Practical Manual

on

Production Technology for Ornamental Crops, MAPs and Landscaping

APH 277 2(1+1)

(For Undergraduate Agriculture students)

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College of Horticulture & Forestry
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Syllabus APH 277 2(1+1):

Practical: Identification of Ornamental plants. Identification of Medicinal and Aromatic Plants. Nursery bed preparation and seed sowing. Training and pruning of Ornamental plants. Planning and layout of garden. Bed preparation and planting of MAP. Protected structures – care and maintenance. Intercultural operations in flowers and MAP. Harvesting and post-harvest handling of cut and loose flowers. Processing of MAP. Visit to commercial flower/MAP unit.

Name of Student .....

Roll No. .....

Batch .....

Session .....

Semester .....

Course Name : .....

Course No. : .....

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Practical No. 1

Objective: To identify ornamental plants: trees, shrubs, climbers, perennials and annuals.

Exercise 1: Identify different ornamental plants of the campus and note down distinguishing characteristics along with common name and family.

Common Name	Botanical Name	Family	Characteristics

Practical No. 2

Objective: To study about nursery raising of flowers.

MATERIAL REQUIRED: Soil, sand, FYM, seeds of marigold/annual flowers, tags, watering can.

Methods of nursery raising:

- Various annual flowers are commonly propagated through seeds. For better seed germination, optimum temperature range between 18 to 30^{o} C is required.
- Land is prepared by ploughing or digging up to 30 cm depth and exposed to sun for at least 15 days.
- Well rotten FYM at the rate of 5 kg/ m^{2} should be thoroughly incorporated in the upper 10-15 cm soil of the beds at least 7 days before transplanting.
- Soil is levelled properly and stones are removed. Raised nursery beds up to 15cm height is prepared in rainy season.
- Seeds are treated with Thiram or Captan @ 2g/kg seeds before sowing.
- Lines of uniform depth are prepared at a distance of 5- 10 cm and seeds are placed in these lines.
- Seeds are then covered with a mixture of soil+ sand+ FYM (1:1:1, v/v).
- Beds are immediately watered with help of watering can using a fine hose.
- Beds are kept moist by sprinkling water as and when required.
- Nursery becomes ready for transplanting in about 20-25 days in summers and 30-35 days in winters.

Exercise: Prepare a nursery bed of size 5m x 1m (in groups of 5 each) and write the procedure followed.

Practical No. 3

Objective: To study propagation methods and cultural practices followed in chrysanthemum.

MATERIAL REQUIRED: Secateur, rooting hormone (NAA @ 500 ppm), sand, cocopeat, watering can, mother plants of chrysanthemum.

Exercise: Make terminal cuttings of chrysanthemum (50 each) and write down the procedure followed.

Methods of propagation of chrysanthemum:

1. Propagation through suckers: ……

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2. Propagation through terminal cuttings: ……

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Procedure of making rooting hormone: ……

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Procedure of making terminal cuttings and planting in rooting medium: ……

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Cultural practices followed in cultivation of chrysanthemum:

1. Pinching: ……

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2. Disbudding: ……

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3. Deshooting: ……

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4. Staking: ……

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5. Weeding and hoeing: ……

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Practical No. 4

Objective: To study propagation and planting of tuberose.

Material required: Secateurs, fungicide solution, knife, bulbs of tuberose

Exercise: Write down the method of propagation of tuberose and its planting in the field.

Propagation through bulbs and bulblets:

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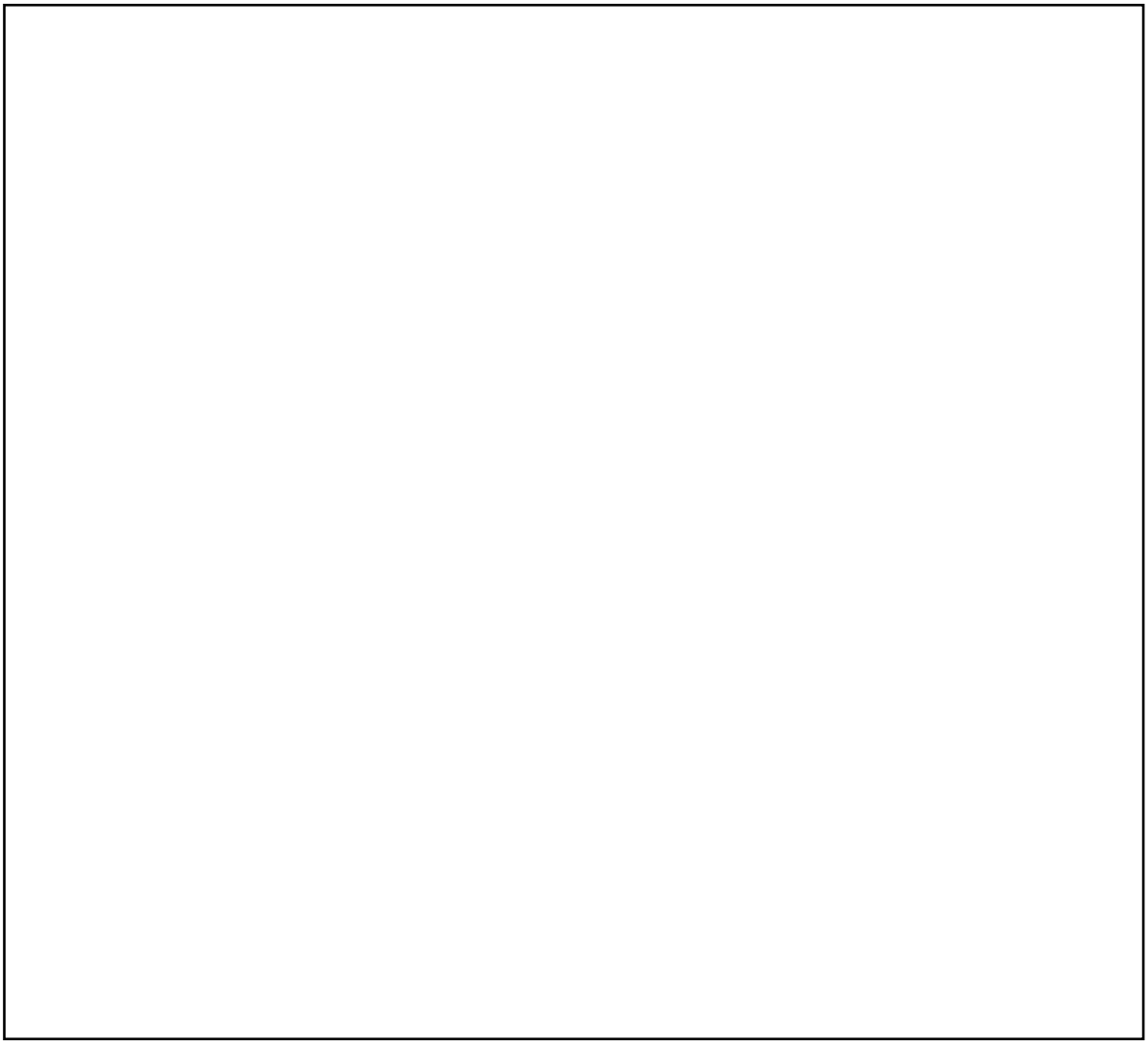
Draw a neat diagram of bulbs of tuberose.

Planting of bulbs in field:



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Practical No. 5

Objective: To study propagation method and cultural practices followed for cultivation of Gladiolus

Exercise: Write down the method of propagation of gladiolus through corms and cormels.

Propagation through corms and cormels: ……

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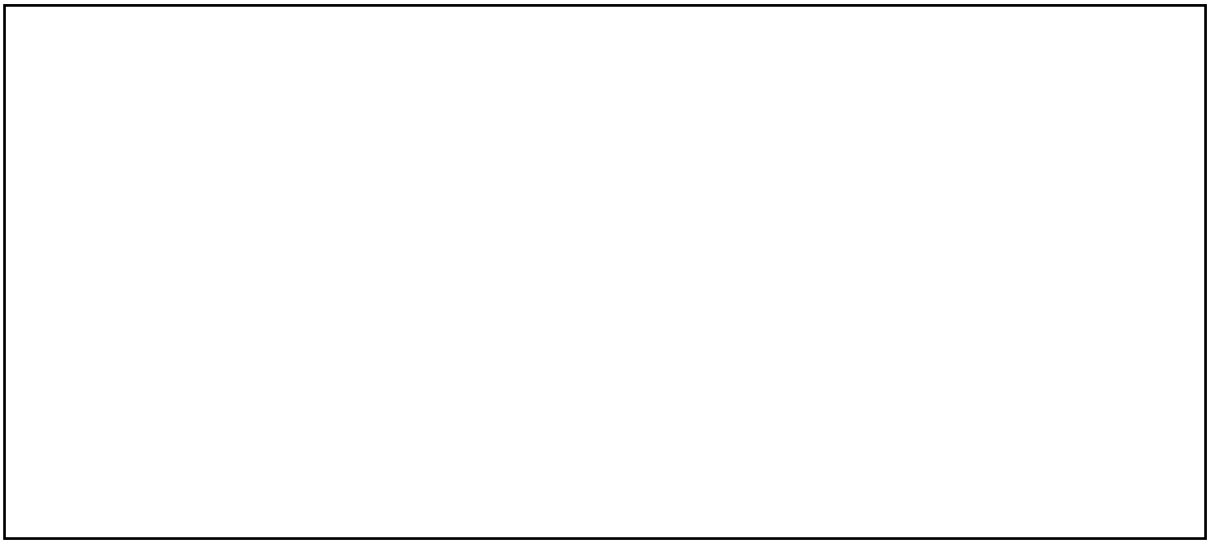
Draw a neat and labelled diagram of gladiolus corm.



Planting of corms: .....

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Cultural practices followed:

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Practical No. 6

Objective: To study propagation methods, cultural practices and training pruning of rose.

Material Required: Secateur, budding knife, plastic strips, rose scion, rootstock

Exercise: Prepare cuttings of rose (100 no. of cuttings by group of 5 students) and write down the procedure.

Methods of propagation of rose

1. Propagation through cuttings: ……

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2. Propagation through T-budding: ……

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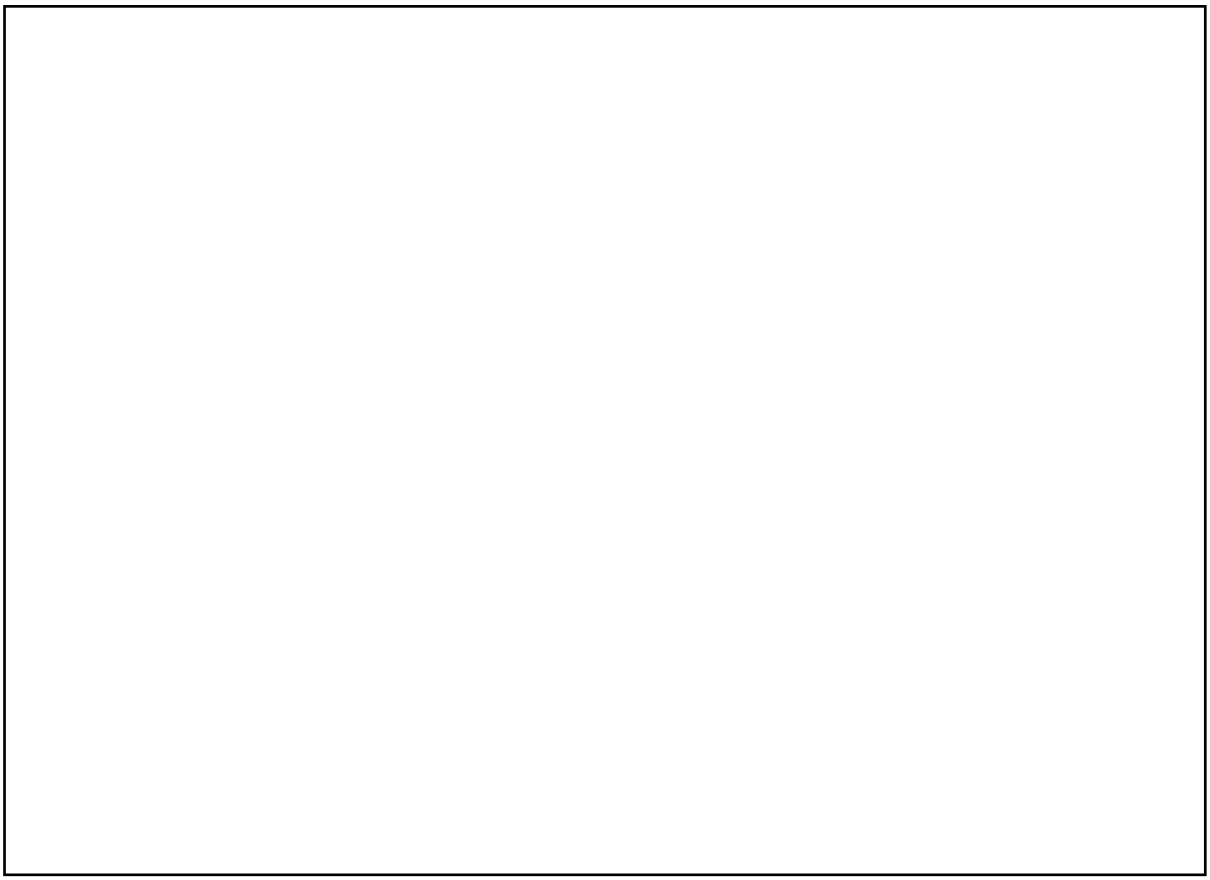
Draw neat and clean diagram of T-budding in rose



Cultural practices followed in rose:

1. Disbudding: ……

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2. Deshooting: ……

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3. Bending: ……

4. Pruning: ……

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Practical No. 7

Objective: To study different species of jasmine, their varieties and method of propagation

Exercise 1: Write down botanical description of important species of Jasmine and its varieties.

1. *Jasminum grandiflorum:* ……

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Varieties: ……

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2. *Jasminum sambac:* ……

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Varieties:

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3. *Jasminum auriculatum:* ……

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Varieties:

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Exercise 2: Prepare semi-hardwood and hardwood cuttings of different jasmine species and write in detail methods of propagation.

Procedure of making rooting hormone: ……

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Propagation through cuttings: ……

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Propagation through layering: ……

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Practical No. 8

Objective: To study classification of orchids and different methods of propagation.

Exercise: Write down morphological description of different types of orchids

1. Monopodial Orchids: ……

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Examples of monopodial orchids: ……

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2. Sympodial Orchids: ……

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Examples of Sympodial orchids: ……

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Draw a well labelled diagram of monopodial and sympodial type of orchids

Monopodial orchid	Sympodial orchid

Exercise 2: Write in brief about different methods of propagation of orchids

1. Through division: ……

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2. Through keikies: ……

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3. Through cuttings: ……..……

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4. Through seeds: ……..……

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Practical No. 9

Objective: To study different types of cultivars, propagation methods and different cultural practices followed in cultivation of carnation.

Exercise: Give description of types of cultivars of carnation along with examples

1. Standard type: ……

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Examples of cultivars: ……..……

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2. Spray type: ……

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Examples of cultivars: ……...

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Exercise 2: Write down method of propagation of carnation through terminal cuttings.

Propagation through terminal cuttings: ……

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Cultural practices:

1. Pinching

(i) Single pinch: ……

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(ii) Pinch and a half: ……

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(iii) Double pinching: ……

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2. Disbudding: ……

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3. Deshooting: ……

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4. Staking: ……

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Practical No. 10

Objective: To study post-harvest handling and the methods for prolonging the vase life of cut flowers

Exercise 1: Write down the steps in post-harvest handling of cut flowers

1. Harvesting of cut flowers:

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Stage of harvesting of different cut flowers

(i) Rose: ……..

(ii) Chrysanthemum: ……

(iii) Carnation: ……

(iv) Gerbera: ……..

(v) Orchids: ……

(vi) Lilium: ……

2. Pre-cooling: ……

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3. Post-harvest treatments for prolonging vase life of cut flowers:

(i) Pulsing: ……

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(ii) Pulsing/Loading: ……

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(iii) Holding: ……

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4. Grading ……

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5. Storage:

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6. Packaging: ……

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Exercise 2: Give different pulsing and holding treatments to cut flowers of Gladiolus or Tuberose

Material required: ……

Procedure of preparing pulsing and holding solution

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Observations to be recorded:

Treatment	Vase life

Practical No. 11

Objective: To identify medicinal and aromatic plants present in the campus

Material required: Notebook and pen

Exercise 1: Identify different medicinal and aromatic plants of the campus and write common name, botanical name and family along with medicinal uses and active chemical constituent present.

Common Name	Botanical Name	Family	Active chemical constituent	Medicinal uses

Practical No.12

Objective: To study Production Technology of Senna, Periwinkle and Sarpagandha

Methodology: Production Technology of medicinal and aromatic plants can be studied under following heads:

Plant information	Students observations in nursery
Botanical Name	
Family	
Habit	
Description of Species	
Varieties	
Propagation method/ sowing method	
Seed pre-treatment /root hormone treatment	
Date of sowing	
Bed area and number of seed sown	
Records of germination	
Survival percent	
Transplanting stage	
Harvest and Yield	
Value added products	

Botanical Name	
Family	
Habit	
Description of Species	
Varieties	
Propagation method/ sowing method	
Seed pre-treatment /root hormone treatment	
Date of sowing	
Bed area and number of seed sown	
Records of germination	
Survival percent	
Transplanting stage	
Harvest and Yield	
Value added products	

Botanical Name	
Family	
Habit	
Description of Species	
Varieties	
Propagation method/ sowing method	
Seed pre-treatment /root hormone treatment	
Date of sowing	
Bed area and number of seed sown	
Records of germination	
Survival percent	
Transplanting stage	

Harvest and Yield	
Value added products	

Practical No. 13

Objective: To study Production Technology of Aswagandha, Coleus and Aloe

Methodology: Production Technology of medicinal and aromatic plants can be studied under following heads:

Plant information	Students observations in nursery
Botanical Name	
Family	
Habit	
Description of Species	
Varieties	
Propagation method/ sowing method	
Seed pre-treatment /root hormone treatment	
Date of sowing	
Bed area and number of seed sown	
Records of germination	
Survival percent	
Transplanting stage	
Harvest and Yield	
Value added products	

Plant information	Students observations in nursery
Botanical Name	
Family	
Habit	
Description of Species	
Varieties	
Propagation method/ sowing method	
Seed pre-treatment /root hormone treatment	
Date of sowing	
Bed area and number	

of seed sown	
Records of germination	
Survival percent	
Transplanting stage	
Harvest and Yield	
Value added products	

Plant information	**Students observations in nursery**
Botanical Name	
Family	
Habit	
Description of Species	
Varieties	
Propagation method/ sowing method	
Seed pre-treatment /root hormone treatment	
Date of sowing	
Bed area and number of seed sown	
Records of germination	
Survival percent	
Transplanting stage	
Harvest and Yield	
Value added products	

Practical No. 14

Objective: To study Production Technology of Safed Musli, mint and patchouli

Methodology: Production Technology of medicinal and aromatic plants can be studied under following heads:

Plant information	Students observations in nursery
Botanical Name	
Family	
Habit	
Description of Species	
Varieties	
Propagation method/ sowing method	
Seed pre-treatment /root hormone treatment	
Date of sowing	
Bed area and number of seed sown	
Records of germination	
Survival percent	
Transplanting stage	
Harvest and Yield	
Value added products	

Plant information	Students observations in nursery
Botanical Name	
Family	
Habit	
Description of Species	
Varieties	
Propagation method/ sowing method	
Seed pre-treatment /root hormone treatment	
Date of sowing	
Bed area and number	

of seed sown	
Records of germination	
Survival percent	
Transplanting stage	
Harvest and Yield	
Value added products	

Plant information	**Students observations in nursery**
Botanical Name	
Family	
Habit	
Description of Species	
Varieties	
Propagation method/ sowing method	
Seed pre-treatment /root hormone treatment	
Date of sowing	
Bed area and number of seed sown	
Records of germination	
Survival percent	
Transplanting stage	
Harvest and Yield	
Value added products	

Practical No. 15

Objective: To study Production Technology of Lemon grass, Palmarosa and Vetiver

Methodology: Production Technology of medicinal and aromatic plants can be studied under following heads:

Plant information	Students observations in nursery
Botanical Name	
Family	
Habit	
Description of Species	
Varieties	
Propagation method/ sowing method	
Seed pre-treatment /root hormone treatment	
Date of sowing	
Bed area and number of seed sown	
Records of germination	
Survival percent	
Transplanting stage	
Harvest and Yield	
Value added products	

Plant information	Students observations in nursery
Botanical Name	
Family	
Habit	
Description of Species	
Varieties	
Propagation method/ sowing method	
Seed pre-treatment /root hormone treatment	

Date of sowing	
Bed area and number of seed sown	
Records of germination	
Survival percent	
Transplanting stage	
Harvest and Yield	
Value added products	

Plant information	**Students observations in nursery**
Botanical Name	
Family	
Habit	
Description of Species	
Varieties	
Propagation method/ sowing method	
Seed pre-treatment /root hormone treatment	
Date of sowing	
Bed area and number of seed sown	
Records of germination	
Survival percent	
Transplanting stage	
Harvest and Yield	
Value added products	

Practical No. 16

Objective: To extract essential oil using Clevenger apparatus

Material required: Clevenger apparatus, heating mantle, plant material, collecting bottle, round bottom flask

Procedure: ……

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Exercise: Perform extraction of essential oil using Clevenger apparatus and draw diagram of steps followed.

Observations:

Species for oil extraction----------

Quantity of biomass per batch----------

Time period for extraction----------

Yield of essential oil:

$$\text{Yield (\%)} = \frac{\text{weight of extracted oil (gm)}}{\text{weight of plant material (gm)}} \times 100$$

Any other observation----------

Practical No. 17

Objective: To study harvesting, drying, grading, storage, processing and value addition techniques for medicinal and aromatic plants.

Exercise 1: Students in groups will carry out harvesting for different locally available medicinal and aromatic plants mentioning its botanical name, plant part extracted and method of extraction along with the time and location of the harvested medicinal and aromatic plants.

Sr. No.	Name of the medicinal & aromatic plant	Plant part harvested/ collected	Month/time/location of collection	Method of collection	Remarks

Exercise 2: Students in groups will carry out collection, harvesting, drying, grading, storage, processing and value addition for different locally available medicinal and aromatic plants.

Methodology: Post harvest management of medicinal and aromatic plants can be studied under following heads:

1. Harvesting: ……..…….

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2.Drying:……...……..

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3. Garbling (Dressing):

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4. Grading: ……...

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5. Storage and Packing……

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6. Processing or Value addition……

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7. Preservation:……..……

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8. Active constituents:

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Practical No.18

Objective: - To visit commercial MAP unit / Ayurvedic Pharmacy/ Commercial Floriculture Unit

Exercise: Students will prepare individually the field report on the Ayurvedic Pharmacy or MAP processing unit or Commercial floriculture unit visited. The report has to include the standard operations, process involved in products making, plant species cultivated, cultural practices followed etc.

Report: .....

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APPENDICES

IDENTIFICATION OF ANNUALS

1. Winter season Annuals:

Sr. No.	*Botanical Name*	Common Name	Family	Colour	Description
1.	*Acroclinum roseum*	Paper Flower	Asteraceae	Pink & White	Grown for bedding purpose and as dry flowers for decoration.
2.	*Ageratum houstonianum*	Floss Flower	Asteraceae	Blue, white or pink	Grown for bedding purpose
3.	*Alcea rosea*	Hollyhock	Malvaceae	Various colours	Used for screening purpose, background and borders
4.	*Antirrhinum majus*	Snapdragon	Plantaginaceae	White, yellow pink, rose mauve	Bedding and pots, good cut flower
5.	*Arctotis stoechadifolia*	African Daisy	Asteraceae	White	Bedding purpose and herbaceous borders
6.	*Brachycome iberidifolia*	Swan River Daisy	Asteraceae	White, pink and blue	Bedding purpose and herbaceous borders.
7.	*Bracteantha viscosa*	Sticky paper daisy	Asteraceae	Yellow	Bedding purpose and good dry flower
8.	*Bellis perennis*	English daily	Asteraceae	White, pink, red	Bedding purpose
9.	*Bromus* sp.	-	Poaceae	Green to pale	Used as bedding plant and excellent dry flower
10.	*Briza maxima*	Greater quacking grass	Poaceae	Green to pale	Used as bedding plant and excellent dry flower
11.	*Calceolaria herbeohybrida*	Lady's purse, slipper flower	Calceolariaceae	Orange, yellow and red	Easy to grow indoors or outdoors in pots or beds. Suitable as potted plant for temperate areas.
12.	*Calendula officinalis*	Pot marigold	Asteraceae	Yellow, orange	Bedding and pots
13.	*Callistephus chinensis*	China aster	Asteraceae	White, pink, blue	Bedding and pots, good cut flower
14.	*Centaurea cyanus*	Corn flower	Asteraceae	-do-	Bedding purpose
15.	*Centaurea moschata*	Sweet sultan	Asteraceae	Mauve, white, yellow	Bedding purpose and pots, having scented flowers
16.	*Erysimum cheiri*	Wall flower	Brassicaceae	Yellow burnt orange	Bedding purpose and pots, having scented flowers
17.	*Clarkia elegans*	Clarkia	Onagraceae	White, rose, pink, purple	Bedding purpose
18.	*Coreopsis tinctoria*	Plains tickseed	Asteraceae	Yellow	-do-
19.	*Coreopsis lanceolata*	Lance-leaved coreopsis	Asteraceae	Yellow	-do-
20.	*Cosmos bipinnatus*	Garden Cosmos	Asteraceae	White, pink, mauve, magenta	Bedding purpose and can be grown throughout the year
21.	*Cosmos sulphureus*	Sulfur Cosmos	Asteraceae	Yellow	-do-
22.	*Consolida ajacis*	Larkspur	Ranunculaceae	Blue	Bedding purpose
23.	*Dahlia variabilis*	Dahlia	Asteraceae	Various colours	Bedding purpose and pots
24.	*Dianthus barbatus*	Sweet William	Caryophyllaceae	White, pink and red	Bedding purpose and as cut flower, have scented flowers
25.	*Dainthus chinensis*	Chinese pink	Caryophyllaceae	-do-	Bedding purpose.
26.	*Dimorphotheca Sinuate*	African daisy	Asteraceae	White	Bedding purpose and pots
27.	*Eschscholtzia californica*	Californian poppy	Papaveraceae	Yellow and Orange	Medium growing, for bedding purpose

28.	*Gazania splendens*	Treasure daisy	Asteraceae	Yellow and dark brown	Bedding purpose and pots
29.	*Glebionis coronaria*	Annual chrysanthemum	Asteraceae	White, yellow	Bedding purpose and good loose flower.
30.	*Gypsophila elegans*	Annual baby's breath	Caryophyllaceae	White, pink yellow	Bedding purpose, good cut flowers used as fillers.
31.	*Helichrysum bracteatum*	Straw flower	Asteraceae	Yellow, white, pink	Bedding purpose and good dry flower
32.	*Iberis amara*	Candytuft	Brassicaceae	White, pink	Grown in pots and for edging of herbaceous border
33.	*Lagurus ovatus*	Hare's-tail or Bunnytail	Poaceae	Green	Bedding purpose, pots and excellent dry flower
34.	*Lathyrus odoratus*	Sweet pea	Fabaceae	Various colours	Annual climber with fragrant flowers, suitable for screening and trellises.
35.	*Limonium sinuatum*	Sea-lavender /Statice	Plumbaginaceae	White, pink, yellow purple	Fairly drought resistant, very good cut flower as filler and as dry flower
36.	*Linaria bipartite*	Toadflax	Plumbaginaceae	Various colours	Grown in semi-shady places, good for bedding and pots.
37.	*Lobularia maritima*	Sweet Alyssum	Brassicaceae	White, lilac	Bedding purpose and pot plants
38.	*Lupinus hartwegii*	Lupin	Fabaceae	Purplish blue	Bedding purpose and as cut flower
39.	*Mathiola incana*	Stock	Brassicaceae	White, purple, yellow	Bedding purpose and good cut flower
40.	*Dorotheanthus bellidiformis*	Ice plant	Aizoaceae	Pink, white, yellow	Leaves are fleshy and have small dew like natural eruptions. For edging, pots, hanging baskets, rockery.
41.	*Euryops chrysanthemoides*	African bush daisy	Asteraceae	Bright yellow	Edging plant and pots
42.	*Mimulus tigrinus*	Tiger Monkey flower	Phyrmaceae	yellow with brown blotches	Partially shady places, suitable, good for pots
43.	*Moluccella laevis*	Bells of Ireland	Lamiaceae	Green like bells	Used in flower arrangements and good dry flower
44.	*Nemesia strumosa*	Nemesia	Scrophulariaceae	Yellow, red, orange	Bedding and pots
45.	*Nigella damascena*	Love -in- a -mist	Ranunculaceae	Blue, white, purple	Sunny areas and pods are used as dry flowers
46.	*Petunia hybrida*	Petunia	Solanaceae	Various colours	Good for pots, hanging baskets and bedding purpose
47.	*Phlox drummondii*	Drummond's Phlox	Polemoniaceae	Various colours	Dwarf plants are very showy when grown in borders, baskets and pots
48.	*Papaver orientale*	Common poppy	Papaveraceae	Red	Good for bedding purpose and herbaceous borders
49.	*Primula melacoides*	Fairy primsore	Primulaceae	Mauve, pink, white	Good for bedding purpose and pots. Suitable for temperate areas.
50.	*Salvia splendens*	scarlet sage	Lamiaceae	Scarlet, red, white, purple	Easily grown in shady places and rockery, used as bedding plant and in pots
51.	*Senecio cruentus*	Cineraria	Asteraceae	Various colours	Grown in shady places, good for bedding purpose and pots
52.	*Tagetes erecta*	African Marigold	Asteraceae	Yellow, orange	Easily grown, good for bedding, pots and commercially grown for loose flowers
53.	*Tagetes patula*	French Marigold	Asteraceae	Yellow, orange, red	Hardy annual used for bedding purpose, pots and as loose flower.
54.	*Torenia fournieri*	Wishbone flower	Linderniaceae	blue, purple, pink, rose and white	blooms abundantly in shady conditions, good for edging and containers
55.	*Tropaeolum majus*	Nasturtium	Tropaeolaceae	-do-	Mostly grown in rockeries. It has trailing habit, so used as climbers and in hanging baskets.
56.	*Verbena hybrida*	Verbena	Verbenaceae	Purple, pink, blue, red, white	Good for bedding purpose, pots, hanging baskets, window boxes and rockery.
57.	*Viola tricolor* var *hortensis/ Viola wittrockiana*	Pansy	Violaceae	Yellow, blue, red, purple, violet bicolor	Sunny location is preferred, good for bedding and hanging baskets. Flowers resembles with the butterflies

2. Summer and rainy season annuals

Sr. No.	Botanical Name	Common Name	Family	Colour	Remarks
1	*Celosia cristata*	Cock's comb	Amaranthaceae	Pink, yellow, orange	Very hardy and longer flowering period and makes good crest
2	*Celosia plumosa*	Plumed cokscomb	Amaranthaceae	-do-	Flowers like plume of ostrich. Good for bedding purpose.
3	*Amaranthus caudatus*	Love-lies-bleeding	Amaranthaceae	Pink & White	Due to variegated leaves, it is also grown in pots for indoor

					decoration
4	*Gaillardia pulchella*	Blanket flower	Asteraceae	Yellow, orange scarlet brown	Resist dry conditions and can be grown as perennial also. Good cut flower
5	*Gomphrena globosa*	Bachelor's button	Amaranthaceae	Pink, Magenta	Good for dry conditions and used as dry flower.
6	*Helianthus annus*	Sunflower	Asteraceae	Yellow orange	Grown throughout the year and sown directly from seeds into permanent places
7	*Portulaca grandiflora*	Moss Rose	Portulacaceae	Various colours	Easily propagated by cutting, can be grown in pots, hanging basket and small boxes.
8	*Bassia scoparia/ Kochia scoparia*	Summer Cypress	Amaranthaceae	---	Mostly grown for foliage beauty due to uniform, well-shaped and bushy growth.
9	*Impatiens balsamina*	Balsam	Balsaminaceae	Various colours	Early flowering and for short duration, very delicate and needs much care
10	*Impatiens walleriana*	Impatiens	Balsaminaceae	pink, red or white	Suitable for pots and bedding purpose.
11	*Tithonia speciose*	Mexican Sunflower	Asteraceae	Orange, scarlet	Sown directly from seeds
12	*Catharanthus roseus*	Periwinkle	Apocynaceae	Purple, Pink white	Grown throughout the year
13	*Zinnia elegans*	Zinnia	Asteraceae	Various colours	Very hardy and grown easily for longer duration

CLASSIFICATION OF TREES

Ornamental flowering trees: Grown for the beauty of their showy and ornamental flowers.

Sr. No.	Botanical Name	Common Name	Family	Flower colour and time	Description
1.	*Acacia auriculiformis*	Earleaf Acacia/ Auri	Fabaceae	Yellow, August-September	An evergreen tree with pendulous branches and phyllodes leaves. The tree is medium sized
2.	*Alstonia scholaris*	Devil's tree	Apocynaceae	Greenish white, March- April	Tall, spreading and shady tree. Leaves are shiny and dark green. The tree bears small greenish white flowers during Nov –Dec.
3.	*Azadirachta indica*	Neem	Meliaceae	White, April- May	10-15 m high, good shady tree. It grows successfully on rocky and alkaline soils. Very good shade tree for tropical/sub-tropical areas
4.	*Bauhinia purpurea*	Orchid tree/ Purple Bauhinia	Fabaceae	Rosy- purple, Nov – Feb.	Medium sized tree suitable for avenue planting,
5.	*Bauhinia tomentosa*	Yellow Bauhinia/ Orchid tree	Fabaceae	Yellow, April-June	Small tree with drooping branches which bear showy yellow flowers and suitable for growing in gardens.
6.	*Bauhinia variegata*	Orchid tree / Kachnar	Fabaceae	White-pink, Feb-April	Small sized tree, bear flowers when the tree is leafless. The flowers are edible and used for culinary purpose.
7.	*Bombax ceiba*	Silk Cotton tree/ Simbal	Malvaceae	Red, orange, Jan- March	Large deciduous tree, stem is straight and undivided. The young stem is covered with sharp prickles. It bears flowers when tree is leafless.
8.	*Butea monosperma*	Dhak/Palash/ flame of the forest	Fabaceae	Orange red, March- April	Small deciduous tree having irregular branches. It bears showy flowers when the tree is leafless. It is drought resistant tree and can be grown in alkaline soils
9.	*Callistemon lanceolatus*	Bottle Brush	Myrtaceae	Red, Round the year	Beautiful small tree having weeping habit, the crowded scarlet flowers are borne in spikes almost throughout the year.
10.	*Cassia fistula*	Indian Laburnum/ Amaltas	Fabaceae	Yellow, May-June	Medium sized shady tree, bears pendulous racemes of large bright yellow flowers, when tree is leafless. It is drought-resistant and can tolerate quite a high salt level.
11.	*Cassia javanica*	Java Cassia	Fabaceae	Pink, May- June	Medium sized tree with spreading crown, bears clusters of pink flowers with the foliage.
12.	*Cassia renigera*	Burmese Pink Cassia	Fabaceae	Pink, May- July	Bears flowers in clusters giving appearance of bunches of roses on long branches.
13.	*Cassia siamea*	Kasod tree	Fabaceae	Yellow, Nov- Feb	Medium sized shady tree. It is drought resistant and can tolerate lot of dust. It is suitable for planting along roadside.
14.	*Ceiba speciosa*	Silk floss tree	Malvaceae	Pink, July-August	Beautiful tree with a bottle shaped green thorny trunk
15.	*Delonix regia*	Gulmohar/ Royal Poinciana	Fabaceae	Scarlet red, April-June	Large tree with umbrella like crown and feathery leaves.
16.	*Erythrina indica/ E. variegata*	Indian Coral tree	Fabaceae	Scarlet, crimson, March- April	Quick growing tree. It bears flowers when the tree is leafless.
17.	*Grevillea robusta*	Silver oak	Proteaceae	Yellow, April-June	An evergreen tree with a conical crown. The leaves are fern like and silvery from the lower side. It bears coppery yellow flowers in April.
18.	*Jacaranda mimosaefolia*	Neeli Gulmohar	Fabaceae	Purple-mauve, March- May	Medium to large sized tree, with feathery bipinnate leaves. Quick growing tree suitable for avenue planting
19.	*Kigelia pinnata*	Sausage tree	Bignoniaceae	Dark red-maroon,	Large tree with good spreading crown. Sausage like fruits borne on

				April- May	long pendulous stalks can be seen hanging on trees.
20.	*Lagerstroemia speciosa*	Giant Crepe Myrtle	Lythraceae	Mauve/ pinkish, April to August	Medium sized deciduous tree. Suitable for avenue planting.
21.	*Madhuca indica*	Mahua	Sapotaceae	Cream, Feb-March	Fast growing large deciduous tree. The leaves are borne in clusters near the end of the branches and are coppery coloured when young. The flowers are used for making vegetables and wine.
22.	*Magnolia champaca*	Champak/ Champa	Magnoliaceae	Light yellow, May- September	Medium sized evergreen tree. Bears fragrant flowers
23.	*Magnolia grandiflora*	Bara champa	Magnoliaceae	White, April- May	Medium sized, evergreen tree with beautiful foliage, large scented white flowers.
24.	*Millingtonia hortensis*	Tree jasmine/ Indian cork tree	Bignoniaceae	White, April-June	Tall evergreen tree which bears sweet scented flowers. The tree is quick growing.
25.	*Milletia ovalifolia*	Molumein rosewood	Fabaceae	Light pink, pink, Feb- March	Medium sized tree. Bears profuse flowers when the tree is leafless
26.	*Peltophorum pterocarpum*	Yellow Flamboyant	Fabaceae	Yellow, Sept-November	Deciduous tree with bipinnate leaves, erect trunk and suitable for avenue planting
26.	*Plumeria acutifolia*	Pagoda tree/ Temple tree	Apocynaceae	White, April-November	Dwarf evergreen tree with large green leaves with acute tips.
27.	*Plumeria alba*	Pagoda tree/ Temple tree	Apocynaceae	White, April-November	Dwarf evergreen tree with large glaborous dark green leaves with round tip, bear fragrant flowers
28.	*Plumeria rubra*	Red Frangipani	Apocynaceae	Pinkish red, red, April- November	Dwarf deciduous tree with large dark green conical leaves, bear red flowers
29.	*Saraca indica*	Sita Ashoka	Fabaceae	Bright orange-Red, April – May	Evergreen tree with drooping branches, bear fragrant flowers.
30.	*Spathodea campanulata*	Fountain tree/ African Tulip tree	Bignoniaceae	Red, Feb-May.	Monotypic genus in the family Bignoniaceae, A medium sized tree. Flower on pressing trickles out water like a fountain.
31.	*Tabebuia rosea*	Rosy trumpet tree	Bignoniaceae	Deep rose pink, Feb- April	Large tree which bears flowers when leafless.
32.	*Tabebuia argentea*	Silver trumpet tree	Bignoniaceae	Yellow, March-May	Quick growing tree, bears flowers when leafless. Suitable for avenue planting.
33.	*Tecomella undulata*	Roheda	Bignoniaceae	Orange, March-April	Dwarf tree, evergreen to semi-deciduous tree suitable for dry and desert areas.

2. Foliage trees: Trees grown for their showy ornamental foliage or for providing shade in garden.

S. No.	Botanical Name	Common Name	Family	Description
1.	*Alstonia scholaris*	Sat Patia or Devil's tree	Apocynaceae	Bright green leaves borne in cluster of seven. It is good shady tree, used for avenue planting and near parking areas
2.	*Araucaria cookii*	Monkey Puzzle Tree	Araucariaceae	Symmetrical growth habit. Good for planting as specimen tree. Propagated from seed.
3.	*Casuarina equisetifolia*	Australian pine tree	Casuarinaceae	Tall columnar tree with needle like leaves, suitable for wind breaks
4.	*Cedrus deodara*	Cedar pine/ Deodar	Pinaceae	Evergreen pine tree of temperate areas, suitable for roadside planting and timber.
5.	*Cupressus sempervirens*	Saru	Cupressaceae	Conical tree with thin foliage and suitable for planting in the graveyard.
6.	*Dillenia indica*	Chalta	Dilleniaceae	Dwarf slow growing tree with shiny green serrated leaves.
7.	*Eucalyptus spp.*	Blue gum tree/ Safeda	Myrtaceae	Slender trunk, smooth clean few branches lemon scented leaves. Grow rapidly and planted as avenues on marshy land.
8.	*Eugenia jambolina*	Jamun/ Java plum	Myrtaceae	Tall and spreading with dark green foliage, suitable for providing shade. It bears fruits and attract birds.
9.	*Ficus benghalensis*	Bohr or Banyan tree	Moraceae	Tall, round shaped foliage tree, usually grown for providing shade in gardens.
10.	*Ficus religiosa*	Pipal	Moraceae	Tall, evergreen, round shaped tree usually grown for providing shade in gardens.
11.	*Ficus elastica*	Rubber tree	Moraceae	Evergreen medium size tree, bright shining blackish green leaves, can be used as a specimen tree and as a pot plant.
12.	*Juniperus chinensis*	Chinese Juniper	Cupressaceae	Conical growth habit and fine needle like thin green leaves, can be planted as pot plant or as specimen.
13.	*Melia azedarch*	Chinaberry tree/ Drake	Meliaceae	Winter deciduous tree, light green shiny foliage, suitable for plantation as shady tree
14.	*Melaleuca bracteata*	Golden Bottle brush	Myrtaceae	Tree with pendulous branches, leaves are golden-greenish in colour.
15.	*Mimusops elengi*	Spanish cherry. Maulsari	Sapotaceae	Slow growing tree with round canopy and dark green foliage, bears scented flowers
16.	*Polyalthia longifolia*	False Ashok	Annonaceae	Tall evergreen tree with a symmetrical columnar crown, good for screening and roadside planting.
17.	*Pinus roxburghii*	Chirpine	Pinaceae	Evergreen pine tree grown in hills. It can be grown as specimen tree.
18.	*Pongamia pinnata*	Pongam tree	Fabaceae	Medium size shady tree with dark green foliage, bears purplish white flowers.

19.	*Pterospermum acerifolium*	Bayur tree/ Kanak Champa	Malvaceae	Medium sized evergreen tree with beautiful foliage and creamish yellow scented flower which appears from April to June.
20.	*Pterygote alata/ Sterculia alata*	Buddha coconut	Malvaceae	Tall slow growing tree with broad leaves, less spreading, suitable for planting as avenue tree.
21.	*Putranjiva roxburghii*	Putrajiva	Putranjivaceae	Large tree with a semi-globular crown dense glossy, foliage, good for avenues.
22.	*Terminallia arjuna*	Arjun tree	Combretaceae	Large evergreen shady tree. Flowers are not showy. Suitable for planting along roads and in groups for shade.

IDENTIFICATION OF SHRUBS

1. Flowering shrubs: Shrubs are grown for their beautiful flowers.

S. No.	Botanical Name	Common Name	Family	Flowering time	Identifying characters
1.	*Abelia grandiflora*	Abelia	Caprifoliaceae	May-June	Grows to a height of 1.5-2m, spreading habit and propagated through cuttings.
2.	*Abutilon pictum*	Chinese lantern	Malvaceae	Orange-yellow	Short shrub, propagated from seeds and cuttings and prefer partial shade.
3.	*Acalypha hispida*	Chenille plant/ Cat's tail	Euphorbiaceae	Throughout the year, red	Bushy shrub with dark green foliage and long red coloured fuzzy pendulous inflorescence which looks like cat's tail.
4.	*Achania malvaviscus*	Sleeping Hibiscus	Malvaceae	Throughout the year, red	Popular shrub used as hedge, easily propagated from cuttings
5.	*Asclepias currassavica*	Milk weed	Asclepiadaceae	Summer season Orange-yellow	As a specimen shrub, good for border, propagated from seed or cuttings
6.	*Barleria cristata*	Philippine violet	Acanthaceae	Oct-Dec. Violet blue, pink, white	Small shrub, winter deciduous in nature propagated from seed.
7.	*Bauhinia tomentosa*	Bell bauhinia	Leguminosae	August-October Sulphur yellow	5-8 m high, winter deciduous shrub, quick growing. Grown for foliage and flower beauty. Propagated from seed.
8.	*Bougainvillea* spp	Bougainvillea	Nyctaginaceae	Red, yellow, white, purple, pink	Multipurpose shrub, quick growing. Hardy and can be grown under neglected conditions for screening purpose.
9.	*Brugmansia suaveolens*	Datura	Solanaceae	Pink flowers	Very good landscape plant, prefers partial shade.
10.	*Caesalpinnia pulcherrima*	Peacock flower	Leguminosae	May-Aug. Scarlet, yellow	Medium sized shrub grown for foliage and flower beauty. It is a quick growing shrub suitable for dry areas.
11.	*Calliandra brevipes*	Pink Powder puff	Leguminosae	Red, pink, white	Medium to tall, evergreen shrub with beautiful foliage.
12.	*Camellia japonica*	Camellia	Theaceae	April-June Red, Pink	Very good specimen shrub suitable for high elevations.
13.	*Carissa carandus*	Karonda	Apocynaceae	March-April, white	Hedge plant and can be planted in a large shrubbery.
14.	*Cascabela thevetia/ Thevetia peruviana*	Pili Kaner	Apocynaceae	Year round, Yellow	Tall evergreen shrubs with shining leaves, for roadside plantation and screening, propagation is from seed.
15.	*Cassia biflora*	Desert Cassia	Leguminosae	Feb-April Yellow	6-8 ft. in height propagated from seed and air layering, used as specimen shrub.
16.	*Cassia glauca*	Scrambled egg bush	Leguminosae	Mar-May, Sept. –Nov., Yellow	Tall, evergreen, quick growing shrub suitable for arid areas.
17.	*Cestrum diurnum*	Din ka Raja	Solanaceae	June-Aug, White	Medium quick growing, evergreen shrub with blue berries.
18.	*Cestrum elegans*	Pink Cestrum	Solanaceae	Sept-Dec. Purple red	Suitable for temperate climate and high altitudes.
19.	*Cestrum nocturnum*	Rat ki Rani	Solanaceae	Spring & Rainy season white	5-6 ft high, evergreen, hardy quick growing shrub, propagated from cuttings, fragrant flowers open at night.
20.	*Clerodendrum thomsonae*	Bleeding heart	Verbenaceae	Rainy season Scarlet with white calyx	Very attractive shrub/climber suitable for tropical areas.
21.	*Cotoneaster microphyllus*	Rockspray Cotoneaster	Rosaceae	White flowers	Prostrate trailing shrubs, climbs over rocks and suitable for rock gardens.
22.	*Cuphea hyssopifolia*	False Heather	Lythraceae	July-September blue flowers	Evergreen shrub suitable as good edging plant bearing pinkish purple flowers.
23.	*Galphimia gracilis*	Golden shower	Malpighiaceae	Jul-Nov. Yellow	Evergreen medium shrub, can be used as hedge. Propagated through seed.
24.	*Gardenia jasminoides*	Gandhraj	Rubiaceae	March-Sept. White	Evergreen medium shrub. Grown as a specimen shrub, bears sweet scented flowers.
25.	*Hamelia patens*	Firebush/ humming birdbush	Rubiaceae	Year round Red	Tall shrub. On rockery it can be trained as small bush, grown for the foliage and flower beauty and for screening.

26.	*Hamiltonia suaveolens*	-	Rubiaceae	Feb-March Lavender	Medium to large shrub 6-8'. Propagated from cutting, used for group plantation.
27.	*Hibiscus mutabilis*	Changeable Rose	Malvaceae	White to Pink to red	Tall growing, deciduous shrub with large leaves.
28.	*Hibiscus rosa-sinensis*	China Rose	Malvaceae	Year round White, pink rose, yellow	Evergreen medium sized. Used for making flowering hedge.
29.	*Hibiscus syriacus*	Rose of Sharon	Malvaceae	Summers, White & Mauve	Deciduous shrub 5-6'. Propagated from cuttings. Good for temperate climatic areas.
30.	*Holmskioldia Sanguinea*	Cup-n-Saucer	Verbenaceae	Yellow, red	Medium sized shrub. Long branches used for dry decoration.
31.	*Ixora coccinea*	Jungle geranium	Rubiaceae	Deep scarlet July-Aug	Evergreen specimen shrub. Prefers partial shade for growth.
32.	*Ixora parviflora*	-do-	Rubiaceae	White, Mar-Apr	Tall evergreen specimen shrub with sweet scented flowers.
33.	*Ixora singaporiensis*	-do-	Rubiaceae	Pinkish red	Dwarf shrub, used as a specimen bush. Prefers partial shade for growth.
34.	*Jacobinia carnea*	Jacobinia	Acanthaceae	Orange	4-5' evergreen shrub, bears tubular orange flower, grown for making flowering hedge.
35.	*Jasminum humile*	Peeli chameli	Oleaceae	Feb-Mar, Yellow	Evergreen shrub. Thrives well in poor soil, can be used as climber.
36.	*Jasminum sambac*	Motia	-do-	March-Sept. White	Dwarf shrub, planted for sweet scented flowers. Propagated by suckers and cuttings.
37.	*Lagerstroemia indica*	Sawani	Lythraceae	May-Aug Mauve, pink and white	Tall, winter deciduous shrub, Propagated from cuttings.
38.	*Lantana sellowiana*	Trailing Lantana	Verbenaceae	Year round Pale mauve	Medium shrub, evergreen, good for planting on mounds and rockeries.
39.	*Mussaenda frondosa*	Mussaenda	Rubiaceae	Summers White sepals	Evergreen shrub. Long white sepals form a part of flowers.
40.	*Nerium oleander*	Kaner	Apocynaceae	May-Oct White, pink, Red	Evergreen shrub. Suitable for roadside plantation, screening. Variegated varieties are used as specimen plant.
41.	*Nyctanthes arbor-tristis*	Parijaat/ Har-Shingar	Oleaceae	October- January White with orange peduncle	Tall evergreen shrub, with numerous sweet-scented flowers, propagation is from seed.
42.	*Plumbago capensis*	Chitra	Plumbaginaceae	Mar.-Oct., White turn light blue	Evergreen shrub, used as ground cover, pot plant or for foundation plantation.
43.	*Poinsettia pulcherrima*	Christmas Flower	Euphorbiaceae	Dec.-Jan Yellow and Red	Deciduous shrub, 5-6 ft height, terminal leaves look like flowers.
44.	*Ruellia simplex*	Mexican petunia	Acanthaceae	Spring to summers, Purple, pink, white	Thriving best under semi-shade, suitable for shrubbery and hanging baskets.
45.	*Russelia juncea*	Fire cracker plant	Scrophulariaceae	June to Aug, Coral red	Dwarf, evergreen shrub, used as foundation plant, bears tube like flowers. Used in bouquet making.
46.	*Tabernaemontana coronaria*	Pinwheel flower/ Chandni	Apocynaceae	Round the year, white	Tall evergreen shrub with glossy leaves used in shrubbery, specimen shrub, avenue and screening.
47.	*Tecoma stans*	Yellow trumpet bush	Bignoniaceae	Year round, Golden yellow	Dwarf growing shrub grown in shrubbery or as hedge.
48.	*Thunbergia erecta*	Purple king's mantle	Acanthaceae	Year round, Dark blue	Medium sized evergreen shrub, used for making flowering hedge.
49.	*Volkemeria inermis /Clerodendrum inermi*	Forest Jasmine	Verbenaceae	July-Nov. White	Evergreen shrub, good for hedge making, can be trained for topiary making and good for dry areas.

2. Foliage shrubs: These shrubs are grown for their foliage either green or variegated

S. No.	Botanical Name	Common Name	Family	Flowering time	Identifying characters
1.	*Acalypha wilkensiana*	Acalypha	Euphorbiaceae	-	3-4 ft. in height. It is good for hedge, foundation plantation and pot plant. It prefers partial shade for healthy growth.
2.	*Duranta repens*	Golden Dewrop	Verbenaceae	May-Jul, Blue	Medium sized, suitable for dry areas, propagated through cuttings. Used for edge & hedge making.
3.	*Euonymus japonicus*	Privet or Japanese spindle	Celastraceae	-	Medium sized shrub, used for hedge making, as pot plant, foliage is used as cut stem.
4.	*Euphorbia cotinifolia*	Caribbean copper leaf	Euphorbiaceae	-	Fast growing shrub with reddish foliage, suitable as pot plant, shrubbery and specimen
5.	*Excoecaria bicolor*	Chinese croton	Euphorbiaceae	-	Attractive leaves, red and green on opposite sides of leaf blade, good shrub for pots.
6.	*Ficus benjamina*	Weeping fig	Moraceae	-	Shrub with dark green leaves suitable for hedges, specimen and topiary.

7.	*Justicia gendarussa*	Willow leaved Justicia	Acanthaceae	-	Medium shrub, good for making edges. Can also be grown under partial shade.
8.	*Lawsonia inermis*	Mehndi	Lythraceae	Creamy white	Medium sized fragrant, quick growing shrub, powder of its leaves used for decorating hand and feet.
9.	*Ligustrum ovalifolium*	Japanese Privet	Oleaceae	Dull white	It is popular as a hedge plant can be propagated through cuttings.
10.	*Malpighia coccigera*	Miniature Holly	Malpeghiaceae	Throughout the year, White	Evergreen shrub with small dark green spiny leaves. Good for making topiary, hedges, edges and bonsai.
11.	*Melaleuca bracteata*	Golden bottle brush	Myrtaceae	April – Oct, White	Shrub of weeping habit, most suitable for topiary making, can be propagated from cuttings.
12.	*Phyllanthus myrtifolius*	Mouse tail plant	Phyllanthaceae	May- Sept., red	Evergreen shrub with small light green leaves borne on drooping branches, producing a dense crown. Suitable for hedges, edges and topiary.
13.	*Pseuderanthemum carruthersii*	False Eranthemum	Acanthaceae	June- October, White, pink	Medium growing evergreen shrub, with green, dark purple and variegated leaves, suitable as pot plant
14.	*Vitex negundo*	Nirgundi	Verbenaceae	May-June Lilac	Tall shrub, silvery leaves. Suitable for saline, alkaline soil, drought resistant.
15.	*Volkemeria inermis /Clerodendrum inermi*	Forest Jasmine	Verbenaceae	July-Nov. White	Evergreen shrub, good for hedge making, can be trained for topiary making. Propagated from cuttings and is drought resistant.

IDENTIFICATION OF ORNAMENTAL CLIMBERS

S. No.	Botanical Name	Common Name	Family	Flower colour and flowering time	Identifying characters
1.	*Allamanda cathartica*	Allamanda	Apocynaceae	Yellow, May-September	Light green foliage with narrow pointed leaves arranged in whorl of four. It can be grown as garden shrub or as climber.
2.	*Antigonon leptopus*	Coral Vine	Polygonaceae	Rose-pink, July-October	Deciduous quick growing climber, good for trellis and cascading
3.	*Aristolochia elegans*	Duck flower	Aristolochiaceae	June-September	Deciduous quick growing climber, good for trellis and cascading
4.	*Bauhinia vahlii*	Climbing bauhinia	Caesalpiniaceae	Creamy-white, May-June	Large, evergreen climber/ rambler, good for growing in foothills in drought prone areas.
5.	*Beaumontia grandiflora*	Nepal trumpet creeper	Apocynaceae	White, January-April	Evergreen quick growing heavy climber with shining coarse textured foliage
6.	*Bougainvillea* spp	Bougainvillea	Nyctaginaceae	Pink, magenta, white, orange, Throughout year	Evergreen to semi-deciduous climber usually pruned for restricting growth. It is valued for coloured bracts
7.	*Clerodendrum splendens*	Flaming glory bower	Lamiaceae/ Verbenaceae	Red, January-April	Large evergreen climber with coarse textured dark green foliage.
8.	*C. thomsonae*	Bleeding Heart	Lamiaceae	White bracts, red flowers, Jan- April	Evergreen climber dark green foliage and suitable for pots.
9.	*Clitorea ternetea*	Asian pigeon wings/ Butterfly pea	Fabaceae	Blue, white November-March	Annual climber, slow growing, can be grown as a pot climber
10.	*Combretum indicum/ Quisqualis indica*	Rangoon creeper/ Jhumka bel	Combretaceae	Reddish pink, Round the year	Beautiful creeper with moderately scented flowers. Used on long pillars, arches and trellis.
11.	*Dolichandra unguis-cati/ Bignonia unguicati*	Cat's claw	Bignoniaceae	Yellow, March-July	Evergreen light climber and have ability to climb over bare walls and pillars, emerging leaves purple-red. Good for making topiary.
12.	*Ficus repens*	Creeping fig/ Chipku bel	Moraceae	-	Evergreen climber and climbs with help of root exudates on walls, dead trees etc. and cover the wall. Best for growing in shady situations
13.	*Hiptage benghalensis*	Madhavi lata	Malphigiaceae	Creamy-white, February-June	Heavy woody semi-deciduous climber with shining foliage, emerging orange-red and red purple in autumn with fragrant flowers.
14.	*Ipomoea cairica*	Railway creeper	Convolvulaceae	Purple, Throughout year	Evergreen quick growing climber.
15.	*Ipomoea learii*	Morning glory	-do-	Scarlet-pink, blue, June-September	Annual climber and usually grow in wild as weed.
16.	*I. quamoclit*	Cypress vine	-do-	Red, Oct-March	Annual climber with fine textured dark green leaves like fern

17.	*Jasminum auriculatum*	Juhi	Oleaceae	White, April-July	Evergreen climber with fragrant flowers.
18.	*J. grandiflorum*	Chameli/ Spanish jasmine	-do-	White, March-October	Evergreen climber with dark green fine textured foliage and fragrant flowers.
19.	*Lonicera japonica*	Honeysuckle	Caprifoliaceae	Creamy-white, Throughout year	Evergreen heavy quick growing creeping plant with fragrant flowers.
20.	*Mansoa alliacea/ Adenocalymma alliacium*	Garlic Vine	Bignoniacae	Mauve-purple, March-June	Hardy climber with shinning leaves which produce garlic like smell on rubbing. Suitable for pergolas and arches.
21.	*Pandorea jasminoides*	Australian bower plant	Bignoniaceae	Reddish pink, April-Nov.	Light climber with shining green foliage
22.	*Pyrostegia venusta*	Golden shower	Bignoniaceae	Orange, February-April	Heavy climber with drooping branches.
23.	*Passiflora caerulea*	Blue Passion flower	Passifloraceae	White with blue filament, Sept-Nov	Flowers look like clock/ watch, planted on arches and entrances.
24.	*Passiflora coccinea*	Red passion flower	Passifloraceae	Red, August-November	Tropical climber bears showy scarlet red flowers, suitable for sunny and high humidity.
25.	*Petrea volublis*	Purple wreath	Verbenaceae	Spring, purple	Creeper with woody stem with drooping long racemes of star like flowers.
26.	*Rosa* sp.	Climbing rose	Rosaceae	Many colours, Feb-July	Many varieties of climbing rose are suitable for growing in arches, pergolas and trellises.
27.	*Rosa banksiana*	Banksian Rose	Rosaceae	Creamish white, white, March- April	Trailing type of species which produces small flowers in bunches.
28.	*Solanum jasminoides*	Potato vine	Solanaceae	White, bluish white Sep- Feb	A slender twining shrub suitable for medium to high elevations.
29.	*Tecoma grandiflora/ Campsis grandiflora*	Trumpet flower	Bignoniaceae	Orange, March-October	Deciduous climber and have ability to climb over walls. Bear glossy dark green leaves.
30.	*Tecomeria capensis*	Cape Honeysuckle	Bignoniaceae	Orange, throughout year	Evergreen climber, it can be trimmed to give shapes.
31.	*Thunbergia grandiflora*	Bengal Clockvine	Acanthaceae	Sky blue, Feb-Mar	Dense green foliage, heart shaped. It can cover walls, trees
32.	*T. mysorensis*	Mysore trumpet vine	Acanthaceae	Orange, red, yellow, Jan- March	Flowers are borne in pendulous racemes, suitable for arches, pergolas and trellis.
33.	*Trachelospermum jasminoides*	Star jasmine	Apocynaceae	April-June, white	Evergreen climber, suitable for growing in shady situation and bears fragrant flowers.
34.	*Wisteria sinensis*	Chinese Wisteria	Fabaceae	Purple, white, February- March,	It is a winter deciduous creeper which can be trained over pergolas, fences and trellis.
35.	*Tarlmounia elliptica*	Curtain creeper	Asteraceae	Foliage shrub with white flowers	It is evergreen climber with drooping branches. Good for covering boundary wall and verandas.

PROPAGATION METHODS OF CHRYSANTHEMUM

Chrysanthemum is propagated through terminal cuttings, micropropagation, suckers and seeds.

1. **Terminal cuttings:** Terminal or Shoot tip cuttings of 8-10 cm length are taken from healthy and disease-free mother plants. Cuttings are prepared by removing the basal leaves and apical 2-3 leaf pairs are retained. Cuttings are then treated with fungicide solution containing Indofil M-45 (0.2 %) plus Bavistin (0.1 %) for 30 minutes. After this a sharp cut is given at the basal end below the node. Then, cut end is dipped in a rooting hormone solution of NAA (500 ppm) following quick dip method before planting of cuttings. Cuttings are placed in rooting medium like sand, cocopeat or mixture of sand and cocopeat (1:1, v/v) for rooting beds of propagation chamber or pro trays. Rooting of cuttings takes place in 25-30 days after which rooted cuttings are ready for planting in the field.
2. **Suckers:** Cuttings of shoots just after flowering induces formation of side suckers. These suckers are separated from the mother plant and directly planted in field or pot. Optimum time of separation of suckers from mother plant is when 5-6 leaves appear. Propagation through suckers is done in the month of February- March in hilly areas and May- June in plains.

CULTURAL PRACTICES IN CHRYSANTHEMUM

Pinching: Pinching is one of the important operations in chrysanthemum cultivation. Pinching is removal of terminal or

apical growing portion when the plants are 15- 20 cm tall with 10-12 leaves. It produces axillary branches. Only soft vegetative tips about 1.5- 3 cm long are removed after one month of planting or at 4-6 pair leaves stage. It increases the number of side shoots and flower production.

Disbudding: Removal of unwanted buds is called disbudding. In Standard type of cultivars terminal bud is allowed to grow and axillary buds are removed. However, in Spray type cultivars terminal bud is removed and axillary buds are allowed to bloom.

Deshooting: Deshooting is removal of undesirable lateral shoots in a stem. Deshooting is practiced for improving the size and form of flower in a cut stem.

Staking: Staking is necessary to keep plants erect and to maintain proper shape of plants and bloom. When the shoots are 30 cm tall provide the support. It can be done with bamboo sticks or sutli.

PROPAGATION METHODS AND PLANTING OF TUBEROSE

Propagation by bulbs: Most common method practiced for the commercial multiplication of tuberoses is through propagation by bulbs. The bulbs remain dormant during the winter months in places where the temperature is low. The dormancy of the bulbs can be successfully broken by dipping the bulbs in 4% Thiourea solution for one hour if early planting is desired. Ethylene chlorohydrins can also be used for breaking the dormancy of bulbs. The bulbs are separated from the clumps by rubbing off the loose scales and the long roots should also be removed. Selection of suitable bulbs is very important for successful cultivation. In general, spindle -shaped bulbs free from diseases having diameter between 1.5 and 3.0 cm are suitable for planting. About 1.25 - 1.5 lakh bulbs (8 to 9 tons of bulbs) are required for planting one hectare.

Propagation by bulb segments: Propagation through mature bulbs is expensive, therefore, multiplication of growing stock can be done by division of bulbs. Large sized bulbs having 2.1 cm or more diameter are suitable for planting purpose. If the bulbs are very large, they are cut into 2 to 3 vertical sections, each containing a bud and part of the basal plate. Each of these sections is treated with copper fungicide and planted vertically in a rooting medium with its tip just showing above the surface. A moderately warm temperature should be maintained. New bulblets along with roots develop from the basal plate. At this stage, bulblets are transferred to the ground.

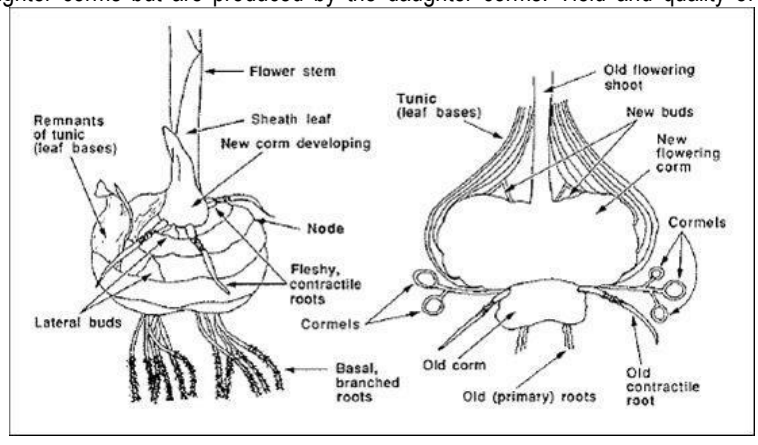
Spacing: Spindle shaped bulbs are planted at an optimum spacing of 30 x 20 cm or 20 x 20 cm. About 1,00,000 to 2,00,000 bulbs are required for planting one hectare of land.

Depth of planting: The depth of planting varies from 3.0 - 7.0 cm depending upon the diameter of the bulb and the soil type. It should be 2.5 times more than the diameter of bulbs. While planting, the bulbs are planted at the recommended plant-spacing, 4-6 cm deep on the sides of the ridges. Planting is deeper in sandy soil as compared to clay soil. In sandy loam soil planting of bulbs is done at the depth of 6.0 cm. In general, planting is done in such a way that the growing portion of the bulb is kept at the ground level.

Seed / bulb treatment: Dipping the bulbs in 4% solution of thiourea can break the resting period. Pre-plant storage of bulbs at 10°C for a period of 30 days will improve the plant growth, increase spike and flower yield. Pre-planting treatment of bulbs with GA3, etherel or thiourea promotes early appearance of flower spike and produces longer spikes with maximum number of florets. The bulbs are first thoroughly cleaned and treated with Bavistin (0.2%) for 30 minutes. Dry in shade before planting or storing.

PROPAGATION OF GLADIOLUS

The most commercial means for the propagation of gladiolus is by means of **corms** and **cormels**. Corm is a thickened underground perennating structure consisting of short vertical stem having many ring- like nodes which bear buds covered with dry scale leaves and a disc-like root zone at the base. Commercially corms are produced from **cormels,** which grow in clusters on stolons between mother and daughter corms but are produced by the daughter corms. Yield and quality of commercial cut flower production in gladiolus is influenced by a number of factors. One such important factor is the size and weight of the corm to be planted. It is well known that bulbs below a certain size do not flower and if they do so, the quality remains poor. The critical size of the corm for flower production is 2.5 cm in diameter. According to the North American Gladiolus Council, corms and cormels can be classified into different grades depending upon their sizes. The corms, on the basis of



their spherical diameter, are classified into two categories, *viz.* the flowering stock (>2.5 to 5.0 cm or more in diameter) and planting stock (>1.0 to 2.5 cm in diameter). The flowering stock is used for production of cut spikes, whereas the planting stock is used for the production of flowering grade corms for the subsequent planting season. There exists a positive correlation between the weight of corm planted with plant growth and flower production. Larger the size better is the growth.

CULTURAL PRACTICES FOLLOWED IN GLADIOLUS

Weeding: Weeds compete with the crop for space, light, nutrients and water. Generally, it is done by mechanical ways i.e., hand weeding or through ploughing. Chemical weed control is essential for commercial operations and herbicides selection depends upon the nature of weeds infesting the crop and the sensitivity of the crop towards the herbicide. Some pre-emergence herbicides reported for gladiolus are alachlor and metachlor (4.5kg/ha), simazine and atrazine (4kg/ha) and oxyfluorfen (0.5kg/ha). Among post-emergence herbicides, stomp 30 EC @ 1-6litres /ha is effective.

Mulching: Mulching between rows is beneficial to improve plant growth and also keeps weeds under control. Fresh manure, chopped straw, dried grass, clippings, saw dust, peat, husk, bark and strips of black polythene can effectively be used as mulching materials.

Earthing-up: Earthing up to a height of 10 -15cm is done when plants are 20cm high. This enables the plants to grow erect despite high winds and rains and reduces weed growth.

Staking: Especially large flowered varieties of gladioli grown outdoors are susceptible to lodging, hence need staking. Stems should be tied with strings to thin but strong supports. Plants should be tied loosely around the stem to allow further growth of plants.

PROPAGATION OF JASMINE

Material required: Secateurs, mother plants, knife, rooting hormones, rooting medium, tags, watering can

a) **Semi-hardwood cuttings**:

- Semi-hardwood cuttings are those made from woody or with partially matured wood.
- Cuttings of broad-leaved evergreen species are generally taken during the summer through early fall from the new shoots just after a flush of growth has taken place and the wood is partially matured.

b) **Hardwood cuttings**:

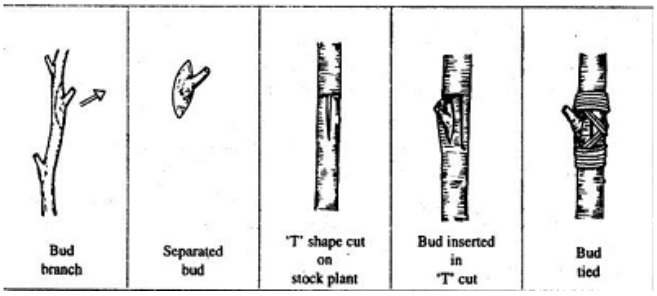
- Hardwood cuttings of narrow- leaved evergreens are also dormant and in deciduous plants, their foliage is retained when propagated.

PROPAGATION METHODS AND CULTURAL PRACTICES OF ROSE

(i) **Seed propagation:** This method of propagation is generally adopted by breeders for developing new cultivars with desirable characters. Seedlings of rose species are also used as stock for grafting or budding. The rose fruits (hips) are harvested when fully ripe and thoroughly dried before extraction of seeds. In rose seed germination is very poor because most of the seeds when mature are in resting conditions requiring an after-ripening period before germination. So, stratification of seeds at 1.6-4.4^{o}C for 6 weeks improves germination. Germination can also be improved with scarification with different chemicals like sulphuric acid for 1-2 hours.

(ii) **Cuttings:** Propagation of roses by cuttings is normally done to raise rootstocks for grafting or budding especially for greenhouse cultivation. Raising plants by stem cuttings is one of the least expensive and one of the easiest methods of rose multiplication. Hardwood cuttings are collected form healthy mother plants having 15-20 cm length and 3-4 nodes. Cuttings are treated with IBA @ 1000ppm depending upon type of cutting. Cuttings are planted in mist chambers for easy and fast rooting. Temperature required for rooting of cuttings is around 24-28^{o}C with relative humidity of 90-100%. Propagation through cuttings is generally done during winters i.e., Oct-Dec in plains and Feb-March in hilly areas.

(iii) **Budding:** Roses are propagated through T-budding; it is the commercial method of propagation of rose. Rootstocks used for budding are *Rosa canina, R. multiflora, R. indica* var. *odorata, R, bourboniana*, Nishkanth (thornless rootstock developed at IIHR, Bangalore), Natal Briar (used worldwide these days). For the bud wood, select strong-growing, ripened shoots. For roses, select a flowered shoot about 30cm (1ft) long with three or four growth buds. Remove the foliage and place in a plastic bag to prevent drying out. Cut away a healthy bud with a strip of bark extending about 2.5cm (1")



above and below the bud. Carefully pull away the woody material from behind the bud. Cut the rootstock just deeply enough to pierce the bark and make a T-shaped incision at a height of 15-30cm (6-12") from the base, with the horizontal cut about 13mm (0.5") long and the vertical cut 2-4cm (1-1.5") long. For rose bushes, insert the bud 5-10cm (2-4") above ground level and, for standard roses, two or three buds are grafted 7.5cm (3") apart spread around the stem at the height at which the top is required. Ease the flaps of the T outwards to reveal the cambium layer (green wood) beneath. Insert the bud behind the bark flaps with the bud just below the cross-stroke of the T. Secure the bud using a rubber binding tie or damp raffia around the grafted area. When the shoot develops the following spring cut off the growth above the bud.

Time of budding: In North Indian plains during November–December and in hilly areas from February-March

(iv) **Stenting:** stenting is a rapid propagation method in which a cut rose is placed on an unrooted piece of rootstock. Rooting of the rootstock and fusion between graft and rootstock take place simultaneously. In the technique of stenting the base of the scion wood and the top of the rootstock are cut in 30^0 angles, both sections are fitted on one another and fixed with budding tape. Rootstock used for stenting should be hardwood cutting and it is treated with IBA @ 1000ppm and stent is placed in rooting medium (cocopeat or vermiculite or perlite). Temperature required for rooting of cuttings is around 24-28^0C with relative humidity of 90-100%. Stenting can be done throughout the year however; best results are obtained from October onwards as high temperature during summers result in increased losses due to black rot.

Cultural practices

Bending: Bending is necessary for keeping enough leaves on the plants. From each plant, a minimum of four stems, either flowering or blind shoots must be bent. It is important to take off buds from the bent shoots as these can be hiding place for thrips and source of *Botrytis* rot. The shoots should be bent at a place close to the original shoot (maximum 5cm), without breaking the branches. To avoid breaking of branches it is advisable to do bending in the afternoon and to make two 45^0 bends rather than one 90^0 bend. The bending should be such that the tops of the stems are below horizontal. It is done to break apical dominance.

Pruning: Pruning is practised to encourage the regular development of strong and healthy basal shoots to obtain good flower yield. Plants get automatically pruned with harvesting of cut flowers, while harvesting the rose cut flowers, there should be at least 1 to 2 mature leaves with five leaflets left on the plants. This will the new shoots to develop from dormant buds on the remaining stem portion.

Disbudding: In hybrid Tea roses only one terminal bud is allowed to flower upon each shoot so as to have larger sized bloom. All other buds which arise in leaf axils are removed at pea size stage of growth.

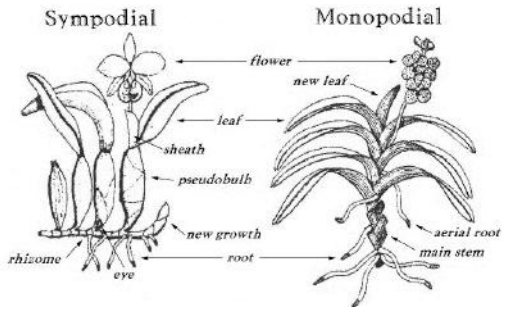
De-shooting: Removal of lateral shoots and to allow only terminal shoots is advised. It is necessary otherwise plants get heavily branched with large number of small flowers.

Desuckering: Desuckering is removal of suckers which appear on the rootstock of the plant.

CLASSIFICATION OF ORCHIDS

Based on growth habit:

Monopodial: These orchids grow from a single vegetative apex. These orchids have main stem which continues to grow year after year producing inflorescence from leaf axils. Monopodial orchids are *Aerides, Phalaenopsis* and *Vanda.*



Sympodial: These orchids have a rhizome, which grows horizontally producing new growth. These orchids have a main stem which terminates growth after each season or flowering. The new shoot (lead) then grows from the base forming its own bulbous stem called pseudobulb. A well-developed sympodial plant contains a clump of shoots of different sizes and age e*.g., Dendrobium, Cattleya, Oncidium, Cymbidium.*

Propagation methods of orchid

Seeds: Orchid seeds are tiny, powdery and varies in number from 1300 to 14,00,000 per capsule. Orchid seeds lack endosperm, cotyledon and have relatively undifferentiated embryo. They require association of appropriate mycorrhizal fungus for supplying nourishment for proper seedling growth. Moreover, because of their specific mycorrhizal association

less than 5% seed germinates in natural condition. The orchid seeds could be grown artificially in asymbiotic condition and it could be exploited for commercial purpose given by Kundson (1946).

Keikis: Some orchids like Ascocenda and Phalaenopsis produce offsets or small aerial plants in an axil of leaves at upper nodes. These are called 'keikis' meaning 'babies. Offshoots root while still attached to the plant. Once 4 or more roots have formed, offshoots are removed and grown as a plant.

Division: The most commonly used method of propagating orchids is through division. This is one of the simplest methods of producing more plants of the same variety or species. Division means splitting the plant into two or more parts each with at least one new shoot and each will produce a fully grown mostly flowering size plant that is capable of flowering in the following season. Best time to divide and multiply is when the plant outgrows the pot or when the canes start growing out over the edge of the pot. It involves division of large clumps into smaller units. This is usually done in those plants that have 6-8 or more pseudobulbs. The rhizome is cut between 3rd or 4th pseudobulb. Each unit should have at least 4 – 5 shoots including old ones. This method is suitable *for Dendrobiums, cattleya, cymbidiums, Paphiopedilum*

Stem cutting: Monopodial orchids are generally propagated through cuttings. Cuttings generally have aerial roots. About 12-15cm long cuttings having 10-12 leaves, 2 nodes and aerial roots are used for propagation. The cut pieces need to be treated with fungicides like Bavistin (2g/litre) for 30 minutes and air dried. The basal portion of the cuttings should be treated with IBA 200 ppm for root initiation and it can be planted in the sand or cocopeat. Relative humidity of 70-80% and temperature around 25-30^{O}C will initiate rooting and new shoots within a month. Orchids like Aerides, Arachnis, Epidendrum, Renanthera, Phalaenopsis, Vanda and Dendrobium can be propagated through cuttings.

Micro propagation: Commercially orchids are propagated through micro propagation Explants in sympodial orchids like Cattleya, Cymbidium and Dendrobium is young shoot arising from backbulb. Axillary buds and apical buds are also used. Commercial method of orchid propagation. Explants in sympodial orchids like *Cattleya, Cymbidium and Dendrobium* is young shoot arising from backbulb. Axillary buds and apical buds are also used. While monopodial orchids like *Vanda, Aerides, Phalaenopsis*, nodal sections, shoot apices, keikis or offshoots can be used.

Seed Culture: The culture of immature seeds, often called green pod culture or embryo culture. Orchid seeds are orthodox in their storage and thus can be stored for long period at -18^{0} C temperature. First orchid seed germination was recorded by Knudson in 1923 and called Knudson-C medium. Rate and speed of germination of mature seeds of orchids is less as compared to immature seeds. In 7-8 weeks, old seeds about 10-50 % germination is observed.

METHODS OF PROPAGATION AND CULTURAL PRACTICES IN CULTIVATION OF CARNATION

Propagation through terminal cuttings: Carnations are multiplied vegetatively through terminal cuttings with 3-4 nodes weighing around 10g is ideal for multiplication. Terminal cuttings measuring about 10-15cm and 7-10cm long with four to five pairs of leaves are selected for standard and spray cultivars, respectively. Do not harvest all the cuttings from a plant at one time otherwise plant will lose too much of the assimilating leaves. If the cuttings are left on the plant too long, they will start to elongate and flower induction might start. Generative cuttings are useless for commercial flower production. Unrooted carnation cuttings can be stored in a cold store for several months. Cuttings are packed in polyethylene bags and stored at 1-3^{0}C. The main propagation season extends from mid-October to the end of March. However, in cooler areas like Himachal Pradesh, propagation can be done up to June. Treatment of un-rooted cuttings with fungicides viz. Dithane M-45 (0.2%) + Bavistin (0.1%) for half an hour before planting reduces the spread of fungal diseases during rooting. Fresh cut is made at lower end of the cuttings and treated with rooting hormone such as NAA @ 500ppm for 10 sec. Cuttings are spaced at 5 cm apart and intermittent misting should be used for good rooting. Cuttings normally develop good root system within 21 days. Rooting medium used for carnation cuttings is mixture of sand: cocopeat (1:1, v/v). Immediately after planting spray the cuttings with mister or foot sprayer manually. Frequent misting is required during the summer than the winter. Cuttings strike roots 20-30 days depending upon the seasons.

Cultural Practices: Various cultural practices followed for cultivation of carnation are as following:

(1) Pinching: For successful production of top-quality Carnations, pinching is an important operation. During pinching, the tip of the stem is removed to encourage the growth of the lateral shoots. Only 4-6 well grown lateral shoots will be allowed to grow. Pinching is done after 30-35 days of planting leaving only 6 pairs of basal leaves. If too many leaf pairs remain, stem and flower quality may be reduced considerably. Similarly, production will decrease if few leaf pairs will be left. There are three types of pinching methods generally followed.

- **(i) Single pinch:** In single pinch, apical portion measuring 5-7cm is pinched off to give about 4-5 lateral shoots, which produces flower. This is done for early crop.
- **(ii) Pinch and-a- half:** This method involves single pinching of the main stem to give 4-5 side shoots. Only half of total numbers of lateral shoots are pinched when they are about 5 cm long and half are not pinched. The shoots which

are not pinched will flower earlier as compared to pinched ones. This method reduces the load of first crop and provides a steady supply of flowers throughout the year.

(iii) Double pinch: In this method all the lateral shoots arising from the first pinch are again pinched when they are 5-7 cm in length at 2-3 nodes. It is done approximately 5-6 weeks after first pinch. This is generally done for late harvesting or delaying the flowering period. Approximately 8-10 shoots are retained. This method produces large number of flowers bearing shoots; however, the quality of cut flowers is poor hence not preferred.

(2) Staking: In order to obtain straight stems and to prevent lodging of plants, Carnation needs supporting nets of 4-5 layers. These plants are planted within the net of mesh size 7.5x7.5 cm. Nets are gradually raised with plant growth. For every 2.5 to 3.0 m, the metal wires or nylon rope should be supported with poles. The first net should be fixed at 12.0 cm above the bed. The remaining nets, whose squares should be 12.5x12.5 cm or 15x15 cm, are placed over the first net. These nets are placed at a height of 15 cm from each other.

(3) Disbudding: Disbudding is the removal of unwanted buds. It is practiced in carnation to obtain good quality flowers. Buds are taken away before they get too big, as they will considerably reduce the flower size. In case of standard carnation, the lateral flower buds are removed leaving only the terminal or main flower bud. In spray or miniature carnation, the terminal or main flower buds are removed, to encourage lateral flower buds. Disbudding help to produce quality bloom in standard carnation.

(4) Deshooting: Unwanted shoots on the flowering stems are removed with the hands when they are about 2-3 cm long.

POST- HARVEST TREATMENT OF CUT FLOWER

Pre-cooling: Packed or unpacked flowers have to be pre-cooled before storage or shipment, time between harvest and pre-cooling should be as short as possible. Forced air cooling is most effective in removing the field heat from flowers. Pre-cooling is done by forced air cooling or cooling to bring down he temperature to 1^0C in a short period.

(i) Conditioning: Conditioning or hardening is a simple process where the flowers are kept or made to stand loosely in a big container of water so the air circulates around the stem. This treatment is done to restore turgidity of cut flowers as various kinds of water stress during handling, storage and transport might have affected the turgidity of flowers. Flowers can be conditioned in the dark so that their stomata will close, reducing the amount of water loss by transportation. Conditioning is achieved by treating flowers with demineralized water supplemented with germicides and acidified with citric acid to pH 4.5-5.0 but with or without sugar.

(ii) Pulsing solutions: Pulsing refers to short duration (16-24 h) pre-shipment or pre storage treatment. The effect of such a treatment lasts throughout the entire vase life of the flower. Sugar (sucrose) is a main component of the pulsing solution. Since pulsing involves short duration treatment, relatively higher levels of sucrose are used.

(iii) Bud opening solutions: Immature buds of many flowers can be made to open in chemical solutions, referred to as "bud opening solutions" The components of bud opening solutions are essentially the same as those of pulsing solutions, but in case of bud opening solutions, lower concentrations (2 to 5 per cent) of sucrose are used.

(iii) Holding or vase solutions: Holding or vase solutions are meant to hold flowers continuously, till it reaches consumer or till the termination of vase life. The level of sucrose in vase solutions is, kept very low (0.5 to 2 per cent). Many commercial vase preservatives are available for use in many countries as holding solutions and are required to be used as per recommendations of the manufacturer.

Packaging: The main challenge faced in the flower industry is to transport fragile, fresh cut flowers while avoiding flower breakage and bruising. During transportation constant movement can cause can result in bruised or broken flower heads, torn petals and other damage. Packaging and storage affect the postharvest life of flowers, as appropriate packaging of flowers along with pulsing may aid in keeping flowers fresh for consumer and may also extend their vase-life. Bunch of flowers previously wrapped in paper or cellophane and then placed in corrugated fibre board (CFB) boxes to protect flowers against water loss, physical stress, and various other external conditions that may damage the flowers. Cushioning material is also used which can be pieces of shredded paper or tissue paper. In case of gerbera anthurium individual flower is sleeved with polyethylene cups and then packed in CFB boxes.