PRACTICAL MANUAL
ON
PRODUCTION TECHNOLOGY FOR ORNAMENTAL CROPS, MAP AND LANDSCAPING

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Contents

PRACTICAL – 1
IDENTIFICATION OF ORNAMENTAL PLANTS

OBJECTIVE: Identification of different ornamental plants like trees, shrubs, climbers, *etc*.

Ornamental plants: Plants grown for ornament or beauty are called as ornamental plants. Ornamental plants include trees, shrubs, climbers, palms, cactus, succulents, *etc*.

TREES

Tree is a woody perennial plant having a clean trunk up to 2 to 3 meters and a height of more than 4 meter and single erect stem with crown at top. They are used in landscape plan for aesthetic and functional purposes. They are grown for their economic importance or aesthetic value or both. Trees should be planted carefully and thoughtfully for the benefit of height, shade, colour and vertical emphasis.

Significance of trees in landscaping

- Trees form the main framework of the garden.
- Some trees produce attractive and beautiful flowers including fragrant flowers
- Some trees are noted for their attractive foliage
- Some trees are known for their peculiar shape or form which is used as specimentrees.
- Plays important role in controlling air and sound pollution in cities.

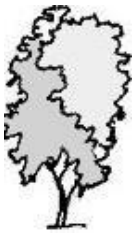
Uses:

- Beautification: i) Flower: Cassia, Jacaranda, Gulmohar
  ii) Foliage: *Casuraina*, Kusum, Christmas
- Wind-breaks: *Casuarina*, Eucalyptus
- Shade: Rain tree
- Architecturally: Wall – *Casuarina*, Roof – Rain Tree
- Medicinal : Margosa, Jamun, Ashoka
- Protection: Erythrina, Amli
- Food: Moringa, Jamun, Tamarind, Aonla
- Fodder: Gliridicia, Subakul, Erythrina
- Wood: Teak, Shisam/Sissoo
- Pollution Control: Peltophorum, Neem, Spathodia

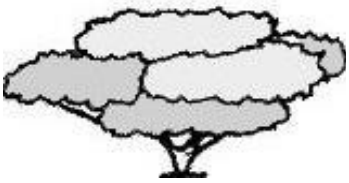
Types of Trees according to canopy or shape

Columnar tree

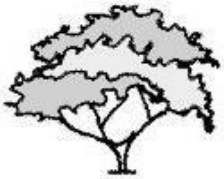
Conical tree - Pyramidal



Upright tree – Oval



Spreading tree - Layered



Umbrella shape

Round-headed tree

Description of some important ornamental trees:

Botanical name (common name)	**Family**	**Flower colour**	**Flowering season**	**Remarks**
Ailanthes excelsa (Treeof heaven)	Simaroubaceae	Greenish-yellow	January-March	Deciduous, medium sized foliage tree, goodfor planting plains and low hill areas
Albizzia lebbek (Albizzia, Shirish)	Fabaceae	Greenish white,	April-May	heavy fragrance, Attractive foliage, 16-20 cm long pods
Anthocephalus indicus (Kadamb)	Naucleaceae	yellow	July to September	Deciduous, coarse texture foliage tree andglobosely
Azadirachta indica (Neem)	Meliaceae	white	April to June	Evergreen, medium sized foliage tree
Bauhinia purpurea (Mountain Ebony)	Caesalpiniaceae	Lilac to red purple	Septemberto January	Semi-deciduous quick growing medium height tree having bi-lobedleaves
Bauhinia variegata (Kachnar)	Caesalpiniaceae	White with redpurple markings	Februaryto may	Deciduous quick growing medium heighttree having bi-lobed leaves
Butea monosperma (Flame of the Forest,Kesudo)	Fabaceae	Orange,red	Feb - March	Flowers used as dyes, gum is used for tanning
Callistemon lanceolatus (Bottle brush)	Myrtaceae	Scarletred	Througho ut the year	Evergreen, slow growing dwarf-medium height tree, Drooping / pendulous growth habit, bottle- brush shapedbright red flowers
Cassia fistula (Golden shower, Garmalo, Amaltas)	Fabaceae	Yellow	February –May	Medium sized tree
Cassia javanica (JavaCassia)	Caesalpiniaceae	May	Pink	Deciduous, Quick growing medium- tall height with large compound leaves having small leaflets and pink flowers borne in clusters in leaf axisduring
Delonix regia (Gulmohar)	Fabaceae	March-July	Scarlet, Yellowplus orange	Large deciduous tree, umbrella shaped crown,12-20 m height

Ficus bengalensis (Banyan tree, Vad,Ficus)	Moraceae	-	-	Large, 30 m tall, horizontal spreading
Ficus religiosa (Pipal)	Moraceae	-	-	Large upright tree, used for shade
Lagerstroemia speciosa (Pride of India)	Lythraceae	April to August	pink-red to purple-pink	Deciduous, medium sized tree with informalto umbrella canopy
Peltophorum pterocarpum (Peltophorum, Copperpod tree)	Fabaceae	March-April, partiallyin rainy season	Yellow	Large tree (30 m) spreading crown, roadside planting
Plumeria alba - white; Plumeria rubra - pink,red) (Champa/ Pagoda tree / Temple tree)	Apocynaceae	Summer; *P. alba* - through out year	White or shades of pink, red and yellow	Medium sized deciduous tree
Pongamia pinnata (Karanj/ Pongamia)	Fabaceae	May-June	Lilac colouredor pale pink	Moderate sized tree (10-15 m), shining darkgreen leaves
Peltophorum pterocarpum (Peltophorum, Copperpod tree)	Fabaceae	March-April, partiallyin rainy season	Yellow	Large tree (30 m) spreading crown, roadside planting
Plumeria alba - white; Plumeria rubra - pink,red) (Champa/ Pagoda tree / Temple tree)	Apocynaceae	Summer; *P. alba* - through out year	White or shades of pink, red and yellow	Medium sized deciduous tree

Fruit trees for avenues

Botanical name	**Family**	**ommon name**	**Characters**
Averrhoea carambola	Oxalidaceae	Carambola	Medium sized tree and very ornamental
Mangifera indica	Anacardiaceae	Mango	An evergreen tree
Phyllanthus emblica	Euphorbiaceae	Amla	Ornamental tree
Syzygium cumini	Myrtaceae	Jamun, Malabar plum, Java plum, or black plum	An evergreen tropical tree
Tamarindus indica	Fabaceae	Tamarind	Large tree

SHRUBS

Shrub is defined as a perennial plant having many woody or semi woody branches arising from the base, attaining height of about 0.5 to 4 m. and generally having erect or bushy growth. Most of the shrubs required regular pruning to maintain their desired shape.

Details of important ornamental shrubs:

Botanical name **(Common name)**	**Family**	**Description**
Bougainvillea species (Bougainvillea)	Nyctaginaceae	Climbing type thorny evergreen shrub valued for ornamental bracts with almost every colour throughout the year. Good for planting in tropical to sub-tropical areas.
Calliandra brevipes (Powder puff)	Fabaceae	Bushy shrub with branches drooping and spreading. Flowers arise in clusters with numerous fine pink stamens. The plants are multiplied from seeds or layers. Flowering seen almost throughout the year.
Cestrum nocturnum (Night queen, Ratrani)	Solanaceae	A large bush with weak branches; leaves are oblong and alternate. Flowers grow in axillary or terminal panicle, creamy white and night scented; Propagated by cutting and layering.
Duranta plumeri (Duranta, Pili mendi)	Verbenaceae	A tall, bushy shrub with axillary spines. Branches are4 angled. Flowers are blue in loose terminal panicles. Fruits are yellow in colour propagation is by cuttings.
Hibiscus rosa sinensis (China rose, Jasood)	*Malvaceae*	Tall or medium sized, evergreen shrub with ovate, coarsely toothed leaves and large, solitary, axillary, single or double flowers, having shades of one or two or more colours. propagated by cuttings.
Ixora singaporensisIxora coccinea	Rubiaceae	Popular and useful flowering shrubs in the garden and almost all the species and varieties flower very freely in the summer and rains. Many types of Ixora produce seeds, but cuttings and layering are the common methods of propagation
Jasminum spp. (Mogra, Chameli)	Oleaceae	Group of shrubs of commercial importance. Leaves are opposite or alternate; flowers are in terminal or auxiliary corymbs and flowering seen for 5-6 months in summer and rains. Large-scale propagation is done by cuttings.
Lantana camara	Verbenaceae	Prickly stemmed bushy plants of half to two meters height. Leaves are opposite, ovate or oblong, toothed, coarse. Flower colours range from yellow, bright red, white *etc*. (cuttings or seed)

CLIMBERS

Climbers can be used to cover unsightly walls, fences or tree stumps, they are very effective trained over archways and pergolas and are useful trained upon fences by driveways where space precludes the planting of trees. They are even useful as groundcover plants on embankments where without any support they will trail effectively.

Popular climbers and creepers used in landscape gardening:

Botanical name (Common name)	**Family**	**Description**
Aristolochia elegans (Duck flower)	Aristolochiaceae	Deciduous quick growing climber, good for trellis and cascading.
*Bougainvillea species (*Bougainvillea*)*	Nyctaginaceae	Evergreen climber, valued for bracts and foliage.
Clitoria ternatia	Leguminoceae	It is an annual twining climber, leaves pinnately compound flowers are solitary, blue or white, and pods are long. Propagated by seeds. Ideal climbersfor low trellis.
Hiptage benghalensis (Madhavi lota)	Malpighiaceae	Large deciduous rambling shrub with orange-lightred emerging foliage and turning reddish in autumn and creamy white fragrant flowers are borne during February- June. It is good for planting in subtropical to sub-temperate areas.
Tecoma jasminoides	Bignoniaceae	It is a handsome flowering climber. Corolla is tubular and companulate; white or rosy pink flowers and the color is deeper at the throat. Propagated by cuttings.
Ipomoea palmatae (Railway creeper)	Convolvulaceae	A perennial vigorous climber. Flowers are purple, the corolla is campanula ate, the color is deeper in the throat, used for screening purposes. Propagation is by cuttings in sand media.
Passiflora edulis (Passion fruit)	Passifloraceae	It is a strong woody climber. The flowers are solitary, terminal or auxiliary. 5 petals, the petals are often tinted with purple.
Quisqualis indica (Rangoon creeper)	Combretaceae	A large and vigorous climber. The flowers are initially white, turn pink and finally it becomes red. Numerous bunches of drooping white, pink or red with slightly fragrant are produced during summer and rains. Propagated by cuttings.

PALMS & CYCADS

Family: Palms: Palmaceae/ Areaceae

Cycads: Cycadaceae

Palm: is an un-branched evergreen tree of tropical and warm regions, with a crown of very long feathered or fan-shaped leaves, and typically having old leaf scars forming a regular pattern onthe trunk.

Some Attractive Palms & Cycads for the Garden

Name	**B.N**	**Description**
Traveller's Tree or Traveller's palm	*Ravenala madagascariensis*	It is not a true palm (family Arecaceae) but a member of the bird-of-paradise family, Strelitziaceae. It hasbeen given the name "traveler's palm" because the sheaths of the stems hold rainwater, which can be used as an emergency drinking supply, especially for the traveler.

Fishtail palms	*Caryota* spp. *C. cumingii*	They are often known as fishtail palms because of the shape of their leaves.
Foxtail palm	*Wodyetia bifurcata*	Flowering palm. Attractive palm with long (2-3m.) plumose leaves (hence the name 'Foxtail'), and up to 10 m tall with a grey trunk. It produces large (about the size of a duck egg) orange fruit.
Rhapis palm *(Lady palm/ Rattan palm)*	*Rhapis excelsa*	*Rhapis excelsa* also known as Broadleaf Lady Palm is a species of fan palm. *Rhapis*, meaning "needle"; and the species name is Latin for "tall", an ironic name choice as *R. excelsa* is not the tallest in the genus.
Royal palms *(Bottle palm)*	*Roystonea regia / Oreodoxa regia / Roystonea ventricosa*	*Roystonea* is a genus of large, unarmed, single- stemmed palms with pinnate leaves. The large stature and striking appearance of a *Roystonea* palm makes it a notable aspect of the landscape.
Livistona palm (Chinese palm)	*Livistona spp.*	They are fan palms, the leaves with an armed petiole terminating in a rounded, costapalmate fan of numerous leaflets.
Areca palm	*Areca lutescens / Dypsis lutescens*	*D. lutescens* is a small to medium-sized palm, growing to a height of 6 to 12 meters. It has multiple stems emerging from the base. The leaves are arched, 2-3 m long, and pinnate, with 40-60 pairs of leaflets. It produces offsets, and these can be cut off, when mature enough, as a propagation method.

Online link:

https://www.youtube.com/watch?v=OcOiEFelPx0
https://www.youtube.com/watch?v=P3ibaX_rmmA

PRACTICAL – 2
IDENTIFICATION OF MEDICINAL AND AROMATIC PLANTS

OBJECTIVE: Identification of major & minor medicinal and aromatic plants.

A) MEDICINAL PLANTS

Medicinal plants are those plants, which are rich in secondary metabolites and are potential source of drugs. The secondary metabolite includes alkaloids, glucosides, coumarins, flavonoids and steroids.

Metabolites **:** A metabolite is any substance that is produced during metabolism or that takes part in metabolism.
Alkaloids **:** Large group of nitrogenous base elements used as drugs.
Glucosides **:** The compound, which give glucose and other product.
Coumarins **:** Nutritive substance.
Flavonoides **:** Protective compound, which have flavour.
Steroids **:** A group of organic compound with 4 C ring includes some hormone and physiological substances.

1. Isabgol

Botanical name **:** *Plantago ovata*
Family **:** Plantaginaceae
Method of propagation : Seeds

Use: Seeds are used in herbs. It is diuretic, useful in constipation. Seeds have cooling and demulcent effect. Cure dysentery and diarrhoea.

Description: Almost stem less, 30-40 cms in height covered with dense or short hairy growth, leaves are 8 - 15 cm long, very narrow, flower are minute, seeds are 8 mm long, seeds are boat shape.

2. Aswagandha

Botanical name **:** *Witthania somnifera*
Family **:** Solanaceae
Method of propagation : Seeds

Use: The drugs consist of dried roots of the plants. Useful in sexual and general weakness. Itis diuretic, means it promotes urination. Root powder is applied locally on ulcers.

Description: It is small or middle size shrub up to 1.5 meter in height. Stem and branches covered with minutes' star shape hair. Leaves are 10 cm long, hairy like, branches, pale green flowers, small flowers (1 cm), fruits are 6 mm in diameter.

3. Guggal

Botanical name **:** *Commiphora wightii* & Commiphora mukul
Family **:** Burseraceae
Method of propagation **:** By stem cutting and air layering

Use: Gums having herb value. It controls cholesterol blood. Increase milk, excites uterus and useful in ladies treatments.

Description: It is shrub reaching height up to 3 to 4 m, branches are naughty, aromatic and atthe end sharp spine. Leaves are alternate 1 to 5 cm long and 0.5 to 2 - 5 cm broad. Plants having bisexual and male flower.

4. Sarpagandha

Botanical name **:** *Rauvolfia serpentina*
Family **:** Apocynaceae
Method of propagation **:** Seeds, Roots and Stem cutting

Use: Roots are used in medicine. Used in hypertension. As sedative used in asthma useful in painful delivery of child besides controlling high blood pressure.

Description: It is an erect evergreen perennial plant growing up to 0.75 m in height, leaves are simple long elliptical. Bears many flowers of white or pink colour. The root system consists of a prominent tuberous short tap root up to 6 cm diameter.

5. **Senna**

Botanical name **:** *Cassia angustifolia*
Family **:** Fabaceae/ Fabaceae
Method of propagation : Seeds

Use: Leaves and pods are well known for purgative medicines all over the world. **Description:** It is perennial, bushy plant; height is 0.7 to 1 meter. Leaves are narrow glabrousleaflets. The flowers are brilliant yellow colour. Pods are black; thin contain five to sevendark brown seeds. All parts contain senosides. Leaves and pods contain maximum.

6. **Kalmegh (Kariyatu)**

Botanical name **:** *Andrographis paniculata*
Family **:** Acanthaceae
Method of propagation : Seeds

Use: It is a bitter tonic, useful in curing fever, worms dysentery, general weakness excessive gas formation in stomach. It is useful in children suffering from liver and digestion complaint. Drug consists of all parts of plant.

Description: As erect branch annual herb. Branches are sharply four angled. Flowers are rose coloured one cm long.

7. **Aonla**

Botanical name **:** *Emblica officinalis*
Family **:** Euphorbiacea
Method of propagation **:** Patch budding

Use: It is very rich source of Vita-C (600-800 mg/100g pulp) therefore regarded very important for medicinal value in Ayurvedics. It is an important ingredient of Triphla and Chayanpras. It is useful in haemorrhages, diarrhea, dysentery, anaemia, jaundice and cough. Fruits are commonly used as preserve pickle, candy, jelly and jam. It is also used in preparation of inks, hair dyes and hair oil. It is great health and vitality restorer.

Description: It is a tall tree, quite hardy, prolific bearer, deciduous tree. Phyllanthoid branching habit with two types of shoot determinate and indeterminate. The leaves are simple1 to 2 cm long. Flowers are borne in the axils of the leaves. Fruits are capsular.

8. **Stevia**

Botanical name **:** *Stevia rebaudiana*
Family **:** Asteraceae
Uses **:** Calorie-free sweetener, reduces elevated blood pressure and a sugar substitute for diabetic patients.

Description: The plant is a slender, perennial herb growing up to a height of 60 to 70 cm.For diabetic's people, sugar obtained from stevia is considered to be the best alternate source.

9. **Aloe**

Botanical name **:** *Aloe barbadensis*
Family **:** Liliaceae
Method of propagation **:** By sucker

Use: It is antihelminthic, purgative, stomach cure, constipation, use in cough and nervous system diseases. It is also used in improving fertility and also use in hair problem. It is use formaking Shampoo, cream *etc*.

Description: Plant height is 50 - 60 cm; Leaves are succulent and spine on leaf blade. They are perennial in nature. Flower stocks arise from centre of the leaves. Flowers are orange or pink in colour.

10. **Ocimum (Tulsi)**

Botanical name **:** *Ocimum gratissimum* L.
Family **:** Labiatae
Uses **:** Cosmetics, Drugs, flavoring & perfumery

Description: Ocimum is a tall, many-branched and perennial aromatic shrub. The stem is erect, green with short hairs and attains a height of1.25 to 2 m. The leaves are ovate, coarsely crenate serrate, pubescent on both surfacesThe flowers are white to pale yellow in colour.

B) AROMATIC PLANTS

Aromatic plants are defined as 'those plants which possess essential oil in them'. This essential oil is the odoriferous, volatile, constituents of the aromatic plants. They are mainly

complex mixture of acyclic and or cyclic monoterpenoids. These terpenoids are basically secondary metabolites and they have no apparent function in the plants primary metabolism. The essential oils are used in perfumery, cosmetics and pharmaceutical industries where as the essential oils obtained from spices and condiments which impart the flavour and improve the taste of the food are used in several flavouring industries.

1. **Lemon grass**

Botanical name **:** *Cymbopogon fIexuosus*
Family **:** Gramineae

Methods of propagation **:** Seeds and by old clumps

Uses: Preparation for α- lonone. Used in flavours, cosmetics and perfumes and β-lonone are used in synthetic vitamin A. Lemongrass is used for treating digestive tracts, stomachache, high blood pressure, vomiting, cough, achy joints (rheumatism), fever, the common cold, and exhaustion. It is also used to kill germs and as a mild astringent. Lemongrass oil, used as a pesticide and preservative.

Description: Grass comes to harvest 90 days after planting and subsequently it is harvested 50 - 55 days interval. Grass is cut 10 cm above the ground level, 5 - 6 cuttings are taken in a year.

2. **Citronella grass**

Botanical name **:** *Cymbopogon winteriness* (Java)
Family **:** Gramineae
Methods of propagation **:** Rooted slips in April- May

Uses: Oils as bactericidal, insect repellent and medicinal use oil used for scenting soaps and detergents. Oil recovery 1-1.2% according to the dry bases. Major constituent in oil is citral (80 %). Used in perfumery and cosmetic.

Description: It is a moisture loving plant with sandy loam soil is most suitable. This grasscan be grown in natural soil. First cutting may be ready after 4 - 5 months after planting and next cuttings are taken at the two months intervals where atmospheric humidity is high.

3. **Vetiver (*khas*)**

Botanical name **:** *Vetiveria zizanioides*
Family **:** Gramineae
Methods of propagation **:** Slips and tillers (June - July)

Uses: It is used in making vetiver oil or soap making, after extraction of the oil from the roots. Roots are used for making mats, screen, pillow and mattresses. Roots are used in pharmaceuticals and Ayurvedic. Oil is light yellow and contains 65 - 75 % vetiver oil.

Description: It is a perennial grass. Plant height (1-1.8 meters). Root portion is branching type, spongy aromatic and fine rootlets. It grows in large clumps, leaves are long, erect and narrow and nonaromatic andup to 1 meter in length.

4. **Palmarosa (***Rosha, Tikhadi*)

Botanical name : *Cymbopogan martinii*
Family : Poaceae/ Gramineae
Method of Propagation : Through seeds, rooted cutting, slips
Uses : Essential oil for soaps, cosmetics, tobacco blending and perfume industries

Description: The plant is perennial, sweet scented grass with 1.5-2.5 M height.

5. **Mints**

*** Japanese mint**
Botanical name **:** *Mentha arvensis*
Family **:** Labiateae
Methods of propagation **:** Suckers

*** Common mint**
Botanical name **:** *Mentha spicata*
Family **:** Labiateae
Methods of propagation **:** Cuttings
Uses **:** Mentha oil, after steam distillation is extracted which is used in manufacture of menthol

Description: Suckers are planted 75 x 15 cms distance. Suckers are cuts into 10 -12 cm. inlength and then planted.

6. **Rose**

Botanical name : *Rosa damascana*
Family : Rosaceae
Methods of propagation : Cutting, air layering, T budding and root division
Uses: It is used for production of oil, Rose attar for commercial purpose, rose water, gulkand.The yield of oil is around 0.0045 % (fresh weight bases).
Description: It is perennial, hardy shrub with long life span of 20 - 30 years under cultivation. It grows to a height of 2.5 to 3 meters. Leaf is compound type with 5 - 7 leaflets. Flowers are sweet scented, pink, red or sometimes white, striped in colours

7. **Jasmine** (*Mogra*)

Botanical name : *Jasminum sambac*
Family : Oleaceae
Methods of propagation : Stem cutting, Root cutting, Layers and air layers.
Uses **:** Cultivated for extraction of perfumes. Also uses in gardens as hedge or in borders. Concrete recovery 0.14 - 0.19 %
Description: It is dwarf 'growing shrub, hardy and leaves are big having wavy margins. Flowers may be single, semi double or perfectly double.

Online link:

https://www.youtube.com/watch?v=XNp8PXCQAlE

PRACTICAL – 3
NURSERY BED PREPARATION AND SEED SOWING

Introduction:

Nursery is a place where seedlings are grown before transplanting them in the main plots. Generally, seed are to grow vegetables and to raise seedlings. Therefore, quality of seed is very important based on which the vegetables and spices seed are sown.

Objectives:

The development of seedling in nursery is not only reduces the crop span but also increase the uniformity of the crop and thus, harvesting as compared to direct sown crops.

Transplanting of seedling are also eliminate the need of thinning and providing good opportunities for virus free vigorous off season nursery, if grown under protected condition. Nursery is helpful and convenient to manage seedling under small area and grower can get timely plant protection measures are with minimal efforts.

Development of a nursery provides favorable climate to emerging plants for their better growth and development.

The effective utilization of unfavorable period by preparing nursery under protected condition. Seed cost of some flowers can be economized through nursery.

Nursery production help in maintaining effective plants stand in shortest possible time through gap filling.

Criteria for selecting Nursery:

1. Site for nursery should be selected at such places where abundant sunshine and proper ventilation is available.
2. Nursery site should be on higher location so that water stagnation is a voidable.
3. In humid and rain prone areas nursery place should be well protected from heavy rains through protected structures.
4. The site should be nearer to irrigation facilities and accessible.
5.It should be protected from stray animals, snail, rats etc.
6.Soil should be sandy loam or loamy with free from pathogenic inoculums.

Materials required for raising plug tray nursery:

Good quality seeds, plug tray/poly tray, coco peat, vermicompost, Nursery net, mulching sheet, rose can etc.

Procedure:

1. The seedling tray (pro tray) is filled with the growing medium (coco peat/Soil).
2. A small depression (0.5 cm) is made with fingertip in the center of the cell of the pro tray for sowing. One seed per cell is sown and covered with medium.
3. After sowing 10 trays are kept one over other for 3 to 6 days, depending on the crops. The entire stack will be covered using polyethylene sheet or paddy straw to ensure conservation of moisture until germination.
4. The trays are irrigated lightly every day depending upon the prevailing weather conditions by using a fine sprinkling rose can. Drenching the trays with fungicides as a precautionary measure against seedling mortality is also being done.
5. he seedlings at right stage of planting are hardened by withholding irrigation and reducing the shade before transplanting or selling to the growers. Systemic insecticides are sprayed 7 - 10 days after germination and before transplanting for managing the insect vectors.
6. The seedlings would be ready in about 21-30 days for transplanting to the main field depending upon the crop.

PRACTICAL – 4
TRAINING AND PRUNING OF ORNAMENTAL PLANTS

Training and pruning are important operations. Both the operations form an indispensable process having direct bearing on growth and vigour of plants and yield and quality of flowers / fruits. A properly trained and pruned plant sustain heavy crop load and produce bounteous harvest of quality. Both the operations of training and pruning work together in maintaining shape and size of tree and harvesting desirable yield.

1. Training: Training refers to the judicious removal of plant part / parts to develop proper shapeof a plant capable of bearing a heavy crop load.

Training is a treatment given to the young plants to get a suitable or desirable shape with strongframework. It may or may not involve pruning.

The reasons / objectives for training ornamental trees, shrubs, *etc*. are:

- There are no. of plants, which grow wild and don‘t bear if they are left to themselves andwill not have any symmetry in their growth.
- Most of the time, the untrained trees put forth vegetative growth only. Hence, bearing willbe delayed.
- When plants are grown in rows at close spacing, they grow tall and occupy interspaces,making intercultural operations difficult to practice.
- For want of sunlight, the lower branches wither and die. The shaded flowers/ foliage fail todevelop colour.
- Untrained trees will generally be less productive because of excessive vegetative growth formost of the time.
- The framework being weak in untrained trees, it breaks easily due to strong winds as wellas heavy loads of crop. All the above problems can be overcome by training the trees.
- Man can train the plant to suit his desire.
- The flowering and ornamental shrubs, *etc*. can be trained to a particular shape like animals,birds, *etc*.

Principles of training:

1. Formation of the mainframe work must be strong the branches must be suitable spacedapart and the tree must be balanced on all the sides.
2. Never allow several branches to grow at one place or very near each other.
3. Careful training of main branches is very essential.
4. Another important point about training is that if two branches are growing at the same pointtry to train them to grow at a wider angle. Narrow angle is always weak.

2. Pruning: Pruning is refers to removal of parts of a tree, especially shoots, roots, buds, or nipping away of the terminal parts.

Objectives:

- To remove the unproductive growth, because plant bears flowers on a new shoot.
- To ensure production of large number of strong and healthy shoots.
- To improve the flower production with quality.
- Pruning will force the eye bud to produce the strongest shoot.
- It keeps the plants in proper shape and size.
- To allow light and air to reach the centre of the plant.
- To facilitate various cultural operations like hoeing, weeding, soil scraping, sterilization,manuring, harvesting, *etc*.
- To rejuvenate the old plants. Cut off the old plants from the base to get strong shoots.
- To remove dried and diseased affected portion of the plant.
- To make a plant more manageable for maximum returns.
- To give more aesthetic look to plant.

Pruning in Rose:

- Pruning is done once in year during second or third week of October.
- In old hybrid tea bushes, the previous season's thick shoots are pruned up to half the length,keeping about 5 or 6 eyes on each stem.
- In Hybrid tea and Floribunda, keeping only 3 or 4 shoots with 3 or 4 eyes from the base toobtain exhibition blooms.
- A slant cut is made little above an eye.
- Floribundas are pruned moderately.
- The climbing roses do not require any pruning, except the removal of unhealthy and deadtwigs.

Where and How to Prune Roses:

- Every rose stems has eyes (buds) alternating on opposite sides in the leaf axils (usuallyoutward and inward).
- The basic rule in pruning is always to make the cut about half a centimeter above avigorous bud that finds in the direction one desires the new shoot to grow.
- Since the rose bush has to be kept open in the centre.
- The cut is made at an outward growing bud in standard roses as well as in floribundas.
- Where as in climbing roses the pruning is done at a bud pointing more or less upward.
- Always encourage outward bud to expose the center open.
- Whichever the bud is selected the cut should be slightly slant. As the horizontal cut retainsmoisture / sap and therefore, is liable to cause fungal growth,
- While making the cut care should be taken not to make it too high above the eye (bud) asthere may be chance of die back of shoot.
- On the other hand if the cut is very nearer to the bud, it may die due to want of sap flow.So cut one inch above the bud.
- It is absolutely necessary to cut the sharp end clean because the broken tissues, bruises orhanging shreds of bark will invite for infestation of pests & diseases.
- All the cut ends should be pasted with cane sealer (copper fungicide) against the attack offungus and cane boring insects.
- Within a fortnight after pruning new flush of growth will start and within 45 days ofpruning new flowers are ready for harvesting.

Types of pruning:

The intensity of pruning markedly influences the growth and flowering or roses depending upon the extent and level of shortening, there are three types of pruning.

1. Light pruning – strong & sturdy plants are prunes lightly.
2. Moderate pruning – moderate growers pruned moderately.
3. Hard pruning – weak plants/old bushes.

Online link:

https://www.youtube.com/watch?v=D-0JPGl-Fkk
https://www.youtube.com/watch?v=J2zwWZ6ULPI

PRACTICAL – 5
PLANNING AND LAYOUT OF GARDEN

OBJECTIVES: To study about different types of garden

Planning and layout of garden is as important as planning of a building. It is a useful exercise to draw the plan on a paper with proposes and position of the garden features, according tosize, shape, colour and structure. The art of designing of garden is known as landscape gardening. Planning and designing known as Landscape architecture of Landscape gardening.

I. Styles of Garden:

1. Formal Garden:

It is laid out as per symmetrical or geometrical methods, in such gardens everything is planted in straight line or curve. The plants, flowers beds, borders, shrubbery are arrange in geometrical design. e.g. Mugal, Persian, Italian and Frech garden.

Features of a Formal Gardens:

- First plan is made on paper and then land is selected accordingly
- Land is leveled
- Symmetrical design
- Geometrical: Square, rectangular, circular beds and borders
- Roads and paths cut at right angle
- Balance is symmetrical as same feature replicated on both sides of central axis
- Hedges, edges and topiary are trimmed
- Trees can be selected as individual feature

2. Informal Garden:

The whole design looks informal as the plants and the features are arranged in natural way without observing hard and fast rules but planning is done with the think of fully, maintain, creation and attraction. The idea behind this design is to initiate the nature. e.g. English and Japanese garden.

Features of an Informal Gardens:

- Plan is forced to fit the land
- Main aim is to capture natural scenery
- Land is not leveled
- Asymmetrical design
- Non-geometrical beds and borders
- Untrimmed hedges, edges and topiary
- Individual plants are not selected as feature

3. Wild garden:

The term "Wild garden" was given by William Robinson in the last decade of 19th century. The concept of wild garden is not only against all formalism but is also breaks the rules of styles. The grass remains unmoved and bulbous plants are planted scatter.

II. <u>Creating a new garden:</u>

It is important to design the garden in relation to its setting and to take into account some factors such as soil type, slope, weather, local planting materials, irrigation facilities, *etc*. It mayseem simple to dig up the entire garden which has jungle-like tangles of trees and neglected shrubs and weeds. But it is better to proceed with caution. The inclusion of one or more mature specimens in a new garden provides a framework around which to design the planting scheme and also helps to counteract raw appearance.

III. <u>Considerations for garden designing:</u>

The basic considerations to be taken before developing a garden are given below:

1. **Climate:** This includes annual rainfall, relative humidity, temperatures, sunshine hours and special climatic influences on particular area. For example, town gardens are usually warmer and more sheltered all year round than those in rural areas. In addition, the microclimate should be assessed such as which parts receive sun and shade in different time of the day and of the year.
2. **Soil:** It is essential to find out characteristics of the soil which includes, type-heavy or light, texture-clay or sandy, acidic or alkaline (pH), *etc*. The soil types affect drainage, the type of plants that may be grown, type of irrigation and the ease of cultivation tasks such as digging and planting.
3. **Design:** When designing a garden, consider it in the context of its surrounding rather than in isolation. For example, it may be in a terrace or suburban setting with good or bad outlooks. The more detailed plan may be drawn showing view of site, direction of wind and where shelter or screening is required.
4. **Maintenance:** All gardens need some care and attention to keep them in good conditions. Before deciding a design, be realistic about the amount of work and energy required for maintenance of the garden. Also assess how much time and help will be available or affordable for different operations.
5. **Cost:** This includes all type of cost like cost of construction, cost of soil preparation and modulation, cost of irrigation system, cost of establishment of plants and their maintenance cost. During planning and designing one has to consider the expenditure of the garden as well as the budget of the owner and then planning should be carried out.

IV. Steps for creation of design:

1) **Exploiting natural characteristics:** Always try to work with given conditions using natural features of site. Slopes, banks and changes in level may offer scope for constructing terraces, retaining walls, stepped beds, a watercourse or a rock garden. Poorly drained or damp problemareas are good for making bog or marsh gardens using moisture loving plants.
2) **Assessing existing features:** Make separate lists of planting material and hard elements present on the site. Note their position in the garden. When preparing garden plan, this information will be helpful to decide which element or plant to reposition or remove or modify.
3) **Measuring the site:** First of all, measure the boundaries of the plot. If the site is irregularly shaped, divide it into small sections and measure it separately. Alternatively, a surveyor may be employed to prepare a scale plan.
4) **Making a scale plan:** Next step is one has to draw a scale diagram of the site as a basic plan on which various designs may be drawn. These may differ greatly in styles; the space allocated for each feature, and the sense of proportion, but makes each one on a scale plan so that it has a realistic basis.
5) **Changes of level:** If there are marked changes of level on the site, indicate this at the survey stage, as the new design may have to incorporate certain features to accommodate the gradients. A gentle slope may keep as such for proper drainage and a steep slope may necessitate the building of terraces or retaining walls.
6) **Preparing the first plan:** The site measurements take on paper to create a scale-based plan of the garden which should include all boundaries together with all elements which one want to retain from the existing garden. If making several different designs for comparison, draw each on tracing paper fixed over this scale plan so there is no need of redrawing.
7) **Choosing the design style:** There are many variations of styles that provide potential for creating a unique design but preference is given to personal taste. All the basic principles should be kept in mind, whatever may be the design. Style of the garden is also depending on position and surroundings of site.
8) **Drawing up the final design plan:** Draw this working plan accurately as per the scale on paper, using numbers and symbols for various features. Also indicate the proportion and sizeof the feature so they may not create problems on ground.
9) **Planning the work:** Designer has to prepare a schedule, before embarking on construction and cultivation, to minimize disruption on the site so that the messiest and most elaborate operations, such as constructing a patio or wall, are carried out first. Planting process require clear site, proper time and season for survival and establishment.
10) **Planting:** After completion of skeleton of garden means marking and development of hard elements like paths, steps, walls, *etc*. Planting should be carried out carefully. Growth rate andsize of plant after due course of time and at maturity should be kept in mind. Old hedge or shrubs of poor condition should be removed and replanting with new should be done.

V. Planning or designing is done on the basis of following points.

- ✓ Planning is done according to the hobby and judgment of the owner.
- ✓ As per climate, soil and topography of the land.
- ✓ The position and design of the building or locality.
- ✓ The size of house or building.
- ✓ Source of water, availability of labour and cost.
- ✓ Do not copy down other garden, one has to develop own design.
- ✓ Avoid overcrowding of plants position.
- ✓ Maintain colour, harmony, balance fragrance.
- ✓ Provide attractive frame work.
- ✓ Large compound divided in sub plot.
- ✓ Shape the tree and shrub may take into consideration.
- ✓ Prefer a fountain with a statue.
- ✓ Use wind barriers on back side of the house.

VI. Procedure of layout of garden:

- ✓ Observe the site carefully.
- ✓ Remove big stone, stubbles, unwanted foliage, creepers, trees, *etc*.
- ✓ Cultivate the land, leveled area as far as possible but make slope, elevation as perarchitecture looks.
- ✓ Measure the area.
- ✓ Demarked the land and make sub plot.
- ✓ Designed the road and path according to the site and requirement.
- ✓ Fix the focal point or statue as on attraction place.
- ✓ Make live boundary line (hedge) and divisional line (edge) as per requirement.
- ✓ Draw geometrical design for flower bed near the road side and boundary line on free handbased.
- ✓ Planting of decorative foliage plant on division line.
- ✓ Make mass effect with shrub, creeper, flowering plants *etc*.
- ✓ Raised the lawn.
- ✓ Designed the rockery if require.

Online link:

https://slideplayer.com/slide/3449850/

https://www.slideshare.net/AmitBarkodia/planning-and-layout-of-garden-narender-2011a24bvii

PRACTICAL – 6
BED PREPARATION AND PLANTING OF MAP

OBJECTIVES: To study the bed preparation and sowing of MAP.

Planting and Bed preparation

- The seeds of annual flowers are sown in nursery beds, earthen pots, seed pans or wooden seed trays.
- The seeds of a few annuals like sweet pea, morning glory, lupin, nasturtium and hollyhocks which have bold seeds can be sown directly at permanent places.
- The seed compost should consist of one part each of garden soil, coarse sand, farmyard manure and leaf-mould.
- For preparing the nursery beds, the soil should be dug up thoroughly and sufficient farmyard manure should be mixed in soil.
- Raised nursery beds of convenient size (normally 60cm wide and 15cm high) should be prepared. If soil is heavy, some quantity of sand may be added.
- It is better if the soil of nursery bed or earthen pots is sterilized with 2% formalin.
- For this, soil is drenched with formalin solution and is covered with polythene sheet for 45hr.
- Then afterwards the polythene is removed and soil is dried before sowing the seeds.
- Before sowing, the seeds should be treated with Cerason (0.2%) and Captaf (0.2%) to prevent the seedlings from damping off disease.
- The seeds should be sown thinly and evenly as thick sowing causes damping off of seedlings. Mixing of fine sand in very small seeds is advisable for even sowing.
- The seeds of echium, lobelia and flowering tobacco do not germinate unless first exposed to sunlight, while seeds of nigella and cineraria germinate only in dark.
- The seeds recently harvested from the plant, although given required conditions, fail to germinate. This may be due to physical condition or chemical reaction of seed coat of seeds.
- Seeds of clianthus need stratification or scarification for germination.
- Some seeds require after ripening period for germination. In nursery beds, the seeds are sown in rows spaced 6cm apart.
- Then, they are covered with finely sieved leaf-mould.
- Watering is to be done with a watering can having a fine rose both in beds and pots.
- In beds, when germination is over, water is given for proper moisture.
- Thereafter, the beds should be kept weed-free

Online link:

https://biocyclopedia.com/index/medicinal_plants/production_and_management/preparation_of_beds.php

PRACTICAL – 7
INTERCULTURAL OPERATIONS INORNAMENTAL PLANTS AND MAP

OBJECTIVES: To study about different practices and intercultural operations follows in ornamental plants and MAP.

I. Special Practices in Ornamental Plants:

1. **Bending:** Bending is a major operation necessary to get good quality cut flowers especially done in Roses. It also helps in buildup of strong framework along with good quality flower stem development. Just as the plant is 1-1.5 months, first bending can be carried out. Three– four stems arising after pinching, these should be allowed to develop dark green in colour (stem bronze or reddish leaves should not be selected for bending) and then the weaker ones should be bended. Just one or two stems strong enough should be allowed to grow to bear theflowers.

   Bending procedure:

- Bending should be carried out carefully.
- Bud should be pinched off from the branched intended to bend.
- The branch which arises from the main shoot of the plant, leaving two healthy leaves,the portion above is pressed hard with a twist to split the inner stem portion, than again pressed with thumb and bent smoothly towards the path side of the bed with thumb and index finger.
- Care should be taken that the stem does not break.
- The bend should be more than 90°.
- If the branch is likely to break with a strong bend than two close bends can be givenso that the end stem part is bended at more than 90°.
- The two-leaf axil buds later produce strong healthy tall shoots with flowers.
- This process is repeated.
- By this process stronger shoots are selected and weak ones left as pinched stems toprovide leaf cover.

   Principle:

- The main idea of bending is to encourage the plant for healthy framework at bottom which will give strong-lengthy stalks.
- The bended stem however weak, contribute in increasing carbon assimilation via enhanced photosynthesis with better surface leaf area exposed to light.
- Vegetative growth also gets impetus via bending which forms the basis for development of shoots.
- By bending treatment, the dormant buds below the bend get extraordinary impetus, through reduction of apical dominance and thereby produce long and strong shoots with flowers.

2. **Pinching:** Pinching is refers to the removal of the growing tips of the plant to induce the growth of vegetative laterals. Chrysanthemum, carnation and marigold required pinching.

   Objective: Encourage the branching to produce a bushy growth or production of flowerbuds.

- Time of pinching: At the young stage of the plant.
- Procedure: With the help of thumb and forefinger the top portion of the plant should beremoved, although knives and scissors can also be used.

3. **Disbudding:** Disbudding is important for development of the main bud as it consists ofremoval of all the axillary buds just below the main bud at early stage is known asdisbudding. Eg. Rose, chrysanthemum and annual and perennial plants required disbudding. **Disbudding in Chrysanthemum**:

- This operation is done for large-flowered and decorative chrysanthemum.
- For taking 3 blooms/plant, the first pinching is done in August.
- Three lateral strong shoots are allowed to grow and others are removed.
- Disbudding should be start in October.
- Lateral buds and side shoots are removed at early stage of growth from time to time.
- For taking one bloom/plant no pinching is done.

4. **De-shooting:** Removal of unwanted or water shoots. Perennial plants produce numerous sideshoot which do not bear the flower or inferior quality flower. Only specific shoot are allowedand others are removed at early stage Eg. Carnation & chrysanthemum for exhibition.

5. **Defoliation:** Removal of foliage (leaves) is known as defoliation.
   Objective: For inducing flowering or to reduce transpiration.
   Procedure: Removal of leaves by hand or by secateurs with holding water. Eg. Jasmine.
6. **De-suckering:** It is nothing but the removal of suckers. As the plant grows, a number of suckers also grow from the base of plant or rhizome. These suckers compete with the main plant for its food and nutrients. Thus, controlling these suckers is a must to maintain normal bunch weight and quality. Eg. Gerbera, chrysanthemum, *etc*.
7. **Thinning:** Removal of the undesirable growth like inward growth, weak stems, blind shoots,crowded growth.
8. **Bud Capping or Topping:** The developing buds as they appear reaching maturity in 2-3 days are covered with bud nets made up of nylon nets. The bud net maintains the bud in proper shape maintains it compactness and also helps in proper development with some effect on modified atmosphere surrounding the bud. Eg. Rose.
9. **Wintering:** It is the treatment of exposing the roots to sun light around the plant especially done in roses by digging the soil up to certain depth which will increase & improve flower yield and quality.
10. **Netting (Trellising):** It is done in carnation as it is a very fragile and herbaceous plant and growing stems tend to fall on the sides under their own weight. Hence, plant support by netting is very important. Staking with 4-5 layers of galvanized metal wire or of nylon rope fixed to the frames is an important practice. The first net of the size 7.5 x 7.5 cm mesh (squares), is tied 10 cm above the ground surface and the subsequent nets of 15 x 15 cmmesh are tied at every 15 cm to 20 cm distance from one another. The total 4-6 number of netlayers is required to be, tightly stretched on supports. The nets are usually laid before planting. Rooted cutting are planted within the netting and successively raised with plant growth.
11. **Topiary:** It is an art of clipping & trimming shrubs or trees into different ornamental shapes i.e., of birds, animals, domes, umbrellas, *etc*. It is an old art but now-a-days it is becoming popular in city parks to recreate visitors specially children's.
    Characteristics of plants:

- Plant should be quick growing in nature.
- Leaves should be small, green or yellow in color.
- Ability to withstand frequent clipping/pruning practices.
- Produces good number of lateral shoots.
- Eg. *Duranta plumari*, *D. variegata D. goldiana*, *Thuja orientalis*, *etc*.

12. **Staking:** Staking is necessary to keep plants erect and to maintain proper shape of plants and bloom. Stakes are prepared mostly from bamboo sticks. It is required for vertical support of the plants.
13. **Use of growth substances:** To some extent some growth regulators like GA3 and retardants like CCC are used to get more number of flowers with good quality. GA3 @ 100 to 300 ppm has been found to increase the stalk length, flower size and reduce number of blind shoots in different flower crops.
14. **Mulching:** It is another important cultural operation to maintain optimum soil temperature, conserve soil moisture, suppress weed growth and produce more flowers of better quality. Flower crops beds can be mulched with straw, dry grasses, black polythene film, *etc*.

<u>Special Practices in Medicinal & Aromatic Plants:</u>

15. **Drying:** It is carried to minimize the moisture from the plant or its product in order to increase its storage life.
    Methods of drying: Natural drying under sun, Solar drying, Oven drying, Freeze drying, Dehydration, *etc*.
16. **Curing:** Some bulbous plants are cured for at least two to three weeks or until the tops necks of stem are completely dry and the outer skin becomes slightly crispy on the field itself after harvesting.
17. **Earthing up:** Earthing up hilling or ridging is the technique in of piling soil up around the base of a plant. It can be done by hand (usually using a hoe) or with powered machinery, typically a tractor attachment. It buries the normally above-ground part of the plant, promoting desired growth. It also encourage the rooting and is be used to stabilize the stems of crops which are easily disturbed by wind.
18. **Gum Tapping:** It is generally done in guggal for obtaining gum. The plants are ready forgum tapping after 4 to 5 years of planting. Minimum thickness of stem should be 5 cm. **Method of**

tapping: Bark deep (that is shallow) incision is to be made on bark and whilecarrying out the incision a small quantity of guggal gum (mixed with water) should beapplied to the incised place using the prick–chirel for incision. For this purpose, the sharpend of the instrument is dipped in the guggal solution and an incision is made on the bark,taking precaution that a small amount of guggal solution present on the prick –chirel reachedinside the incised bark.

19. **Rejuvenation:** Some plants or trees after attaining certain age do not or produce very less flowers, so at that time the rejuvenation is practiced to overcome this problem.
    Rejuvenation in Scented Rose:

- Yearly observations have shown that rose plantations do not have a uniform rate of production.
- In the first 5 to 6 years the flower yield rises, but after the sixth year the flower production declines and after 8-10 years, the roses become unprofitable, necessitating rejuvenation.
- Autumn is the most favourable time for rejuvenation.
- The bushes are cut down to the base and on both sides of the rows, trenches 18-20 cmdeep are opened and the soil is spread in the inter-row space.
- In these rows, 20-30 t of FYM along with 60 kg/ha each of P_2O_5 and KO_2 are placedand covered with soil.
- In the spring, new shoots develop and out of them only six to eight vigorous branchesare allowed to grow.
- After 2 years, the yields of rose flowers reach the previous level and the life ofplantation is increased by a further 8-10 years.

Online link:

http://ncert.nic.in/vocational/pdf/kepc102.pdf

https://www.ishs.org/ishs-article/710_1

PRACTICAL – 8
HARVESTING AND POST HARVEST HANDLING OF CUT AND LOOSE FLOWERS

OBJECTIVE:

- To study the proper harvesting stage and method of important cut & loose flowers
- Post-harvest handling of important flowers

Harvesting:

Definition: Harvesting is the process of gathering a ripe crop from the fields

General guidelines for harvesting:

- Spike type flowers: Harvest when one-fourth to one-half of the individual floretsare open.
- Daisy type flowers: Harvest when fully open.

Prior to harvesting:

- Plants should be healthy and turgid.
- White plastic buckets and cutting tools (knives or shears) should be cleaned and sanitized. Avoid stacking buckets if the outside is not as clean as the inside.
- Cutting tools should be sharp. Dull cutting tools can result in crushed stems that reduces water uptake.
- All buckets for harvesting should contain clean water.

Post-harvest handling of cut flowers:

Rose		
Stage of harvesting	**:**	There are cut while still in the bud stage after the sepal curl back and the colour is fully showing. In large flowered roses, flowers along with the stem of prescribed length are cut when the 1st one or two petals start to unfold but do not open fully. In small flower clustered varieties cut when these begin to open in the cluster. In foreign market, the size of stem arises from 60- 90 cm for large flowered roses and 40-50 cm for small flowered. The size of large flowered bud is 3 – 3.5 cm and 2- 2.5cm for small flowered.
Method ofHarvesting	**:**	Done with sharp secateurs at the tight bud stage when the colour is fully developed and the petals have not yet started unfolding.
Time of harvesting	**:**	During early morning
Handling	**:**	The cut roses are kept in plastic buckets / containers filledwith clean water having preservative (silver thio sulphate) to enhance their shelf life. The graded flowers boxes are kept in cold storage at 2^0 – 4^o temperature for 12-24 hours
Spider Lily		
Stage of harvesting	**:**	Unopened but mature stage
Method of Harvesting	**:**	By hand picking

Time of harvesting	**:**	Early morning or evening
Handling	**:**	Bunching 50-100 bud, bunching bud are packed in jute bag or corrugated card board box
Jasmine		
Stage of harvesting	**:**	For fresh flowers, fully developed unopened flower buds for extraction of concrete only fully opened fresh picked flowers are required.
Method of Harvesting	**:**	By hand picking
Time of harvesting	**:**	Early morning or evening
Handling	**:**	For marketing: keep flowers to wet cloth, put it in baskets and send it to market Chemical solutions $Al_2(SO_4)_3$, (0.1%), Silver nitrate (0.01%) and Sodium benzoate (0.1%) were found effective.
Tuberose		
Stage of harvesting	**:**	Ready for harvest in about 3-3.5 / months of planting. For marketing of flower spikes: when 1-2 pairs of flowers open on the spike.
Method of Harvesting	**:**	For individual flower by hand plucking For spike by cutting with knife
Time of harvesting	**:**	Early morning hours before 8 am daily, when they start to open.
Handling	**:**	Pack with 10-12 spike in one bundle for distant market. Double variety are coloured with red yellow or sky blue gets more price. For that dye is used which is generally used in ice cream or sweet making. Put spike for 6 to 9 hours. Cut flower keep for long periodit should be put in flower vase with sucrose (1-4%), citric acid (0.1- 0.5%) or Aluminium sulphate (0.1 to 0.5 %), Gibb relic acid (0.055) or copper sulphate (0.5%) which extent the vase life up to 10-12 days
Marigold		
Stage of harvesting	**:**	Fully open flower
Method of Harvesting	**:**	By hand picking and cutting with knife or scissors
Time of harvesting	**:**	Cool hours of the day
Handling	**:**	Flowers should be covered with moist gunny begs if kept overnight before taking to market.
Golden rod		
Stage of harvesting	**:**	25% open spike
Method of Harvesting	**:**	By cutting with knife
Time of harvesting	**:**	Early morning
Handling	**:**	For marketing: 10-12 spikes / bunch covered with banana leaves or news papers Un open spike and 25% open spike are dip in sucrose 2% + 8 HQC (Hydroxyqvinolin) 0.03% solution will give 10.66 days' more vase life.
Gladiolus		
Stage of harvesting	**:**	After the first floret (the lower most) shows colour
Method of Harvesting	**:**	By cutting with knife
Time of harvesting	**:**	Early morning or evening
Handling	**:**	- Immediately after cutting, the spikes should be placed in

		buckets containing water. Pack with 10-12 spike in one bundle for distant market. When kept in vase, all the upper florets will open in succession and the spikes will last for a long time. Sucrose improved water balance in cut gladiolus. 600 ppm 8-HQc with 4% sucrose effective in white friendship variety. AlSO4 (0.1%) also effectiveas 600 ppm 8HQC.
Gaillardia		
Stage of harvesting	**:**	Loose flower: At fully blooming stage
Method of Harvesting	**:**	By hand picking
Time of harvesting	**:**	For long distant market: One day before in evening For local market : Early morning
Handling	**:**	After harvesting flowers kept in basket and cover with wet cloth.
Chrysanthemum		
Stage of harvesting	**:**	For loose flower: fully open stage For cut flower: un opened but mature stage for nearbymarkets Full open stage for distant markets: 1/2 open stage.
Method of Harvesting	**:**	For loose flower by hand Plucking. Loose flower is harvested with stem and put them in wet gunny begs. For cut flower: by sharp knife and put quickly in water.
Time of harvesting	**:**	Early morning or late evening.
Handling	**:**	Loose flower put in wet gunny begs. Cut flowers put quickly in water after harvesting 50 ppm cycocel spray on flowers gives good storage capacity.
China Aster		
Stage of harvesting	**:**	For cut flower: Flowers along with stalks or whole plants are harvested. For loose flower: Individual flowers are harvested with short stems attached
Method of Harvesting	**:**	For loose flower by hand plucking For cut flower by cutting with knife
Time of harvesting	**:**	Early morning or late evening
Handling	**:**	Immediately after harvest, they are put vertically in a container having clean water. Lower leaves attached to the stalk should be removed tominimize transpiration. Grading is done according to stalk length, size and shape of flowers, freshness and other qualities. While packing no direct contact between the flowers andpacking material. Clear plastic films apart, improve the attractive.

Online link:
https://krishijagran.com/featured/special-horticultural-practices-in-flower-crops/

https://www.agrimoon.com/wp-content/uploads/Medicinal-and-Aromatic-Crops.Pdf

PRACTICAL – 9
PROCESSING OF MEDICINAL AND AROMATIC PLANTS

OBJECTIVE:

To study processing of medicinal plants.To study processing/methods of essential oil extraction in aromatic plants.To know different value added products of MAP.

Processing of Medicinal crops

- Proper drying and storage of medicinal plants for future use are important since moisture encourages the growth of molds and other microorganisms, leading to the destruction of the active principles and the deterioration of the plant drug.
- Air-drying and sun-drying are the methods employed in the absence of temperature- controlled ovens. Properly dried leaves crumble easily.
- Small amounts of material may be dried in a large transparent container in a sunny window, such as an uncapped large jar.
- Large amounts may be hung in bundles, baskets, mesh bags, outdoors or spread on a clean mat in warm, dry place indoors.
- Avoid drying on top of concrete pavements or roof-tops; extreme heat could destroy some of the plant constituents.
- Prevent growth of molds and other microorganisms, infestation by insects and rodentsby keeping the dried plant drugs inside air-tight containers in a cool, dry place away from direct light.
- Stored medicinal plants must be labeled inside and outside the container; include the date of collection in the label.

Extraction of essential oils and value addition in aromatic crops

Technology for processing aromatic crops is quite simple and all the required machineries and manufacturing facilities are available in most parts of our country.

As these extractions plants can be made locally; commercial cultivation would be viable in many parts of our country with participation of even small group of farmers.

For sustainable utilization of the extraction unit, the raw materials will be available through these types and farming clusters.

Distillation procedure for aromatic plantDistillation Process:

Definition:

Distillation is a process of heating a liquid until its more volatile constituents passin to the vapor phase and then cooling the vapor to recover such constituents in liquid form by condensation.

Purpose:

To separate a mixture of several components by taking advantage of their different volatilities or the separation of volatile materials from non-volatile materials. Normally, even though the process may change the composition of the essences due to the heat employed, distillation is used.

This can be divided into three categories,

Simple distillation over direct heat, Steam distillation Vacuum distillation.

Steam Distillation:

Steam distillation is the most common method used to capture essential oils. In fact, about 80% of all the oils are produced via this method. It involves placing thefresh plant material onto a grill situated inside a still.

To know different value added products of MAP.

Technologies are available for isolation of aroma principles from aromatic plants through distillation,

fractional distillation, solvent extraction, expression, super critical fluid extraction *etc*. The products can be obtained from aromatic plants and enterprises can be established based on these products.Essential/ aromatic oilsAroma chemicalsConcretes & Absolutes: obtained from flowers.
Oleoresins: obtained from spices.Resins, resinoids obtained from wood or dry plant parts.
GumsPerfumed water / Hydrosol
These products are widely used in fragrance industry, flavour industry, aromatherapy and pharmaceutical industry. A number of single consumer product or multiple products enterprises can be started at rural and urban centres. Examples of small and medium enterprises in existence include companies manufacturing soaps, agarbatties, rose water, attars, perfumes, hair oils, *etc*.; aromatherapy/ naturopathy centres, beauty clinics, *etc*.
Processed products:
Essential Oils: It is extracted from flowers like rose, jasmine, tuberose, marigold,calendula, *etc* through steam distillation. It is the volatile material(s) derived from odorous plant material of a single botanical species. Chemically these are organic compounds made up of hydrocarbon molecules and can further be classified as terpenes, alcohols, esters, aldehydes, ketones and phenols, *etc*.
Concrete: It is a wax like substance containing the natural flower perfume together with some plant waxes, albumin and colouring matter which is generally absorbed by the solvent in form of volatile material.
Absolute: It is highly concentrated, entirely alcohol soluble and usually liquid perfume material obtained by alcohol extraction of concrete or from fat extracts of plant materials.
Rose water: It is obtained from petals & used as perfume & in medicines &confectionary.
Gulroban/ Gulroghan: It is rose hair oil prepared from rose petals by effleurage with wet sesame seeds. It is used as a hair oil, aromatherapy and body massage.
Gulkhand: It is most delicious and is prepared from rose petals and is rich incalcium and has antioxidant activity.
Pankhuri: Dried rose petals are known as pankhuri which is occasionally usedfor preparing sweetened cold drinks.
Floral Products: edible products like squash, sharbat, syrup, gulkhand, pankhuri,water, tea, jam, *etc* can be prepared from rose.
Bathing and Body Care Products: The best herbal baths includes dried flowersand also used in lotions, toners, facial steams, masks, hair rinses and sprays.
Pharmaceutical Compounds: Like vincristine, catharanthine, *etc* are used incancer treatment. Rose fruits contain vitamin-C which is used for cure of scurvy.

Online link:
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PRACTICAL – 10

VISIT TO COMMERCIAL FLOWER/MAP UNIT/GARDEN.

Introduction

A garden is a planned space, usually outdoors, set aside for the cultivation, display, and enjoyment of plants and other forms of nature. The single feature identifying even the wildest wild garden is control. The garden can incorporate both natural and artificial materials. Gardens often have design features including statuary, follies, pergolas, trellises, stumperies, dry creek beds, and water features such as fountains, ponds (with or without fish), waterfalls or creeks. Some gardens are for ornamental purposes only, while others also produce food crops, sometimes in separate areas, or sometimes intermixed with the ornamental plants. Food-producing gardens are distinguished from farms by their smaller scale, more labor-intensive methods, and their purpose (enjoyment of a hobby or self-sustenance rather than producing for sale, as in a market garden). Flower gardens combine plants of different heights, colors, textures, and fragrances to create interest and delight the senses.

GARDEN FEATURES

In order to break the monotony and to enhance the beauty, any garden should contain components of varying nature. Following are certain important features:

Avenue

An avenue is the row of trees grown on both sides of roads. Shade and beauty are the sole criteria to be considered while selecting avenue trees. The trees should also be selected according to the length and breadth of the road.

AVENUE PLANTING

Topiary

It is the art of developing the plant or training the plant into different forms or shapes like animals, birds, arches, etc. The plant should be amenable for repeated pruning and also flexible with more vegetative growth.

(eg) Hills – Cupressus macrocarpa, Pinus patula

Plains – Casuarina sp., Caesalphinia coriari, Bougainvillea sp., Jaminum sp.

Lawn

It enhances the beauty of a garden whether it is small or large. It finds the most important component of a garden giving a view of a green carpet.

Trophy

It is the arrangement of colourful potted plants in differ-ent tiers around a central object which may be a tree trunk, lamp post or a pillar.

Carpet beds

The art of growing ground cover plants closely and trimming them to a design or alphabetical letters is called a carpet bed. Colourful foliage as edge plants is found to be more suitable for this purpose. (eg.) Alternenthera.

Shrubs and Shrubbery

Growing of shrubs in a group is called shrubbery. It is of two types (i) Pure shrubbery (ii) Mixed shrubbery. Pure shrubbery refers to planting of entire selected area with a single species and the opposite holds good

for mixed shrubbery.

Shrubs for showy or attractive flowers (e.g.) Hibiscus, Ixora, Mussanda, Night queen, Euphorbia etc., Shrubs for fragrance (e.g.) Jasmine, Rose, Nandiayavattai (Tabernaemontana), Pavalamalli (Nyctanthes) etc. Shrubs for foliage (e.g.) Crotons, Polycias, Eranthemum, graptophyllum, etc.

Arboretum

Growing of different species of trees in one place is called ‘Arboretum'. The trees form the main frame work of the garden. Group of trees in one place will help to give depth to the garden. Trees are very fascinating because of their graceful appearance and the abundance of bloom. They are grown for their economic importance or aesthetic value or both.

Flower beds and Borders

Annuals and herbaceous perennials are grown in flower beds to provide massing effect of different colours. Borders are continuous beds of more length than width containing plants of one kind only.

Ground cover

When a dicot plant is of straggling nature is used to cover the ground surface is called ground cover (eg.) Wedalia, Verbena, Ipomea, Acalypha, Portulaca.

Climbers and creepers

A group of ornamental plants used to grow over walls, trellis, arches, pergolas, arbours, pillars, bowers, etc. These are grouped as light or heavy according to the amount of wood it produces.

Annual climbers (e.g.) Clitoria ternatea, sweet pea,morning glory (Ipomoea rubrocaerulea)

Climbers for screening (e.g.) Antigonon leptopus, Passiflora, Porana Ipomoea, Clerodendron splendens, Thunbergia etc.

Climbers for low walls or trellis for this purpose only light climbers are selected. (e.g.) Lonicera japonica, Solanum seaforthianum, Tristellatia australis, Tecoma jasminoides, Jacquemontia violacea.

Climbers for pergola usually heavy climbers are grown. (e.g.) Quisqualis indica, Petrea volubilis, Adenocalymma allicea, Allamanda cathartica, etc.

Climbers for porches (e.g.) Pyrostegia venusta, Petrea volubilis, Clerodendron splendens, Bougainvillea, Jasminum sp. etc.

Flowering climbers in partial shade (e.g.) Passiflora, Aristolochia, Quisqualis indica, Clerodendron splendens, Jacquemontia violaceae. Foliage climbers (e.g.) Scindapsus aureus, Philodendron sp., Monstera deliciosa.

Climbers for pot culture (e.g.) Tristellatia asutralis, Adenocalymma allicea, Clitoira ternatea, Bignonia purpurea etc.

Flowering annuals

Antirrhinum, stocks, dwarf sweet pea, pansy, dahlia, chrysanthemum, marigold, sweet alyssum, phlox, pinks (Dianthus) and verbena.

Herbaceous perennials

Pelargoniums, Michaelmas daisy, Cenna, Mirabilis jalapa, Portulaca, Solidago Canadensis, Vinca rosea, and Perennial verbena.

Trees

One or two drawf trees such Plumeria sp. Callistemon lanceolatus and Gliricida maculata can be grown as specimen plants. Some large to medium trees such as Araucaria cookii, Mimusops elengi, Brassaia actinophylla, etc., can also be grown till they are young.

Bulbs

A variety of bulbous plants of annual or perennial nature can be grown.

Water plants

Water lillies and other water plants can be grown in the lily pool, if any or in cement tubs.

Hedges

With the help of plants, live hedges can be formed and used as a fence or a green wall. It serves to screen a particular site or building or hiding of unwanted places. They help to partition the garden into several parts. It provides a natural background to a garden, like a frame to a picture. The characteristics of a good hedge are that it should be thick and dense; it should have foliage from the bottom to top; it should be trim and neat; if it is a flowering hedge its bloom should not clash with the general colour scheme.

Edges

These are perennial herbs often used as a short border for lawn or ground cover or dividing beds from roads, walks or paths. These herbs often stand frequent trimming. They consist of live material like the dwarf plants or inert material like bricks, stone slabs or corrugated iron sheets. The common evergreen edges used for edging are Eupatorium and Alternanthera. Justicea is capable of standing rainfed or drought conditions. Pilea, dwarf marigold and dwarf Coleus are also used as edges in rockeries.

Sunken garden

It is formed by taking the advantage of a natural depression. The depression is made into different tiers over which ground covers, edges, flower beds and small herbs may be grown. At the center of depression, a pond or pool is formed to grow water plants.

Rock garden

A rock garden is the arrangement of rocks with plants grown in the crevices. Its bold ruggedness is a pleasant contrast to the softness of the flowers. The stones help the plants in retaining their moisture and keep-ing their roots cool. In plains, on the sunny side some of the cacti & succulents; Lantana, Setcreasea, Verbena, etc can be grown successfully. Ferns and some indoor plants also look natural on the rockery slopes in shade.

Water garden

It may have a water course, a water pond and a water foun-tain or any one or more of these features, harbouring water loving and marsh plants. Water gardens, no matter, how tiny, are extremely effective in beautifying the landscape. Water lilies (Nymphaea) are the most popular water plants.Another aspect to be considered is the depth of water. The large tank is around 3-5 m deep at the deepest point. A reflecting garden pool is preferably shallow with a depth of 25-30 cm. If hydrophytic plants are to be grown, varying depths have to be provided in the same pond, which may range from 15 to 90 cm, the deepest portion allotted to lotus and water lilies. In shallow pockets and galleries, swamp plants such as Typha and Cyperus are accommodated. Salvinia, Pista and other floating plants may be conveniently added to this grouping. Provision is necessary to prevent rain water and through it silt entering into the pool. A slightly raised rim to a height of 10 cm will be helpful in this regard. Provision to drain the pool by providing an outlet at its floor level will help to clean it, as often as is necessary.

Garden adornments

There are several garden adornments and accessories such as fountains, statues, garden seats, ornamental posts and pillars, arches and pergolas, trellises, hanging baskets, tubs, vases and urns with plants which make the garden more enjoyable. Playing of a fountain is an interesting feature in a garden and the water in the cistern should be kept clean. Garden seats made up of stones, concrete or metal are placed under the tree. Handsome tubs, vessels and urns are utilized to display plants in conspicuous places. Arbours, arches, pergolas and trellises serve as support to several beautiful plants and to dispel monotony in garden. Arbours are usually open in all sides. Very often a long wall or the end of a pergola leads to an arbour. Arches are generally erected over walks, usually at the entrance and are usually two meters in height. Pergolas are series of arches connected over a walk.

Source

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