready for harvesting. Harvesting is one of the labour-intensive operations in the cultivation of *S. viarum*. The spiny nature of the plant hampers plucking the berries at the right stage of maturity, which is very important. During the first part of the harvesting season, when the fruit is big, on an average, one person with gloves can pluck about 50 kg of berries, while working 8 hours a day. The picking operation spreads over 3 months, because the fruits mature at different times.

**Cinchona-** By judging the amount of vegetative growth, the trees are coppiced when they are 6 to 8 years old. Coppicing involves pruning the trees at a height of 5 cm (2 inches) from the ground-level. The leftover stump regenerates to produce a large number of shoots, but only two or three of these are retained and allowed to grow further. The rest of the coppices are removed. A second coppicing is done 8-10 years after the first coppicing, where only about 2 to 3 shoots are left to grow further. The plants are uprooted in the 30<sup>th</sup> year when their vigor declines. The major harvest is obtained at the time of the first two coppicing. The first set of yields is obtained in the third year after planting. The bark is separated from the coppices by beating it with a mallet and is then peeled by hand or a knife. The peeled bark should be dried immediately in shade to prevent the loss of alkaloids.

**Pyrethrum-** The plants flower within one year of transplanting. The crop gives a poor yield in the first year and the optimum yields are obtained only during the 2<sup>nd</sup> and 3<sup>rd</sup> year. In Kenya and the Nilgiris in India, three harvests of flowers are obtained as the flowering in these areas continues for 9 months. In temperate areas like Kashmir, the first harvest is obtained at the end of June or in the 1<sup>st</sup> week of July. The flowers should be picked when  $\frac{2}{3}$ <sup>rd</sup> of the disc-florets are opened and the ray-florets are horizontal. The harvesting of immature or over-mature flowers decreases their pyrethrin content. The flowers are picked at fortnightly intervals in India. There is a gradual fall in the pyrethrin content of harvested flowers after the third year of planting. The yields tend to become uneconomical after 3-4 years and replanting is necessary.

**Hirda-** Flowering and fruiting generally commence after 8-10 years of planting in the summer season. The tree starts yielding fruits at this time. The trees live for more than 50 years and continue to yield fruits every year.



### HARVESTING OF AROMATIC PLANTS

(Citronella grass, Khus grass, Flag (baje), Lavender, Geranium, Patchouli, Bursera, Mentha, Musk, Ocimum, Lemon grass, Tikhadi)

**Citronella grass-** It is advisable to harvest after 3 months to induce tillering. In the first year only 3 cuts besides the partial harvest can be taken, viz., 5 months after planting and 3 months after the previous harvest. From second year onwards, 5-6 harvests can be taken per year at 2 months intervals. Harvesting is done by sickle and cut at 15 cm above the ground. Cutting close to the ground results into mortality of the plant. Harvesting preferably is done before 12 O'clock.

**Khus grass-** Harvesting is done in between 15-18 months to get fully developed root system and high quality of oil. Harvesting earlier than 15 months after planting, the immature roots yield oil of poor quality with green earthy odour. Properly developed somewhat thicker roots, yields an oil of better quality and its optical rotation and specific gravity are higher, the odour fuller, richer, more lasting. Oils derived from older roots are usually of darker colour than the oils distilled from the younger roots. In general the crop is harvested after 15-18 months during the dry season from December to February for best quality oil. Oil content of root starts decreasing after 20 month sage considerably.

#### Characteristics to determine correct harvesting age

The roots that possess the following characteristics have good oil content. It should

1. Expose a hard surface when the skin is peeled off
2. It should be thick, hard, long and wiry
3. Give a very bitter taste when chewed

#### Digging

The stem portion is cut at a height of 15-20 cm and the clumps are uprooted. About 50-60 % of the roots come away with the clump when dig out by spade or tractor drawn single disc leaving the rest in the soil. The clumps are beaten on a piece of log to remove earth adhering to the roots and the roots are separated from the plants with a sharp knife. As far as possible, digging the soil also collects the roots left in the soil. Single irrigation may be given before harvesting to facilitate digging if available. For mechanical harvesting a disc plough with single disc mounted on a tractor can be used which uproot the roots from 30-35 cm depth. This process saves manpower and also gives about 15 % higher root recovery over manual digging.



**Flag (baje)**-The crop is ready for harvesting in about a year after cultivation. The leaf tip begins to turn yellow this is the indication of crop maturity. The rhizomes are usually collected during autumn (September–October) till early spring (March–April) seasons.

**Lavender**- The plants are harvested once blooming has started. The whole plant leaving the basal one-third of the plant for natural regeneration is harvested. The fresh herbage is used for steam distillation.

**Geranium**- Geranium is harvested 4 months after transplanting when leaves begin to turn light green and exhibit a change from a lemon-like odour to that of rose. The crop should be harvested using a sharp sickle and sent for distillation immediately. The use of sharp sickle is important as it minimizes the jerks, pulls and damage to the crop while harvesting. After every harvest, hoeing, fertilizer application and irrigation are done according to the schedule. The plant then puts forth fresh shoots, grows faster, and reaches the next harvesting stage in 4 months. Thus, a total of 3 harvests can be obtained for 3-6 years. Cultivation under polyhouse conditions is reported to reduce the harvest time by 21 days. The essential oil is distributed over the green parts of the plant, particularly in the leaves. The oil content is higher during the summer months, from April to June. The terminal portion with 6-12 leaves contains more oil than the middle and basal portions.

**Patchouli**- The stage at which crop has to be harvested is very important for a good yield and better quality of oil. The first harvest of the crop is obtained after about 5 months of transplanting. It is harvested when the foliage becomes pale-green to light-brown. Subsequent harvests can be done after every 3-4 months, depending much upon the local conditions and management practices. The length of cut tops ranges from 40-60 cm. It is necessary to leave 4-6 juvenile sprouting buds at the basal region for rapid regeneration. Harvesting is done with the help of a small, sharp sickle or secateurs. The first 2 or 3 harvests of the new plantation give good yield and high-quality oil. The crop can be maintained for about 3 years.

**Bursera**- the whole bark is removed from the tree or the bark is lacerated to induce the seepage of resin. The resin is scraped from the tree and applied directly to the affected area of the skin. The whole bark is usually removed by first making a 12 cm horizontal incision 1 m above the soil line (sometimes as low as 0.5 m).

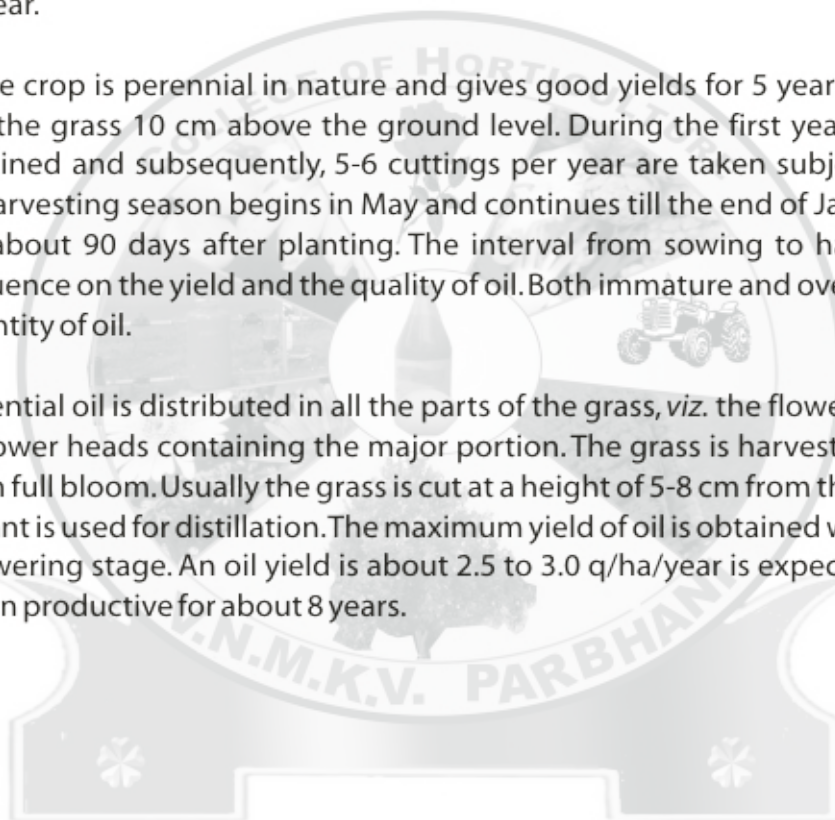
**Mentha**- Japanese mint is generally harvested after 100-120 days of planting, when the lower leaves start turning yellow. If the harvesting is delayed the leaves start falling, resulting in loss of oil. Further, harvesting should be done in bright sunny weather. Harvesting consists of cutting the green herb by means of a sickle 2-3 cm above the ground. A second harvest is obtained about 80 days after the first harvest and the third one after about 80 days from the second harvest. Whereas, in peppermint, spearmint and bergamot mints which are grown in temperate climates, the first crop is ready by the end of June and the second in September or October. A good crop of Japanese mint can give as high a yield as 48 t/ha of fresh herb. However, the average yield of mints from three cuttings is 20-25 t/ha. The fresh herb contains 0.4 % oil.

**Musk**-It sets fruit continuously from October- March. Harvesting starts when most pods begin to turn from green to brown and just start to open. Pods are picked when three quarters of their body has turned blackish- brown; the seed is removed manually. Picking is a hardy task as the plants, including the pods, possess hairs that cause itching. In India harvesting has often stopped by the end of March, as later harvesting rounds yield too little to be uneconomical.

**Ocimum**- The crop is harvested when it is in full bloom. The first harvest is obtained 90-95 days after planting. Afterwards, it may be harvested at every 65-75 days, intervals. Harvesting should be done on bright, sunny days in order to obtain good quality oil-yield. It is not desirable to harvest the crop if it has rained the previous day. The crop should be cut 15-20 cm above ground-level. The harvested produce may be allowed to wilt in the field itself for 4-5 hours, to reduce the moisture content and the bulkiness. About 5 t/ha of fresh herbage can be obtained twice or thrice a year.

**Lemon grass**- The crop is perennial in nature and gives good yields for 5 years. Harvesting is done by cutting the grass 10 cm above the ground level. During the first year of planting 3 cuttings are obtained and subsequently, 5-6 cuttings per year are taken subject to weather conditions. The harvesting season begins in May and continues till the end of January. The first harvest is done about 90 days after planting. The interval from sowing to harvest exerts a considerable influence on the yield and the quality of oil. Both immature and over mature grass gives a lower quantity of oil.

**Tikhadi**- The essential oil is distributed in all the parts of the grass, viz. the flower heads, leaves and stems. The flower heads containing the major portion. The grass is harvested when it is 4 months old and in full bloom. Usually the grass is cut at a height of 5-8 cm from the ground level and the whole plant is used for distillation. The maximum yield of oil is obtained when the entire plant is at full flowering stage. An oil yield is about 2.5 to 3.0 q/ha/year is expected. Palmarosa plantations remain productive for about 8 years.





### CURING AND PROCESSING TECHNIQUES OF MEDICINAL PLANTS

**Definition:** Curing in aromatic and medicinal plants refer to process of drying of economical part or preservation for increased utility.

**A) Curing:** It is conducted immediately after harvesting. It strengthens the skin. The process is induced at reactively higher temperature and humidity, involving suberization of outer tissues followed by the development of wound which acts as an effective barrier against infection. It is formed by high temperature.

**B) Processing:** In the market there is no demand for wet aromatic, medicinal and spice, condiments so we have to cure and process it to set market value.

**C) Purposes of curing:**

- To improve quality of produce/product.
- To improve keeping quality or shelf life.
- To avoid loss due to market glut.
- To utilize it for industrial or medicinal purpose.
- Retention of flower.

**D) Curing and processing of important medicinal plants**

**1. Dioscorea (Medicinal Yam):** It is better to use tuberous roots. It is better to harvest the tubers during dry period i.e. February-March for drying of harvested roots. During this period the plants are dormant stage and we get maximum yield of diosgenin. The tubers are harvested manually, washed with water to remove impurities. Chopped into small pieces and then dried under the sun.

**2. Rauvolfia (Sarpagandha):** The harvested roots are washed to remove the adhering soil and then air dried under sun for curing to reduce the moisture content from 60% to 80% for storage. The roots are cut into 12 to 15 cm pieces for convenience of drying and storage. It can be stored for 2-3 year in godown without loss in potency. Roots stored in godown may be periodically exposed to the air to avoid mould formation and insect damage.

**3. Cinchona :** The extraction of quinine involves beating of the bark with a mallet to loosen it for peeling by hand or knife. The peeled bark is quickly dried to prevent the loss of alkaloids. The fully dried bark is sent to the factories for solvent extraction of powdered bark with slaked lime containing more than 60% calcium hydroxide and the alkaloids removed with amyl alcohol or ether. These alkaloids are in turn extracted from the solvents in acidified water they precipitate out when the water is made alkaline. It is then dried and powdered and is the starting material for the manufacture of quinine base and other quinine salts.



**4. Opium Poppy:** After harvesting crop is left for drying for about 20-25 days when the last lancing on the capsules stops exudation of latex. The capsules are then picked up and the plant is removed with sickles. Harvested capsules are dried in open yard and seeds are collected by beating with a wooden rod or stick.

**5. Pyrethrum:** The flowers are usually carried in baskets so as to allow aeration. The flowers may be dried in the sun or in specially constricted kiln driers. Sun drying will usually take about 4 days and is possible only in dry weather and if the acreage is small. During wet weather and if the quantity of flowers picked is large it is necessary to have kiln for drying.

**6. Isabgol:** The seeds are shed when the spikes are pressed even slightly. At the time of harvest, the atmosphere must be dry and there should not be moisture on the plant. The harvested plants are threshed and winnowed, and the seeds are repeatedly sifted until clean. The seeds may be marketed whole or the husk may be sold separately. Seeds are fed to a series of shellers; in each sheller the grinding pressure is so adjusted to remove only the husk. This is separated by fans and sieves at each shaker and ungrounded material is sent to the next shaker. The husk seed ratio is 25:75 by weight.

**7. Medicinal Solanum:** The berries contain 70 to 75% solasodine and 60% of this is present in the seeds and the rest 40% in the pericarp. Water content in the berries is about 70-75% and hence it should be dried immediately after harvesting. As slow dry causes a loss in solasodine due to degradation hence oven drying is suggested. To hasten drying and to impart better colour, fruits are cut into halves and spread in thin layers on the flowered turn frequently. When the dried berries make cracking sound they are packed in bags. Dried berries should losses not more than 10-12 percent moisture and not less than 2% solasodine.

**8. Periwinkle (Sadafuli):** The usual practice is to uproot the plants, dry them in shade and there after thresh lightly for seeds. The harvested roots are washed well and dried in shade and later made into bundles for marketing.

**9. Withania (Ashwagandha):** After cutting of the crop the roots are separated from the aerial parts by cutting the stem 1-2 cm above the crown. These are then transversely cut into smaller pieces of 7 to 10 cm for drying. Occasionally the roots are dried as a whole. The berries are plucked from the dried plants and are threshed to obtain the seeds.

**Grading:** The dried whole roots undergo cleaning, trimming and grading before dispatch for selling. They are beaten with a club to remove the adhering soil and the thin lateral roots and root lets. The main taproot may be cut into transverse pieces. The entire product is then carefully hand sorted into four grades based on the thickness and uniformity of the pieces.

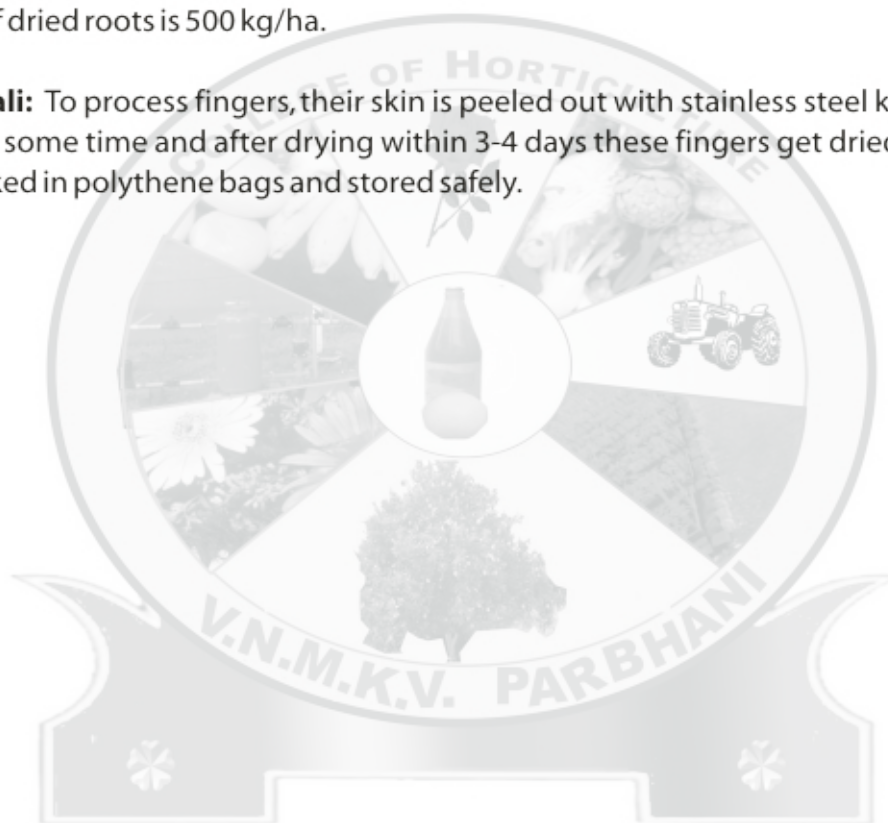
- a) **A-grade:** Roots pieces up to 7 cm in length, solid with 1-1.5 cm diameter, they should be brittle and pure white on the inside.
- b) **B-grade:** Root pieces up to 5 cm in length, solid with a diameter of less than 1 cm, the roots should be brittle and white on the inside.

- c) **C-grade:** Root pieces up to 3 to 4 cm in length, side branches are solid with a diameter of  $\leq 1$  cm.
- d) **D-grade (Lower grade):** Small roots pieces, semi solid, very thin and inside yellowish.

**10. Belladonna:** The harvested and chopped leaves are spread in thin layers on tarpaulin and dried under sun for 2-3 days. Regular turnings must be given to prevent deterioration of leaves. A well dried crop retains its green colour, the crop during drying loses about 70 to 80% of its weight. The woody stems are discarded before drying. After 3 years the roots are also harvested, sun dried and stored.

**11. Panpimpli:** The stems are cut close to the ground and roots are dug up. The spikes, roots and thick stem they are cleaned and cut into small pieces and dried in shade for two days. The average yield of dried roots is 500 kg/ha.

**12. Safed Musali:** To process fingers, their skin is peeled out with stainless steel knife and kept in the water for some time and after drying within 3-4 days these fingers get dried. These dried fingers are packed in polythene bags and stored safely.



### CURING AND PROCESSING TECHNIQUES OF AROMATIC PLANTS

**1. Lemon grass:** Distilled by steam distillation either fresh grass is directly distilled or it is first shade dried for 48 to 72 hours and then distilled after chopping in to small pieces of 5-6 cm. The later method was found to be better.

**2. Citronella grass:** Oil is extracted by steam distillation from herbage. Distil soon after harvest or grass is allowed to wilt in shade for 48 hours. Semi dried leaves are chop into bits of 5-7 cm. Delay in distillation affects aroma and colour of oil. Each batch takes about 90-105 minutes for distillation with 1.0 – 1.2% oil recovery.

**3. Khus or Vetiver:** Clumps are shade dried for 7-10 days to reduce moisture content beaten to remove adhering soil and roots are separated from the stem portion with sharp knife. Clean the roots thoroughly in running water and send for distillation. Oil is extracted by steam distillation herbage is steeped in water for 12 hours. Chopped 5 to 10 cm long bits and distilled. Distillation may take 24 to 36 hrs. Water distillation is the best method though the steam distillation is more economical and gives of oil yet it is not preferred by majority of distillers. It is because of fact that oil produced by steam distillation does not give the same colour as produced by water distillation.

**4. Geranium:** The freshly harvested terminals are used for distillation of oil. The plant materials are stalked near the stills for about 12 to 24 hours. This results in a slight fermentation and splitting of glycosides increases the yield of oil. The distillation process may take 4 to 6 hours depending upon the distillation unit.

**5. Lavender:** The leaves have to be dried in shade first dried or semi dried lavender can be distilled. The yield of oils depends on many factors particularly climate and weather altitude, method of cuttings, the condition of the plant material (fresh/dry) and the method of distillation. The plant material cut during the dry sunny days yields more oil. At the beginning and towards end of the harvest, the yield is lower than during the period of full bloom. The altitude also has some influence on the yield.

**6. Patchouli:** After harvesting, the leaves and stalks are usually dried in the sun. The leaves are spread in thin layers on concrete floor or bamboo racks. Proper drying is great importance for the quality of both leaves and oil. During drying, leaves are regularly turned over by hand or by mean of stick to promote even and thorough drying and prevent fermentation. Depending upon sunshine and the relative humidity of the air, drying of patchouli leaves requires about

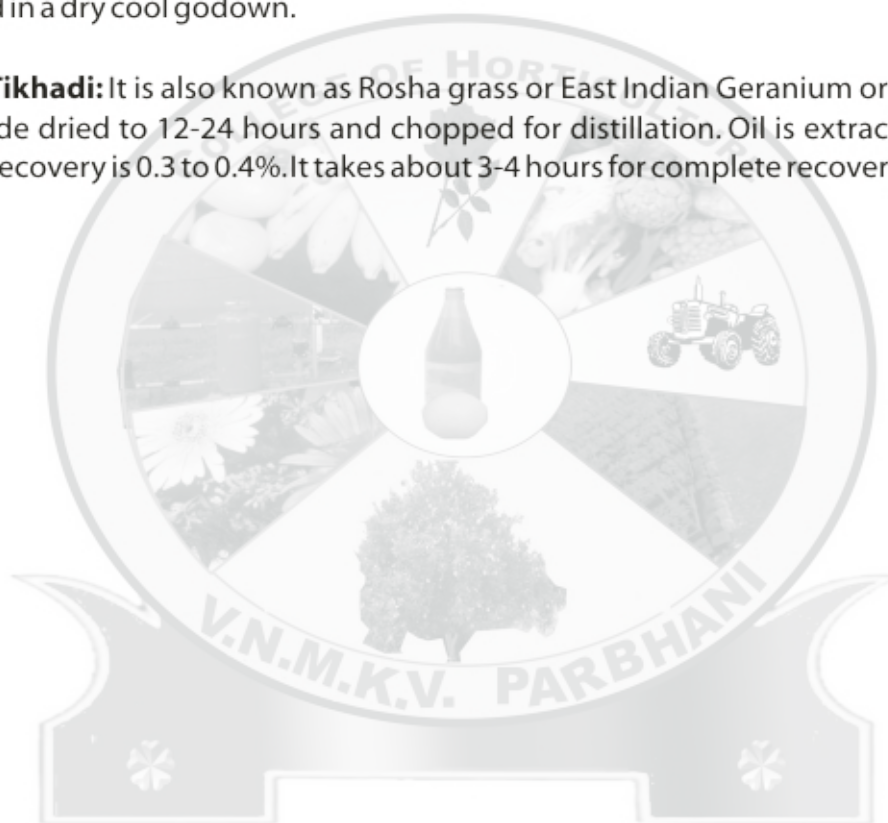


three days. Therefore during the drying process it is most important to avoid fermentation which readily takes place if the leaves are not properly spread and turned over frequently.

**Distillation:** Processed leaves alone should be used for distillation. It is advisable to interchange high and low steam pressure, thus giving full range to the forces and hydro-diffusion, which are important in the distillation of dried plant material, oil recovery generally range from 3 to 3.5 %. The major constituent of oil is patchoulol which varies from 30 to 40% patchouli oils.

**7. Mentha:** For oil extraction, the herbage is left in the field for 6 hours for wilting as it loses 50% of its moisture and then chopped into small pieces and distilled in a steam distillation unit. The oil is dried of adhering moisture and stored in aluminium or mild steel containers, filled up to the brim and stored in a dry cool godown.

**8. Palmarosa/Tikhadi:** It is also known as Rosha grass or East Indian Geranium or Ginger grass. Herbage is shade dried to 12-24 hours and chopped for distillation. Oil is extracted by steam distillation. Oil recovery is 0.3 to 0.4%. It takes about 3-4 hours for complete recovery.



### EXTRACTION OF ESSENTIAL OILS IN MEDICINAL AND AROMATIC PLANTS

The Arabs developed into the scientific side of perfumery more than any other race. In 10<sup>th</sup> of century, Avicenna made efforts to extract perfumes from flowers by distillation. He was however lucky to isolate some perfumes in the form of oil and to produce supplies of rose-water. Famous travellers of the past like Fa-Hien described India as the land of aromatic plants, fruits, flowers, woods, roots and grasses of these best known was sandalwood and its oil. There happens to be a regular barter trade from ancient days for sandalwood, when caravans carried precious wood to countries like Egypt, Greece and Rome. Mughal emperors were great patrons of perfumes and references in 'Ani-e-Akrabary' are testimony to it. The essential oils are extracted from the roots, stems, bark, leaves, flowers, seeds and peels and are different from vegetable oils, in being volatile and compose of chemical constituents of a different nature. Vegetable oils combinations of glycerine and various fatty acids.

In India major part of essential oils are still produced by water distillation on an open fire with old fashioned stills and condensers indoor steam operated stills with arrangement for stripping columns have become into operation in case of oils of palmarosa, sandalwood, vetiver, peppermint etc.

#### **Distillation of essential oils:**

Essential oils are complex mixtures of odoriferous and steam volatile compounds which can be separated by distilling with water. This process is known as hydro distillation. There are three types of hydro-distillation.

**1. Water distillation:** This is the simple method in which the plant material to be distilled comes in direct contact with boiling water in a distillation still. This method is advantages for certain materials especially when they are in finely powdered form. But it is not good for material containing saponifiable or high boiling point constituents.

**2. Water and steam distillation:** This is an improved method in which the plant material is supported on a perforated grid or false bottom above the bottom of the distillation still. The lower part of the still is filled with water to a level below the false bottom. When heated, the wet steam of rises through the material at low pressure. In this method, hydrolysis is fairly at a low rate, while the distillation is rapid, the oil yields are also better and the physico-chemical properties of the oil are also good.

**3. Direct steam distillation:** This method is similar to resemble the second method except that no water is kept in the bottom of the still. Live steam saturated or super heated steam with pressure higher than atmospheric, is passed through the bottom of the still. The rate of distillation is very high with yield and quality of oil are also good in this method. In this process, steam does not penetrate the cell membranes and the essential oil is vaporized only after diffusing out as an aqueous solution through the cell membranes. A steam distillation unit consists of the parts like 1) still 2) condenser 3) separator and 4) steam generator still serves as a container for the plant material to be distilled and is usually cylindrical/vertical tank equipped with a removable cover which can be clamped upon the cylindrical section. There is a grid or



false bottom nearby the bottom on which the plant material rests and live steam is introduced below the grid. The condenser serves to convert the steam accompanying oil vapours into liquid. An efficient type is of multitubular condenser. Condensation is achieved by the circulation of cool water. The function of oil separator is to achieve a quick and complete separation of the oil from condensed water. Volatile oil and water are mutually insoluble. These two liquids form two separate layers due to the difference in their specific gravities. Since the total volume of water condensed is always greater than the quantity of oil, water is removed continuously.

#### **A) Preparation of essential oil containing material**

The proper preparation of the raw material is one of the most important requirements for distillation. The essential oils are found in cytoplasm of the cell, in the intercellular space or in resin ducts. If the cell wall is very tender, the steam may gradually rupture them and bring the volatile oil to boiling point. But when they are woody or thick the raw material must be fragmented or macerated before distillation, so that the E.O. may be removed gradually from the fragments. The process of distillation depends wholly upon the proper preparation of the crude material. An unsuitable maceration not only raises the cost of the steam but also decreases the yield of the oil.

#### **1. Distillation process**

There are two general processes practiced. Where the E.O. is immiscible (i.e. it does not dissolve in water), steam distillation or boiling may be employed. Here, the distillate separates out as layer of oil, distinct from a layer of water. This type of oil extraction is commonly used for extraction of oils from geranium, citronella, lemon-grass and eucalyptus. On the other hand, where the water and components of E.O. are miscible, it becomes necessary to use rectification (separation of volatile and non-volatile components, which is achieved by vacuum distillation) or by fractionation (Separating the volatile oils into various fractions according to their boiling points and the odour, achieved by dry distillation) techniques. In order to isolate an E.O. by steam distillation method; live steam is injected into a still charged with an aromatic material. Under the influence of boiling water or steam, the E.O. will be freed from the glands in the plant tissue. Both the water and E.O. vaporize, to be condensed by an adjacent condenser and drained into a receptacle, where the oil separate automatically, above or below the water, depending up on its density. Steam is continuously charged into still until all the E.O. has been vaporized and the distillate formed in the condenser is essentially pure water. In the second process, involving rectification and fractionation, plant materials are sometimes directly distilled; but more commonly, the mixture of Essential oil produced by the foregoing method are isolated and purified. In its simplest form, the process involves a gradual increase in the temperature of the mixture, during which the more volatile compounds in the oil distil first and the less volatile compounds, progressively later.

#### **2. Effleurage or cold fat extraction**

Where the distillation may deleterious effects on an essential oil, due to hydrolysis, polymerization or revivification or where delicate oils become lost in large volumes of water or where the flowers continue to produce fragrance after the harvest, effleurage is usually



practices. The success of effleurage depends to a great extent, upon the quality of the fatbase (called the corps) employed. The consistency of the corps must therefore, be such that it offers a semi-hard surface from which the exhausted flowers can easily be removed. Since the whole process of effleurage is carried out in cool cellars, every manufacturer must prepare his corps according to the temperature prevailing in his cellars during the month of the flower harvest. Many years of experience have proved that a mixture of one part of highly purified tallow and two parts of lard gives the corps of required type.

### **3. Maceration or hot fat extraction**

In this case a batch of hot fat is systematically treated with several batches of flowers until it becomes quite saturated with the flower perfume. The fragrant fat thus obtained, depending on the flowers used, is called 'Orange Pomade' or 'Rose pomade' and is sold as such or it may be treated further by washing it with strong alcohol, exactly as Jasmine and tuberose pomades are obtained by effleurage. The method of maceration is cumbersome, but it served its purpose in the old days when no better process was available its products (Extracts and absolutes of maceration) often show a fatty by-note which originates from the fat corps and modifies the character of the original flower perfume.

### **4. Solvent extraction**

Although solvent extraction is a comparatively recent process in essential oil production, as early as 1835 it was felt that volatile solvent could be used to extract the essences from flowers more conveniently than by maceration. This method once developed was quickly adopted for processing all types of perfumes from those flowers which do not continue to produce fragrance once they are picked. The principle of extraction with volatile solvents is simple. Fresh flowers are charged into specially constructed extractors at room temperature and treated carefully with purified solvent, usually petroleum ether. The solvent penetrates the flowers and dissolves the natural flower perfume together with some waxes and other albuminous and colouring matter. This solution is subsequently pumped out into an evaporator and concentrated at a low temperature. After the solvent is completely driven off in vacuum, the flower oil is obtained. Since no heat is applied in the method at any stage, the oil is not subjected to the harmful effect of higher temperature and therefore, more truly represents the natural perfume as it is originally present in the flowers.

**Petroleum ether:** Crude petroleum on fractional distillation yields a number of hydrocarbon fractions of different boiling ranges, which find certain industrial applications. The fraction with a boiling point within the range 30 to 70°C is commercially called petroleum ether consisting of saturated paraffin's mainly pentane and hexane, commonly used as a solvent for essential oil extraction. Because of their chemical inertness and complete volatility, these fractions are particularly suited for the production of floral essence. A further advantage lies in their selective power of dissolving; they yield products which contain relatively little wax, albuminous and colouring matter, but correspondingly more of the odoriferous compounds. The petroleum ether must be free from sulphur and nitrogenous compounds.

**Benzene (Benzol):** Benzene ranks next to petroleum ether as a preferred solvent for the extraction of flower oil. It is a coal-tar product made by treating and purifying coal tar naphtha with sulphuric acid and subsequently with sodium hydroxide and thiophene. It has a uniform boiling point and thus, solvent losses are comparatively reduced. Its boiling point is  $81^{\circ}\text{C}$  which is relatively high and makes it rather difficult to remove the last traces of solvent from the concentrated flower oil. It dissolves not only the odoriferous principles but also other material such a wax, albuminous and colouring matter so that the final flower oil extracted with benzene is a dark.

### **B) Supercritical Fluid Extraction (SCFE):**

It is the recent method of extracting essential oil from the plant material; where, the fragrance and flower ingredients resemble their source. Supercritical carbon dioxide has the density of a liquid, low viscosity and diffuses like a gas. It is an excellent solvent for a wide range of natural substrates.

#### **Advantages of SCFE**

1. Through this method, a broad range of low to medium molecular weight compounds like esters, aldehydes and terpenes can be extracted.
2. The extract contains no residual  $\text{CO}_2$  solvent and very similar to the natural product.
3. As the extract is conducted at a temperature low enough (critical temp.  $31^{\circ}\text{C}$ ), the organoleptic properties are unimpaired.
4. It has the status of safe food grade solvent and thus can be used for processing a variety of products.

#### **Extraction process:**

For extraction, the raw material is enclosed in a cylindrical container with porous ends, which is located in the extraction chamber, temperature and pressure is selected (above it critical temp. at  $31^{\circ}\text{C}$  and pressure 73.8 bar) according to the material and desired end-product. Super critical  $\text{CO}_2$  circulates through the material, dissolving the essential oil. Solvent and solute then circulate into a separator, where the pressure is maintained below the supercritical point. The  $\text{CO}_2$  becomes gaseous and its solute precipitates before collection. Further, the gaseous  $\text{CO}_2$  is taken to a heat exchange where it is again cooled and liquefied. The  $\text{CO}_2$  goes back into the extraction unit further use.

#### **Storage of essential oil:-**

Most essential oils exhibit deterioration through oxidation and polymerization upon prolonged exposure to air and light. Hence, producers customarily keep their oils in closed, completely filled containers and the perfumes, particular, store their valuable essence in hermetically sealed bottles kept in dark cool cellars. Without such precautions essences become less intense, grow darker and more viscous, develop a bleaching effect and eventually change into a brown odorless resin.



### **Important terms used in the trade:**

**1. Absolute:** It is a prepared perfume material. Absolute are highly concentrated, entirely alcohol soluble and usually, liquid perfume materials. They are obtained by the alcohol extraction of concretes or other hydrocarbon types of extracts or from extracts of plant materials. Here, the waxes, terpenes, sesquiterpenes and most of the odourless materials are eliminated.

**2. Concrete:** It is non-purified form of essential oil obtained mostly by means of solvent extraction where essential oil, plant pigments and waxes are present. From the concrete, the absolute is obtained. The concrete may yield about 45 to 55% of absolute on a weight basis.

**3. Extract:** An extract is an alcoholic solution of the odorous part of pomade. This is an intermediate product in the preparation of absolutes from pomades.

**4. Fixative:** In perfumery, a fixative literally means a material which slows down the rate of evaporation of the more volatile material in perfume composition, e.g. sandalwood, patchouli.

**5. Oleoresin:** An oleoresin is either a natural or a prepared material. Natural oleoresin are exudations from tree trunks, barks etc. The prepared oleoresin, on the other hand are liquid preparations, extracted from plants with the help of solvents which can extract oil and resinous matter. They consist entirely or mainly of essential oils and resins.

### **Manufacturers/Suppliers/Exporters of MAP**

#### **1. Siddhi Vinayak Exporters, Hyderabad**

Suppliers of oils, geranium, Patchouli, Curry leaves, Davana oil, Citronella oil, Lemon grass oil, Jasmine oil, Sandalwood oil, Cassia tora seed, Ashwagandha, Safed Musali etc. Location: D-4/7, Dae colony, Ecil post, Hyderabad, Andhra Pradesh, India, 500 062.

#### **2. Meenakshi Trading Company, Mumbai.**

Manufacturers of Palmarosa oil, Citronella oil, Eucalyptus oil, clove oil other natural oil etc. Location:- 272/273, Hind Rajasthan shopping centre, 1<sup>st</sup> floor, flat no 113 opp. Sion Hospital, Nurses Quarters, Sion (West) Mumbai (M.S.) 400 022.





## **College of Horticulture**

**Vasanthrao Naik Marathwada Krishi Vidyapeeth  
Parbhani-431 402**