School of Agriculture
Diploma in Commercial Horticulture
DCH-10

Applied Horticulture: Crop Production Technology
(Flowers Crops)
DCH 04

2010-2011
Uttarakhand Open University
Haldwani, Nainital
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### Course Editing

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### Syllabus

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Unit-1: CARNATION

1.1 OBJECTIVES
After the completion of the chapter students will be able to
1. Understand importance of Carnation cultivation.
2. Identify different varieties of Carnation.
4. Perform different cultivation practices of Carnation.

1.2 INTRODUCTION
CARNATION (Dianthus caryophyllus) flower is valued for its excellent keeping quality, wide array of colours and farms, and ability to rehydrate after continuous
transportation. Carnation is indigenous to the Mediterranean areas. Due to high cost of production inside greenhouses in Europe and USA, its cultivation is shifting to more naturally-growing regions where they are being produced at lesser cost. In India, carnation culture is in a budding stage. Very few commercial varieties are seen in the market. The Sim race of carnation was first introduced in India in 1980. In India, it is cultivated in 50ha including annual types. Moderate climatic control measures that are economical can deliver quality carnations at the internationally competitive prices year round. Carnations are now being grown commercially in Solan, Shimla, Mandi, Kullu, Chandigarh, Ludhiana, Delhi, Gurgaon, Bangalore and Kalimpong. A few private growers are also exporting carnations. The mid hills of Himachal Pradesh, Jammu and Kashmir, Uttarakhand, West Bengal, Nilgiri hills, Bangalore and Nasik are potential areas for its commercial cultivation.

1.3 CLIMATE AND SOIL

Tamil Nadu and mid hills of Himachal Pradesh are ideal for round-the-year cultivation of carnation. Since carnation is a quantitative long-day plant, it requires ample sunshine (approximately 21.5k lux for at least 8hr in a day). The locations having a day temperature of 25°C and a night temperature of 10°C are good for high quality carnations. The optimum temperature for standard carnation is 18°C-23°C. The relative humidity inside the greenhouse should be approximately 50-60%. In north Indian plains, carnation plants should be shaded with 25-50% shading nets to get quality flowers. Spray carnations can tolerate slightly warmer temperature.

A rich sandy loam or loam soil is ideal for its successful cultivation. Soils with, higher amount of clay or silt should be amended by incorporating organic matter compost. The pH of 6-7 is ideal. The site chosen should be free from weeds, nematodes or soil-borne
pathogens. Pre plant sterilization is beneficial Sterilization with steam, sun or 5% formaline should be done.

1.4 VARIETIES

Standard and spray types of carnations are grown commercially. Standard types disbudded to a terminal single flower, producing a, large flower on a, sturdy, Of 1g stem. In spray carnations, the center apical bud is removed, allowing the upper buds to develop, these may be on a relatively short stem providing a tight or longer stems originating lower down the stem providing a more open spray.

The standard carnations are more in demand in Indian markets, while in the world trade sprays (miniature) supersede standards. The latest development is micro carnations for polybowls. Wholesalers also dye white carnations to green, blue, yellow and other shades, a process known as tinting. The promising cultivars of carnation recommended for commercial cultivation are given in Table 1.

Table 1. Promising varieties of carnation

<table>
<thead>
<tr>
<th>Location</th>
<th>Standards</th>
<th>Sprays</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solan (Himachal Pradesh)</td>
<td>España, Red Corso, Light Pink, Candy, Raggio-di-Sole, Cabaret, Isaac, Scania, Laspalmas, Style Sestyl and Feyenoord</td>
<td>Sam's Pride, White Lilia and Cherry Bag</td>
</tr>
<tr>
<td>Ludhiana (Punjab)</td>
<td>España, Manon Limra and Raggio-di-Sole</td>
<td>Sam's Pride and Scarlet Elegance</td>
</tr>
<tr>
<td>Pune (Maharashtra)</td>
<td>Fambia, Aristo, Flair Style, Scania and Arthur Sim</td>
<td></td>
</tr>
<tr>
<td>New Delhi</td>
<td>Candy, Pamir, España, Red Corso and William Sim</td>
<td></td>
</tr>
<tr>
<td>Kalimpong (West Bengal)</td>
<td>Irma, Red Corso, Orange Triumph and Candy</td>
<td></td>
</tr>
<tr>
<td>Kodaikanal Tamil Nadu</td>
<td>Arthur Sim, White Sim and Lena</td>
<td></td>
</tr>
</tbody>
</table>
However, some new cultivars recommended for commercial cultivations are given in Table 2.

**Table 2. New varieties of carnation**

<table>
<thead>
<tr>
<th>Colour</th>
<th>Standard Varieties</th>
<th>Sprays</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red</td>
<td>Desio, Master, Impala, Nelson and Dakar</td>
<td>Alister, Darling, Red Arrow and Rony Arony</td>
</tr>
<tr>
<td>Pink</td>
<td>Bologna, Petra and Pink Diamante Pirandello, Dona Brecas, Laurella and Killer</td>
<td>Happiness, Rossini and Fantasia Cherry Bag, Kortina Cherry Ondelia and Ciska</td>
</tr>
<tr>
<td>Pink Cherry</td>
<td>Arony</td>
<td></td>
</tr>
<tr>
<td>Yellow</td>
<td>Esty, Pinto and Tahiti</td>
<td>Guernsey Yellow, Koreno and Castillo</td>
</tr>
<tr>
<td>White West</td>
<td>Sansara, White Giant, Bogota and Rivera</td>
<td>Virgo, Close Up and Crystal</td>
</tr>
<tr>
<td>White</td>
<td>Lavender Lace</td>
<td>Purple Chopin and Roxette</td>
</tr>
<tr>
<td>Orange</td>
<td>Amstel, Orange Pinto Solar and Orange Isac</td>
<td>Niky, Macarena, Sintonia and Target</td>
</tr>
<tr>
<td>Variegated (striped/fancy)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>Forever, Olympus, Tropea, Gianaica, Aledo and Atletico</td>
<td>Saffora, Manatovani and Regis</td>
</tr>
<tr>
<td>Yellow</td>
<td>Super Star, Pontiac and Michelle</td>
<td>Naomi, Garfield, Picaro and Jacobine</td>
</tr>
<tr>
<td>Red Orange</td>
<td>Orange Prestige and Ivonne Orange Minerva, Nicol and Roderic</td>
<td>Sintonia and Fuego and Challenger</td>
</tr>
</tbody>
</table>

Other types of carnations which are recommended for pot culture are:

**Spider type:** Purple Rain (purple)

**Pot carnations:** Maldeves (pink), White Sunny (white), Cerratop (fancy), Charmtop (red), Pinky (red), Davinci (pink)

### 1.5 PROPAGATION

Perpetual carnations are multiplied vegetatively by stem cuttings while seed propagation is normally practiced in raising plants of margurite carnations and border carnations as well as for the purpose of hybridization. Specialist propagators use micro propagation for producing disease free plants commercially.
Terminal cuttings (10-15cm) from healthy, disease-free mother plants are taken and lower 1-2 pairs of leaves are removed. There should be at least 3 nodes on a cutting. Treat them with Bavistan (0.1%) + Dithane M-45 (0.25%) for 5-6 minutes and shake them properly to remove the solution and treat the cut ends with NAA (500ppm) for 10-12 seconds. Plant cuttings at 3cm x 3cm distance in trays or propagation beds containing sterilized sand. Rooting is obtained in 25-30 days with manual misting in a polythene chamber.

After rooting, the cuttings should be transferred in a hardening chamber containing a mixture of sand, farmyard manure, rice hulls and ash (1:1:1:1 v/v). Keep the cuttings under mini portable tunnels of 3m x 1.5m size covered with a layer of hessian cloth or 50% shading net and transparent polythene as required. Supply of nutrients during the rooting period is not necessary if the stock plants are maintained at an adequate level of nutrition. Overhead fogging unit is best for obtaining intermittent mist and is applied on bright days at an interval of 10 seconds out of every 10-15 minutes. Misting schedule can be modified for specific conditions depending upon photoperiod, light intensity and humidity. The cuttings become ready for sale/transplanting into the fields after 3 weeks of hardening period.

Carnations can be propagated round the year provided temperature inside the polyhouse is maintained at 20°C with 75-80% relative humidity. In winter 100 watt bulbs can be hung 1m above the cuttings, 1.5m apart during night. About 15,000 cuttings can be accommodated in a medium-sized chamber of 10m x 4m size. The rooting and hardening media should be treated with 5% commercial formalin before planting (one litre of formalin in 7 litres of water). After treating the media with formalin, it should be covered with polythene for 7 days. Later on, it must be raked daily for 10 days to release the formalin gas.

1.6 GROWING STRUCTURES

Most of the perpetual carnations are commercially grown under protection. These require sufficient light and proper ventilation. Therefore, the design and orientation of the
greenhouse are of great importance. The greenhouse should have the ridge, true north and south, the plants being grown in beds running in the same direction with beds 1-1.2m wide, path 60cm towards the side wall and in between the beds to assist working and ensure adequate air movement. Poly greenhouse fitted with fan and pad system can bring down the temperature by 8°-10°C. However, top ridge and side ventilation also give good fresh air exchange and lower the temperature. The portable tunnel 3m x 1.5m x 1.5m are useful for protecting the open crop during rainy season to save from heavy rains and during winter to increase the growing temperature.

1.7 CULTIVATION

1.7.1 Planting

Planting schedule is very important to regulate the flower production. Under controlled, greenhouse conditions, carnation could be planted round the year. Approximately 150-180 days are required from planting to flower under open conditions. However, under protected conditions, its flowers can be obtained within 120-150 days depending up on the season. The planting done during mid September-November is ideal for northern plains of India to obtain flush of carnation flowers from February to April, whereas October-February planting is suitable for hilly areas to get flowers during mid-April-mid-July. In areas having snowfall planting should be done during March-April to get flowers during August-October.

The carnation cuttings-well-rooted, hardened, disease free-should procure from a reputed source. They should be planted on raised beds, 15-20cm above the ground of convenient size, 1-1.2m in width and 45-60cm path between beds. In high hills, flowers may be taken continuously for 2 years rotation: After flowering, plants should be pruned or hedged 10-15cm above the soil level. The irrigation should be withheld about 1 week before
hedging and the pruned plants should not be irrigated again until new shoots appear (a period of 3-4 weeks).

Traditionally, carnations are planted relatively close together 'about cm x 15cm). A spacing of 20cm x 20cm is preferable and even wider spacing, can be used. Distance between the rows of 20cm allows 5 lines in 1m wide beds. Approximately 75,000 cuttings may be planted in one acre area (1,87,000/ha). Air movement between the plants and spray penetration is improved with wide spacing 30cm x 30cm under ordinary conditions.

1.7.2 Pinching

Pinching or stopping is an important operation in the successful production of quality carnations. It is the snapping off or removal of apical shoot leaving about 5-6 nodes on the plants 30-35 days after planting. Pinching preferably should be done below sixth node, since axillary shoots pinched above sixth node produce flowers on smaller shoots which is not desirable. To get 5-6 well-developed lateral shoots/plant it is necessary to pinch above sixth node from the bottom. Until now growers have seldom allowed the apical shoots to develop a "Crown Bloom" but this is desirable since it spreads the initial flowering period. There are 3 types of pinching methods generally followed:

**Single pinching:** It is the removal of the main shoots below sixth node to give about 5-6 lateral shoots which produce flowers. This is done for early crop.

**Pinch and a half:** This involves single pinching of the main stem and later when the resulting shoots are long enough (8-10cm or 30-35 days after first pinch), half of the largest shoots on each plant are pinched. The half pinch actual is the 2 or 3 pinches/plant at the later pinching time. Two to three flowers are obtained in first flush and 6-8 in the later flush. This system
reduces the amount of first crop and provides steady production of flowers without any peak time.

**Double pinch:** It is the single pinching of the main shoots below **sixth** node and again the pinching of all laterals when they are 8-10cm in length at 2-3 nodes approximately 5-6 weeks after first pinch. This is generally done for late cutting or delaying the flowering period. Generally 8-10 shoots are retained. Generally single pinch, pinch-and-a-half methods produce excellent quality flowers. Double pinching delays the flowering and produces weak shooting

**1.7.3 Flower regulation**

The main objective of a grower is to produce maximum number of excellent quality flowers at the time when the prices are high. Carnations produce, flowers in flushes, as each set of lateral buds extends and terminates in a flower. A steady supply of flowers from hills is most profitable during mid-May-mid. November and December-February from plains. Time of flowering, duration of flush and subsequent flower production may be controlled by the growers. Under mid hill conditions of Himachal Pradesh, flowers can be produced throughout the year. So of the suitable cropping schedule are given Table 3.

**1.7.4 Supplementary lighting**

It is very effective for increasing stem length, flower size and early flower production and should be given with 100 W incandescent bulbs hung at 1.5 above beds at 1m spacing during November-January from dusk to dawn when light intensities are poor.
Table 3. Suitable cropping schedule in carnation

<table>
<thead>
<tr>
<th>Planting time</th>
<th>Flowering time/ Pinching methods</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Single pinch</td>
</tr>
<tr>
<td>October</td>
<td>March-April</td>
</tr>
<tr>
<td>December</td>
<td>May-June</td>
</tr>
<tr>
<td>February</td>
<td>July-August</td>
</tr>
<tr>
<td>April</td>
<td>August-September</td>
</tr>
</tbody>
</table>

1.7.5 Growth regulators

There is a pronounced effect of growth regulators on flower production and regulation in carnation. Spraying of GA3 (100ppm) twice at first pinch and when axillary shoots are 8-10cm in length, produce early flowering with long stems. However, application of BA (50ppm) at monthly intervals increases yield of cuttings. Spraying (twice) of Chamatkar (Mepiqu.lat Chloride) (300ppm each), first when axillary shoots are 8-10cm in length and second at flower-bud initiation reduce calyx splitting, producing healthy stems.

1.7.6 Nutrition

Proper nutrition is very essential for obtaining optimum plant growth and yield of quality flowers. The nutritional doses recommended for standard 4 spray carnations area given in Table 4.

Table 4. Fertilizer recommendations for carnation

<table>
<thead>
<tr>
<th>Fertilizer</th>
<th>Standard type</th>
<th>Spray type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farmyard manure</td>
<td>5-10kg</td>
<td>5-10kg</td>
</tr>
<tr>
<td>N</td>
<td>30g (urea 67g or CAN 120g)</td>
<td>40g</td>
</tr>
<tr>
<td>P2O4</td>
<td>20g (single superphosphate 125g)</td>
<td>20g (single superphosphate 125g)</td>
</tr>
<tr>
<td>K2O</td>
<td>10g (muriate of potash, 17g)</td>
<td>10g (muriate of potash, 17g)</td>
</tr>
</tbody>
</table>
Apply half N before planting and remaining half N one month later. Spray 0.1% urea and potassium nitrate (KNO₃) and 1ppm boron at 10 days interval till flowering. Some micro nutrients may also be required, depending upon type of soil and mineral content of irrigation water. The most likely micronutrients to be added are Fe, Zn, Cu, Mn, Mo and B. Periodic laboratory analysis of plant tissue is advisable to determine whether micronutrient are needed, and also whether the major nutrients are adequate. When liquid feeding is done, foliar analysis is mere satisfactory than soil analysis.

1.7.7 Irrigation

Water requirement is directly related to the soil radiation received by the plant. The growing medium for carnation needs to be kept near field capacity. So regular watering is required at least 2-3 times in a week in summer and 2-3 times in a fortnight during winter. Rooted cuttings need watering immediately after planting. Overhead sprinkler system is quite effective and economical than soil surface irrigation. The overhead system, if employed, should be discontinued when the flower buds appear and replaced by soil surface system. The optimum moisture for the medium should be between 0.3 and 0.5 bar under low light levels, tension less than 0.3 bar produces soft elongated growth and low quality flowers. Water tension greater than 0.5 bar under high light intensities results in poor quality flowers. Open crop yields 150-200 flowers/m² area, whereas greenhouse crop yields 300-400 flowers/m². An additional 50% yield can be obtained in ratoon crop.

1.7.8 Physiological Disorders

Calyx-splitting is a major disorder in carnation. As the flower bud opens and petals approach their full size, the calyx may split down either half or completely. Calyx-splitting occurs in many carnation cultivars, due to low temperature (<10°C) during the growth of
flower bud and an extra whorl of petals is developed inside the calyx. But the calyx is not able to contain these extra petals or petaloids and splits. Low nitrogen, high ammonical nitrogen or low boron levels also enhance calyx-splitting. Higher nitrate to ammonical nitrogen ratio during low periods are recommended to reduce splitting. Small rubber bands can be banded on the bud when it shows a small opening. The cultivars that are less prone to splitting are Espana, Cabaret, Red Corso, Pamir and Raggio-di-Sole.

Slabside is another malformation during cool periods. The bud does not open evenly so that petals protrude on one side only, giving a lopsided shape to the flower. This problem can often be avoided in heated greenhouses but not when temperatures are too cool.

1.7.9 Aftercare

The plants should be supported by a network. The plastic nets having a mesh of 7.5-10 cm supported by stakes of metal fixed at the corner of beds is an ideal method. Make 3-4 layers of mesh laid together on the soil surface, lower is made 15cm above the soil and upper layers are separated 20cm apart. As the plants grow, the stems must be constantly stalled or caged within the respective mesh opening to maintain straight stems. A modern supporting method either of wire or nets comprises 2 vertical posts at both ends, with cross bars at intervals. Lighter grade "ladder", preferably of metal can also be set along the length of the bed 3.5-4m apart. It is convenient if the end ports are fitted into sockets so that they can be easily removed and replanted, and also strengthened by a stake taken down to the side of a bed. The first layer is laid after pinching of plants and others as the plants grow.

Disbudding is the removal of unwanted buds. All plants of standard carnations should be disbudded when terminal bud is 15mm in diameter and other buds below the terminal buds are large enough for easy removal. In spray types, the main flower (terminal) is removed to
encourage lateral flower buds to develop. In de-shooting, the unwanted shoots in the axil of leaves or flowering shoots are removed when they are 2-3cm long.

1.8 HARVESTING AND POSTHARVEST MANAGEMENT

Carnations are highly responsive to post harvest treatments. Longevity of flowers can be increased 2-3 times with various postharvest treatments. Harvesting stage the bud size and petal growth are generally used to judge the stage of harvesting. The flowers of standard carnation are cut when outer petals have unfolded nearly perpendicular to stem or at paint brush stage. Spray carnations are cut, when 2-3 upper flowers in the inflorescence are open and remaining buds are showing colour. In recent years, carnations are cut at tight-bud stage. As soon as flowers are harvested, keep them in water in a preservative solution. Cutting the flower stems leaving 3-4 nodes above the ground is required for growth of the ratoon crop following season.

1.8.1 Grading

Just after harvesting, the flowers must be graded and bunched properly. Various standardized grades based on stem length, flower diameter, and physical condition of flower like stem sturdiness, free from diseases and insects, sleepiness, stem cracks, slabside, bullhead and calyx splitting should be considered while grading carnations. Grading in India is adopted as per the guidelines of the Society of American Florists. Each grade is bunched in a lot of 25 stems. About 600 stems of carnation weigh approximately 22kg.

1.8.2 Conditioning of flowers

Carnation flowers are highly sensitive to ethylene. The flowers after harvesting and grading should be pulsed with 10% sucrose + 1mm STS for 8-10hr before transportation to
increase storability and vase-life of cut carnations. After pulsing, the flowers should be stored at 2°-4°C temperature and 95% relative humidity in water with a nutritive solution. This is necessary to prevent sleepiness in cut carnations.

15.8.3 Packaging and transportation

Carnations are packed in corrugated cardboard boxes. About 800 carnations are packed in a standard-sized carton (122cm x 50cm x 30cm). The boxes should be well-insulated. Bunches of 25 flowers are then packed in these boxes with one half of the total number of bundles oriented on each end of the container. Newspaper layers are placed between the layers to maintain high humidity and then when the container is filled, an insulated layer of paper is put across the box to cover the flowers completely.

Transportation should be done in a refrigerated van at 2°-4°C temperature to maintain the cool chain up to cargo. However, for local markets it should be done by trains, buses and trucks during night hours. Marketing of its cut flowers is not organized. There is a great demand for carnations in Delhi and Bombay.
Check Your Progress

Q.1 Write down the importance of Carnation crop.

Q.2 Write short notes on climate and soil requirement for Carnation crop.

Q.3 List down different Carnation crop.

Q.4 Explain propagation methods of Carnation crop.

Q.5 Elaborate cultivation practices of Carnation crop.

Q.6 What affect the growth of Carnation crop?

Q.7 Write down post harvest practices of Carnation crop.
Unit-2: GLADIOLUS

2.1 OBJECTIVES
1. Understand importance of Gladiolus cultivation.
2. Identify different varieties of Gladiolus.
4. Perform different cultivation practices of Gladiolus.

2.2 INTRODUCTION:
GLADIOLUS (Gladiolus species) is very much liked for its majestic spikes containing attractive, elegant and delicate florets. These florets open in sequence over a
longer duration and hence has a good keeping quality of cut spikes. There is a wide range of
colours-self or bi-colour with or without central mark varying from white to darkest crimson.
The spikes of gladiolus are mainly used for garden and interior decoration, and for making
bouquets. West Bengal, Maharashtra, Uttarakhand, Punjab, Haryana and Andhra Pradesh are
the major gladiolus growing states.

2.3 CLIMATE AND SOIL

It can successfully be grown in a wide variety of climatic conditions. The planting
should be adjusted in such a way that gladiolus crop enjoys favourable weather conditions
throughout its growing, flowering, corm and cormel production period. The favourable
temperatures are about 16°C (lower) and 23°-40°C (higher). There should not be rains
especially during flowering period.

Gladiolus requires open sunny conditions. The longer day length improves its spike
quality. About 12hr day length with high light intensities is preferred over short days with
low light intensities. The site should also be well protected against strong winds by planting a
hedge or windbreak.

Fertile and well-drained soil is better than heavier soils. The texture of heavy soils can
be improved by mixing organic manure and sand. The soil reaction should be around neutral.
If it is acidic or alkaline, it should be corrected.

2.4 VARIETIES

Gladiolus is very rich in its varietal wealth. The commercial life of a variety is about
10-15 years. Every year new varieties are introduced which replace the old ones. Promising
varieties which are popular amongst growers of India are:
American Beauty: Florets; reddish pink in colour (red group; 54B) with whitish throat and whitish blue ant-hers; spikes 70-75cm long; each with 15-16 florets; florets 9.5-10.5cm in size; each corm produces 70-80 cormels.

Anglia: Florets yellow (yellow group 8A); spikes 60-70cm long each having 13-14 florets; florets 9.5-10cm in diameter; each corm produces about 10-15 cormels.

Applause: Florets deep pink (red purple; 67C) with red throat; spikes 90-100cm long having 15-16 florets; florets 8.0-8.5cm in size, each corm produces about 20 cormels.

Blue Sky: Florets violet blue in colour (violet-blue group; 92C); spikes 80-90cm long each having 15-16 florets; florets about 10cm in diameter. Cormel production 25-30/corm.

Eurovision: Florets bright red in colour (red group; 45B); spikes 75-80cm long each having 18-20 florets; florets 10-10.5cm in size; cormel production 25-30/ corm.

Friendship: Florets are carmine-rose (red group; 52C) with yellow throat; spikes. 90-100 cm long, each bearing 18-20 florets of 9.5-10.5 cm size. Each corm produces 15-20 cormels.

65/-Majesty: Florets deep violet in color (violet group; 83C), spikes c-m 65-70cm long each with 13-14 florets; florets 8.0-8.5cm in size; cormel production about 20/corm.

Hunting Song: Floret scarlet red (red group; 40B) with maroon throat having yellow markings; spikes 95-10.0cm long; each with 17-19 florets; florets about 10cm diameter; cormel production about 20/corm.
**Jacksonville Gold:** Florets light yellow (yellow group l0A) with bright yellow throat. Spikes 70-75cm long with 16-18 florets. Florets 9.5-10cm in diameter; each corm produces 10-15 cormels.

**Jester:** Florets deep yellow (yellow-orange group; 16A); with red throat; spikes 90-100cm long with 16-18 florets; florets (9.5-10.0cm in diameter; each corm produces 15-20 cormels.

**Mascagni:** Florets bright red (red group 44B); 9-10cm in diameter; spikes 80- 90cm long each having 15-17 florets. Each corm produces 10-15 cormels.

**Nova Lux:** Florets yellow (yellow group; 12B) with deep yellow throat and purplish base; spikes 90-100cm long with 16-18 florets; florets 9-10cm in size and ruffled; each corm produces 15-20 cormels.

**Oscar:** Florets maroon in colour (red group: 45B); spikes 90-100cm long with 15-18 florets. Florets about 10cm in diameter. Each corm produces 25-30, cormels. This variety is highly susceptible to fusarial wilt.

**Peter Pears:** Florets orange-red (shrimp-red) (Greyed-orange group 1; 170D). Lip petal scarlet with light stripes; Florets 10.5cm in diameter; each corm produces about 25-30 cormels.

**Priscilla:** Spikes pinkish-mauve (red purple group: 71C) with prominent light yellowish-white bases; spikes 60-70cm with 14-15 florets; florets 8.0-~cm in diameter; each corm produces 20-25 cormels.
**Rose Spire:** Florets light pinkish mauve (red-purple group; 57C) with creamish white throat; spikes 95-100cm long, each having 17-18 florets of 10.5-11.0cm diameter; each corm produces about 25-30 cormels/corm.

**Rose Supreme:** Florets light pink (red group; 52D) with dark pink stripes and creamish throat; spikes 100-105cm long each with 16-18 florets of 10.5-11.0cm diameter; each corm produces 20-30 cormels.

**Sancerre:** Florets snow white (white group, 155B) in colour, spikes length 85-90cm; 17 florets/spike – floret size 10-11cm; each corm produces about 50 cormels.

**Suchitra:** Florets light Pink (red group; 49A) with dark Pink strip spikes 80-90cm long, each with 16-18 florets, florets 9-10cm in diameter; cormel production 80-90/corm.

**True Yellow:** Florets yellow (yellow group, 13C); spikes stout, 100-110 cm long each with 13-15 florets; Florets nearly 10-11cm in diameter, ruffled, each corm produces about 8-10 cormels.

**White Prosperity:** Florets white in colour (white group, 155B), spikes 90-110cm long each with 18-20 florets, florets 9.5-10.5cm in diameter. Cormel production about 30-40/corm.

**Wind Song:** Florets purplish mauve (Violet purple group; 81B) with prominent light yellow throat. Spikes 90-95cm long each bearing 15-16 florets. Florets 10-11cm in diameter; each corm produces 20-25 cormels.
Yellow Stone: Florets sulphur-yellow (yellow group; 7B); highly ruffled spike: 70-75cm long each with 14-16 florets; florets 10-11cm in diameter, each corm produces 3-4 cormels.

There is a demand of gladiolus flowers round-the-year. Nowadays gladiolus can be produced from October-end to April by adjusting the planting at 15days or one month interval from July to December in plains of north India. Selection of varieties should be done accordingly. In hilly areas, March-April is planting time to get flowers from June-September. For quality flower production, planting in June, October and November is beneficial, whereas June, February, April and May plantings are better for cormel production. August, September, March and April are not very useful for flower production.

2.5 PROPAGATION

Gladiolus is propagated through corms and cormels, seed and tissue culture.

2.5.1 Corms: Propagation of gladiolus through corms and cormels is most common and commercially used method. A single corm of gladiolus produces an average of 1-3 flower grade daughter corms In a season depending upon its size and cultivar. Normally large-sized corms may produce more daughter corm; than small-sized ones. According to the North American Gladiolus Council, there are 3 categories of corms based exclusively on their size-large, medium and small. Large-sized corms have been put into jumbo (5.1cm diameter) and no. 1 (>3.5-<5.1cm diameter) categories. Medium-sized corms have 2 categories-no. 2 (>3.2-<3.8cm diameter) and no. 3 (>2.5-3.2cm diameter), whereas small-sized corms commonly referred to as cormels have 3 categories-no. 4 (>1.9-<2.5cmdiameter), no. 5 (>1.3-<1.9cm diameter) and no. 6 (>1.0-<1.3cm diameter) respectively. Large and medium-sized corms are used for production of cut spike, whereas small-sized corms are used as planting stock for the production of flower grade corms for the subsequent planting season. Most varieties
produce 1-2 flower grade daughter corms from the single parent corm. Gladiolus varieties Suchitra, Jackson Ville Gold Ot American Beauty produce up to 3-4 daughter-corms/corm.

The number of daughter corms/corm can also be increased by pre-planting (pre-storage or post-storage) treatment of corms with ethrel (500-5,000 ppm for 30 min.). Ethrel breaks apical dominance and promotes the sprouting of lateral buds which eventually increases the number of daughter corms. The large-sized corms are more responsive to the treatment than the small-sized ones. In some cases high concentration of ethrel (1000 ppm or more) also causes some delay in flowering and decrease in spike length. Moreover, the efficacy of ethrel may vary in different cultivars and should be thoroughly tested before use.

Multiplication of gladiolus through corms is, however, a slow process and sometimes leading to high incidence of diseases in the daughter corms. It is cautioned that after few years of cultivation, the corms lose their vigour as a result of which the quality of the spike as well as daughter corm deteriorates considerably. The use of the same corm for more than plantings is not recommended.

2.5.2 Cormels: Multiplication of gladiolus through cormels is an inexpensive and rapid method. The cormels also escape diseases or viruses even if the parent corm is infested. Therefore, corms produced through cormels are usually healthier than those raised from the corms.

The number of cormel is produced by a corm varies with the cultivar and planting time. The cultivars producing 10 or less cormels are poor multipliers, whereas those producing >10-25, >25-50 and >50 cormels/corm can be categorised as moderate, fast and very fast multipliers. Production of cormels can be improved by shallow planting of corms, removing of flowering spike at an early stage, proper nutrition and improved cultural
practices. The off-type plants should be uprooted from the field along with corms and cormels.

In sandy soils, cormels can be grown in flat beds, whereas in heavy soils with poor drainage, planting should be preferred on raised beds. If possible, growing of cormels on heavy soils should be avoided. Cormels are planted closely (3-5cm apart) in rows or ridges about 15-20cm apart and 2.5-3.5cm deep. Cormels should be planted early in the season which results in bigger-sized corms. Best time of planting cormels in north Indian plains is early to mid-September. In hilly areas (temperate region), the cormels should be planted in early spring. Before planting, the cormels should be soaked in water (15\(^{0}\)-20\(^{0}\)C temperature) for at least 24hr to facilitate their uniform germination. The diseased cormels normally float on water and hence, should be discarded. 'Soak and Sun Method' is better in which soaking of cormels in large cloth bags overnight is done in tepid water. After soaking the bags are kept in sun and turned once or twice a day so that all sides are exposed to the sun. The process is repeated for a week when the cormels start germinating. The large cormels show higher germination than the smaller ones. Cormels can also grow faster by pre-soaking in an aqueous solution of gibberellic acid (100ppm for 24hr). The response, however, varies with the cultivar. Cormels maturing under cooler climates show better growth than those maturing under warmer climates. The moist condition of soil facilitates the germination of cormels and also prevent the desiccation of tender plants produced by the cormels. Therefore soil should be kept moist by repeated light irrigations. Waterlogged conditions are, however, harmful.

2.5.3 Seeds

This method is not used commercially but practiced only by the breeders to create new varieties. Mature seeds are collected and after a few days when they are completely dry, the seeds are extracted and stored in desiccators till the next season. The seeds of gladiolus do
not possess any dormancy unlike corms and cormels and can be made to germinate immediately under favourable environment. Before sowing the wings of the seeds should be removed as it improves their germination. The wings can be removed by simply rubbing the seeds between the hands or against any rough surface. Only bold and healthy seeds should be selected for sowing. The seeds can be sown on flat or raised beds very closely (3-5cm) apart in rows about 15cm apart and covered with about 2-3cm thick layer of leaf mold. The beds should be frequently irrigated to keep them moist as moist conditions facilitate seed germination.

Seeds normally take 15-20 days to germinate. A single seed on germination produces single leaf and a small cormel at its base. The cormels thus, produced, are harvested at maturity—when the leaves on the plant start turning yellow. It normally takes 3 years to produce flower grade corms from the seeds.

2.5.4 Tissue culture

This technique is especially useful for multiplying new cultivars; producing disease-free cormels and maintaining germ-plasm of the elite cultivars.

Various parts—axillary buds on corms or spike axes, or stem or floral buds—have successfully been used as explants for in vitro cormel production. The axillary buds on the corms or the spike axes are better because they can be made to form shoot buds directly without any intervening callus formation. The explants are washed with tap water containing detergent teepol (0.1%) and then in running tap water for 10-15 minutes. After this these should be surface-sterilized with sodium hypochlorite (2.5% free chlorine) or mercuric chloride (0.1 %) for 2 minutes.

The sterilized explants are cultured onto autoclaved MS medium containing sucrose (30g/litre), myo-inositol (100mg/litre) and benzylaminopurine (BAP, 5mg/litre) gelled with
agar (7g/litre). The cultures should be maintained at 20°-25°C temperatures and 16hr light (about 3,000 lux intensity) and 8hr dark conditions.

The shoot bud cultures thus established should be sub-cultured on MS medium containing BAP (5mg/litre). Different cultivars of gladiolus may require different levels of hormones in culture medium for the maximum proliferation of shoot buds. Therefore, optimum medium composition for shoot morphogenesis in different cultivars may be required to be worked out.

The shoot buds are made to elongate on BAP-free MS medium. The bud clumps, each containing about 10 buds should be cultured on this medium. These buds start elongating in 7-10 days and attain the length of about 4-6cm in 4 weeks time.

When in-vitro raised shoots attain length of 4-6cm, half strength MS medium containing elevated level of sucrose (6%) and IBA, 2-4mg/litre) should be poured in the culture vessels. The IBA induces profuse root formation at the bases of the shoots, whereas high level of sucrose favours cormel formation. After 10-12 weeks of addition of half strength MS medium containing IBA and sucrose, the shoots start drying and the cormels turn brown. The cormels which are mature by that time should be collected from the culture vessels. These cormels show dormancy and should, therefore, be stored at low temperatures (3°-4 °C) for about 2-3 months before planting. These cormels develop into flower grade corms in 2-3 years.

2.5.5 Corm dormancy

Corm/cormels of gladiolus undergo a period of dormancy or rest during which they do not sprout. Dormancy is more pronounced in cormels and corms produced under warmer climates than those produced under cooler climates. On the other hand they possess very little or even no dormant period. The dormancy of corms/ cormel can be broken by storing them
under low temperature (40-5°C) for 3-4 months. The period of dormancy differs in different cultivars.

Physiological basis of corm or cormel dormancy has been ascribed to the accumulation of growth inhibitory substances, especially abscisic acid (ABA) in tissue as well as the scales encapsulating them. Dormant cormels contain as much as 5-10 times ABA than the non-dormant ones. The dormant corms can also be made to sprout by treating them with growth-regulatory substances like ethylene chlorohydrin, ethrel (1000ppm) and gibberellic acid (100-500ppm). Descaling also stimulates germination of dormant cormels. But since this operation cannot be carried out for a large number of cormels, it is of limited interest.

2.6 CULTIVATION

2.6.1 Land preparation

Sterilize the soil by covering with a black polythene sheet during May-June. This kills all harmful fungi ill the soil. Twenty tonnes of well-rotten farmyard manure should be mixed at least one month before planting corms; 40kg P 2°5 (250kg single super-phosphate) and 40kg ~0(66kg muriate of potash)/acre should also be added.

2.6.2 Planting

Well rested corms measuring more than 5cm are used. This stage can be easily identified by the presence of rootlets at the basal disc. The corms after taking out from cold storage are kept under shade. They are descaled and treated with 0.2% Bavistin for 30 minutes. Corms raised through cormels produce better spikes than those raised through corms.
Gladiolus is generally planted in flat beds 30cm x 20cm apart and 7cm deep. Thus about 60,000 corms can be accommodated in an acre (1,50,000/ha). The distance between row-to-row or plant-to-plant can be increased or decreased. Higher plant population-80,000 or 1,00,000 corms/acre--can also be accommodated. If there is a danger of water logging even for a few days, planting should be done on ridges made 30cm apart. Every year field should be changed. After 3-4 years, the same field may be used again.

2.6.3 Manuring and fertilization

Corms of gladiolus are rich in stored food which is sufficient to sustain plant growth for initial few weeks. The cormels specially require fairly good amount of fertilizers because they contain limited amounts of stored food on account of being small in size. Soils should have all essential nutrients in sufficient amounts support good growth of gladiolus particularly at later crop growth stages. The nutrient application should preferably be based on soil tests.

Gladiolus requires both macro as well as micronutrients for good growth a flower production. The deficiency of these nutrients in the soil is generally expressed in the form of certain disorders on the plant. The deficiency problem particularly severe in light sandy soils which can be corrected by the additional supply of the particular nutrient to the plant. It has been observed that N, P, K and iron nutrients have been found a limiting factor for successful growing of gladiolus.

2.6.4 Inter-culture

Weeding and hoeing are important intercultural operations in gladiolus. Since manual labour is involved to carry out operations, its cost of cultivation increases considerably. Weeds should be removed whenever they appear. Otherwise weeds compete with the main
crop for nutrition and moisture. Weeding 4-5 times required 1:0 raise a crop successfully. The application of 2.5 litres Basalin/ha as pre-planting treatment keeps field considerably clear for 70 days without any harmful effect on corm and cormel production. Earthing-up twice should be done at 3 and 6 leaf stage which coincides with N application. This results in ridge formation if planting is done on flat land.

2.6.5 Irrigation

Irrigation schedule for gladiolus depends upon weather conditions, soil type and rainfall. Normally in sandy loam soils, it should be irrigated at 7-10 days interval.

2.6.6 Physiological Disorder

Gladiolus is an indicator plant for fluoride pollution because it expresses the effects of fluorine at very low-level part/billion. The symptoms of leaf scorching appear drying of tip of leaves and drying descends downwards with the increase in its accumulation. Further the tissues are dead. During humid conditions, saprophytic, fungi appear. The fluoride present in atmosphere is absorbed and accumulated in the tips of leaves. Fluoride toxicity is also associated with heavy application of sulperphosphate. Rock phosphate contains hydrogen fluoride and is a source of fluoride in superphosphate. Different varieties show varying level of fluoride toxicity. Most sensitive varieties are Snow Princess, Trader Horn, Melody and Jacksonville Gold. No harmful effects have been recorded due to fluoride toxicity on flower, corm and cormel production. However, its injury can be reduced by spraying of 5% lime or magnesium sulphate.

2.7 HARVESTING AND POSTHARVEST MANAGEMENT

Normally single vegetative bud sprouts per corm, which inhibits the sprouting other buds resulting in single spike formation on a corm. However, in many cases more than one
buds sprout and depending on number of bud sprouts, number spikes are produced. Thus the yield of spikes increases than the number of corms planted. It has been observed that about 10-15% more spikes are produced than actual corms planted. The yield of spikes also depends upon the density at which planting has been done. Thus 70,000-75,000 spikes are harvested when planting is done as a density of 60,000 corms/acre.

Spikes of gladiolus have better vase-life and can be transported for long distances when properly packed. The stage of harvesting of spikes depends upon the distance to be travelled. For distant market, spikes are harvested when basal floret of the spike shows colour, whereas for local market spikes are harvested when basal floret is fully opened.

For enhancing the vase-life of spikes, pulsing with 20% sucrose and 200pp hydroxyquinoline citrate for 24hr is good. Cut spikes can be successfully stored for 2 weeks at 1°-2°C.

Cut flowers are packed cardboard boxes. Generally cardboard boxes of 100cm 25cm x 10cm size are used. Since these boxes are costly, other old suitable boxes like tube light boxes of other industries can also be used.

Corms and cormels are ready for lifting from the ground 6-8 weeks after harvesting of spikes. Irrigation is withheld at least 2-3 weeks before lifting the corm. Corms show the sign of maturity when yellowing of leaves start. After lifting the corms from the ground, they are kept in shade along with the leaves for drying for a week. Leaves are removed, corms and cormels are cleaned. These cleaned corms and cormels are then dipped in 0.2% 'Bavistin' solution for 30 minutes. These are dried in shade for 2-3 weeks, packed in shallow wooden crates or gunny bags and kept in cold storage at 3°-4°C and 90% relative humidity till the next planting season.
Check Your Progress

Q.1 Write down the importance of Gladiolus crop.

Q.2 Write short notes on climate and soil requirement for Gladiolus crop.

Q.3 List down different Gladiolus crop.

Q.4 Explain propagation methods of Gladiolus crop.

Q.5 Elaborate cultivation practices of Gladiolus crop.

Q.6 What affect the growth of Gladiolus crop?

Q.7 Write down post harvest practices of Gladiolus crop.
Unit-3: CHRYSANTHEMUM

3.1 OBJECTIVES

3.2 INTRODUCTION

3.3 CLIMATE AND SOIL

3.4 VARIETIES

3.5 PROPAGATION
   3.5.1 SEEDS
   3.5.2 SUCKERS
   3.5.3 CUTTINGS

3.6 CULTIVATION
   3.6.1. TRAINING
   3.6.2 SEN RIN TSUKURI
   3.6.3 BUSH FORM
   3.6.4 POT-MUMS
   3.6.5 CASCADE FORM
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3.7 AFTERCARE
   3.7.1 STAKING
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   3.7.3 DE-SUCKERING
   3.7.4 DISBUDDING AND DIS-SHOOTING

3.8 IRRIGATION

3.9 HARVESTING AND POSTHARVEST MANAGEMENT

3.1 OBJECTIVES

After the completion of the chapter students will be able to

1. Understand importance of Chrysanthemum cultivation.
2. Identify different varieties of Chrysanthemum.
4. Perform different cultivation practices of Chrysanthemum.

3.2 INTRODUCTION

CHRYSANTHEMUM (Chrysanthemum species) has earned tremendous popularity as an ornamental flower. Its present-day colourful varieties have risen through indiscriminate inter varietal hybridization, spontaneous and induced mutations and selection. Two kinds of florets are present in a bloom. The mall florets which are present at the centre of the bloom are called disc florets. The outer broad florets are called ray florets. In some cases the disc is visible and well-developed, whereas in others it is covered with florets. Ray florets may have different directions of growth and be arranged on the receptacle in distinctive patterns.

Some of the florets may curve upwards and inwards. The chrysanthemum bloom type depends mainly upon the relative number of 2 kinds of florets, their shapes and directions of growth. They are mainly classified as large-flowered and all flowered. Its commercial cultivation is being done in Maharashtra, Rajasthan, Madhya Pradesh and Bihar. Its cultivation in Delhi, Kolkata, Lucknow, Kanpur and Allahabad is, however, mainly for the sake of decoration of surround and participating in flower shows, with the help of pot grown plants.

3.3 CLIMATE AND SOIL

A well-drained, sandy loam soil of good texture and aeration, with a neutral or slightly acidic pH (6.5-7.0) and a high organic content is ideal for Chrysanthemum. Very light sandy soils are not recommended owing to their poor moisture, binding properties.

3.4 VARIETIES

Chrysanthemum varieties have been categorized depending upon the pure for which they are used. A cultivar suitable for pot-culture may not be fit for growing as cut flower. Similarly, a cultivar may be suitable for cut flower purpose into for garland making.
Garland purpose:
Baggi, Basanti, Shanti, Indira, Rakhi, Red Gold, Birbal Sahani, vaatika, Sharad Mala, Meera and Jaya.

Cut spray
Apsara, Birbal Sahani, Jayanti, Jubilee, Kundan, Purnima, Nanako, Riot, Arctic and Charlia.

3.5 PROPAGATION

Chrysanthemum is propagated by seed, cuttings and suckers. To get true type, it is mostly propagated by cuttings and suckers. All varieties do not set seed. Only a few varieties set seed in large-flowered chrysanthemums, whereas more varieties set seed in small-flowered ones.

3.5.1 Seeds

Small-flowered varieties are grown from seeds; suckers and cuttings due to its polyploidy and heterozygous nature, a wide range of variations are observed from seedlings. Garden chrysanthemums do not reproduce true-to-type from seeds. Seeds are collected during last week of December or first week of January when blooms are dried. The seeds are sown after 15 February either in earthen pots or nursery beds. The seeds are covered with a thin layer of leaf-could and soil and watered. They germinate within 7-10 days. Seedlings are read~ for transplanting, within 40 days. Seedling propagation method is not used normally for routine, cultivation. Due to wide range of variability, sometimes superior varieties are selected from seedlings.

3.5.2 Suckers

Rooted suckers are planted in field during January for stock plants. Regular pinching is performed in these plants for vigorous and profuse branching. Some of these stock plants
are used for potted plants for flower show and other display. The first pinching is performed in April, second in May and third in June. After third pinching, cuttings are taken from these mother plants otherwise, pinching continued in other lot of stock plants. Fourth pinching is performed during August and the final pinching of stock plants is completed by mid-September.

3.5.3 Cuttings

Terminal cuttings of stock plants are taken in June. They are transplanted after rooting in 15cm (6”) pots during June-end. These plants are ready for pinching during July-end or beginning of September. When a plant attains 8-10 leaf stage first pinching is done by removing the terminal portion (with 2-3 leaves). Lateral shoots develop from below the cut.

3.6 CULTIVATION

In fields, chrysanthemum is grown both in pots and beds. The potted chrysanthemums are mostly used for decorating gardens, houses and for displaying in flower shows. Large-scale field cultivation is done for cut flowers to be used for various purposes like garland-and-veni making. Small-flowered double, Korean types are mostly grown in field. Yellow and white varieties are usually preferred for cut flowers. The field is ploughed twice before planting. After ploughing 35-50 tonnes farmyard manure/ha is applied at the time of preparation of beds.

Rooted suckers are normally planted at 30cm (12”) distance. Otherwise a distance of about 20cm x 20cm is recommended for early blooming varieties, 25cm x 5cm for mid-season varieties and 30cm x 30cm for late blooming varieties. A dose of 62.5kg N and 100 kg each of P 2O5 and K2O/ha is applied. Some growers apply urea @ 75kg/ha at colour-showing stage.
In pots, large-flowered chrysanthemums are grown in different ways. These are grown as standards having 1-3 blooms/plant, bushes having 8-12 or 2 blooms or as Sen Rin Tsukuri styles. Suckers of large-flowered chrysanthemums are planted in January. If not trained as per desire, suckers grow vertically till terminal, break bud is formed. The growth is checked and lateral shoots develop. Auxiliary shoots produce terminal buds which are also called crown buds. These buds do not bloom. Secondary shoots develop and also crown buds at each tips. In September, bunches of flowers develop at terminal shoots. The plant gives a bush shape appearance with numerous branches bearing terminal flower buds. Flowers are medium-sized.

For improvement of quality of plant shape and bloom, training is necessary or large-flowered chrysanthemums. They can be easily trained for various decorative and attractive forms—bush, pyramid, fan, cascade or any other desirable shape.

In India small-flowered varieties are mostly propagated by suckers (stolons) inch are developed from underground portion of the plant. Huge numbers of suckers are produced when the plant is cut back after the blooming is over. Suckers are mostly separated and planted during January-February. Transfer of soil-borne diseases through suckers and lack of uniformity in resultant plants are some of the disadvantages of this method.

At the time of planting of suckers, the lower mature stems with eyes are also used for propagation. The entire stem is planted in thali or it is cut longitudinally into 2 pieces and planted and covered with leaf-mould and soil. This method is normally used when the propagating mother plants are less in number. Another important method of propagation is through cuttings. The cuttings are mostly prepared during June/July. The advantage of this method is that the plants developed from cuttings are mostly uniform and the risk of disease transfer is less. Growth is comparatively slow than suckers, mortality rate is higher due to
rooting process. All the plants are encouraged to grow fast from the time of planting. Proper growth takes place from March to May.

3.6.1. Training

Chrysanthemum can be trained for various decorative and attractive forms: Standard: For better shape of the plants and attractive extra large flower, large-flowered chrysanthemums are trained as standards producing 1-3 blooms plant. For this, suckers are planted in January. All care is taken for proper development of the plant. The plants are transplanted several times in bigger pots and finally into 25cm pots in August. These plants bloom in November-December and are normally very tall and need care throughout the year. The lower portion of the plant looks bare as the older leaves drop. According to recent cultural methods for developing better standard, plants are developed from cuttings in July. It avoids unnecessary caring of plants for about 6 months.

3.6.2 Sen rin tsukuri: It is a Japanese style of chrysanthemum culture. It means growing thousand blooms'. In this, plant is designed to a geometric shape (6-10 concentric circles in stepped manner) and it is trained in such a way that about 200-300 blooms/plant are formed having an approximate height of 153-183cm and a diameter of 183-244mm. Varieties suitable for this should have vigorous growth habit in all directions; long internodes, profuse branching habit with flexible stems and strong stem joints; incurve or reflex type with medium-sized blooms, long pedicel and uniform blooming habit.

The suckers are planted in December in 15cm pots filled with compost made of leaf-mould: light clay: charcoal powder (10:2:1). Second potting is done into 20cm pots during February-end in a potting mixture of cow dung manure: leaf-mould: light clay + bone-meal (4:2:2 +1 tablespoonful). The pot is irrigated regularly at fortnightly interval. Two
tablespoonfuls of oil-cake are added on the top of each pot for vigorous growth. The first pinching is performed when the plant attains a height of 20-25cm. For more vigorous growth, plants are shifted to beds in March.

The beds are well-manured with rotten farmyard manure, bone-meal and oil-cake. The planting distance is kept 92cm. The main stem is made vertical with the help of a strong bamboo stake. The lateral shoot which come out after first pinching are made horizontal with the help of hooked wire inserted in the pot. Pinching is continued for profuse branching till June-end. The new branches are trained in desired direction. Liquid cow dung manure and oil-cake are added to accelerate the growth rate. Disbudding is done from October to maintain only one terminal bud. The plants are finally shifted into the container. The lifting of plants from bed to container is a very important operation. It should be performed with great care to maintain beauty of the plants. The plants should be lifted without damaging the ball. The final pot size may be 31cm. When the plants are well-established in pots after lifting, the plant is given the final shape. A structure is made by split bamboo around the plant. The shape of the structure may be given according to choice but the most popular shape is hemisphere or dome shaped. Then branches and individual buds are tied at definite places so as to give the plant a particular uniform shape. Before lifting of plants from bed and at the time of final tying of the branches, irrigation is stopped for 2-3 days so that the branches become soft and more flexible. Beauty, Maud Jefferies, John Weller, Evening Star, Shin Mei Getsu, Allahabad Reflex and Raja are suitable chrysanthemums.

3.6.3 Bush form: This is a specific cultural practice for small flowered chrysanthemums. The plant is given a bush appearance by specific pinching and training. The blooms are arranged compactly to give an effect of a floral carpet. Medium- sized cultivars having profuse branching habit are suitable for bush. Korean, anemone, button, charm, stellate, decorative
and quilled blooms are most suitable. First pinching is started in March when the plants attain about 20 cm heights. The first pinching should be soft pinching after which profuse branching takes place. These lateral primary branches are again soft pinched and the process continued till September. By pinching selectively and regularly, plants may be given a desired shape. The most important is use of soft pinching to outer or lower branches and hard pinching to central or higher branches. Normally, in this case disbudding is not practiced. For maintaining uniform spreading bamboo stakes are used around the periphery and are tied with a ring of wire or sutli.

3.6.4 Pot-mums: In normal practice, one cutting is planted in one pot. The plant grows tall and lower portion of stem looks naked. In recent times 5-7 cuttings are planted in one pot (20-25cm) during June/July. The healthy rooted cuttings are planted at equal distance around the periphery of the pot. Pots are kept in semi shade for about 7-10 days. Then optimum conditions are provided for proper vegetative growth of plants for 2 months till the initiation of flower bud. The compost mixture of clay, farmyard manure and leaf-mould in a 1:2:2 ratios are very good for proper growth of plants. Top dressing with neem cake about a month after potting is very useful. Liquid manuring with a fertilizer mixture during early-September is recommended for vigorous growth.

Pot-mums are grown as such without pinching or they may be pinched as per choice. In no-pinching pot-mums, the numbers of flowers are almost as many as the number of plants (5-7). The flowers are bigger in size. If larger number of flowers are desired the branching is encouraged by soft-pinching. The height of plants of Pot-mums is mostly uniform. Uniformity of height is maintained by selecting proper variety, right time of planting and pinching. Disbudding is adopted for better bloom size and good looks of the plant. This method has become very popular. It requires less time and it can be easily handled due to
small-sized pots and plants. The pots can be shifted easily anywhere for home decoration. The pots may be easily exposed to artificial lighting and shading. Therefore, supply of successive batches of pot-mums is possible for a long period during the year.

Varieties selected for pot-mums are Beatrice May, Kasturba Gandhi, General Petain, Otome Zakura, Pink Cloud, Pink Casket, Fish Tail, Jack Straw. Evening Star, Goldie and John Reid.

3.6.5 Cascade form: The plants trained in cascade form give the effect of a waterfall in blooming stage. This is also a Japanese art of chrysanthemum culture. The stem is made to bend down above the rim of the container. This training method gives an excellent look of the blooms. For beautiful cascades (small, medium and large-sized) selected varieties should have:

- Long internodes for large and short internodes for medium and small cascade
- Thick but flexible stem
- Profuse branching and prolific blooming habit

Anemone and Korean types are also suitable. The selected varieties are planted in the bed during March in a slanting position (60 degrees angle). A strong bamboo stake is also inserted in the soil at the same angle. Another critical stake may be tied with the slanting stake to prevent damage of the plant due to wind. Bamboo frames of desired shape and design are kept ready in June. The plants are dug out very carefully from bed with large balls in July and planted in a large pot at 45 degrees angle. The main stem and branches are tied to the frame at several places. The frame is bent gradually downward by applying pressure taking care that the main stem is not broken or cracked.

The operation should be done very carefully, slowly and step-by-step so that the plant acquires a horizontal shape by August-end. The bending process is continued for the next 2
months (September-October). Sometimes a weight is tied at the tip of the frame for gradual bending.

Pinching is most critical technique in formation of a cascade. It is started at the height of 15-25cm from the ground and continued till September. Both soft and hard pinching are performed. October is most crucial period when bud initiation starts. One should keep regular vigilance of plants and buds should be arranged systematically by bending and tying to cover the entire structure. Perfecta, Modella, Jaya, Aparajita, Mayur and Flirt are most-suited chrysanthemums for cascade form.

3.6.6 Coniform: Normally top of potted small flowered chrysanthemums is flattened in bush type. The shape of the plant may be made conical by special training: The varieties which produce profuse lateral branching from the base of main branch upward are most-suited for this. For giving a perfect coniform shape, staking and pinching are most important. A strong, vertical, bamboo stake is used from the very beginning to keep the main stem erect. The first pinching is performed during late March. The first lateral shoots from the top are removed. Second lateral shoots are allowed to grow upwards. Subsequently other lateral shoots which develop late are pinched selectively. The longer shoots are at the base and shorter ones at the upper level. Due to selective pinching, the base of the plant becomes broad and narrowing upward to give a coniform plant. The last pinching is most important step which is performed in four stages during September. The plant is divide into 4 regions, lower, middle, upper and tip. The branches at lower portion (one third height) are pinched first. The middle portion is pinched after 3-4 days interval. The upper (one-third height) portion is pinched after an interval of another 3-4 days. The top is pinched at the end after about 3 days. To support the branches additional bamboo stakes are used to maintain a perfect coniform plant.
3.6.7 Fan form: This is also a type of training form of small-flowered chrysanthemum. In final form, it looks like a hand fan. The varieties suitable for coniform are also suitably used for this form. A flat around and vertical frame is made of split bamboo. Two identical plants are planted close to each other in 10-pot. In between the plants, the bamboo structure is fixed. All the branches of both the plants are tied to the bamboo structure to give the plants a flat shape. The pinching starts during February-end or beginning of March and continues up to September. Pinching is performed selectively throughout the length of plant and both soft and hard pinching are performed. The hard pinching is done to the branches near main stem and soft pinching to those branches which are away from the main shoot. The new emerging branches are tied simultaneously to the frame for appropriate and desired shape. The last pinching is very important like coniform and it is performed in 4 stages for, simultaneous blooming. The central portion of the plant is made first by hard pinching. The area surrounding the central portion is pinched after 3-4 days. The peripheral area is pinched after another 3-4 days. The pinching date should be calculated in such a way that the last pinching is performed by mid-September.

3.6.8 Manuring and fertilization

The compost used in pots should be rich in nutrients. Soil, farm yard manure and leaf-mould in a 1:2:2 ratio are very good. A small amount of bone-meal super-phosphate (2 tablespoonfuls) is also added sometimes with this compost.

Proper vegetative growth of plants at the early stage is most important. The growth period continues till September. Feeding mixture should be applied regularly. It should be rich in N and K content. Chrysanthemum requires a high level N and K during vegetative growth. The P is used as a basal dressing. If a correct compost mixture is used, extra feeding
can be avoided. Compost with a mixture of soil: farmyard manure: leaf-mould (1:2:2) is recommended for potting small-flow-red chrysanthemums at the onset of rains.

At the early stage, small amount of oil-cake is added over the soil in the pot and it is allowed to dissolve slowly by normal irrigation process. When the root system is well-established (August), application of liquid manure is advised. Fresh cow dung and oil-cake are allowed to rot in a container consisting of water. This decanted solution is applied to plants once a week as watering.

Fertilizer solution is also recommended as liquid manure. During September, liquid manure (5g potassium nitrate and 5g ammonium nitrate dissolved in 10 litres of water) is applied twice at fortnightly intervals. The top portion (about 2cm) of each pot is filled during September-end by a compost mixture and of neem-cake, farmyard manure, soil by wood ash in a 1:4:8:4 ratio.

At the time of flower-bud initiation, 2 doses (at fortnightly intervals) of liquid manure (potassium nitrate 5g + ammonium nitrate 5g dissolved in 10 litres of it water) are applied. Immediately after 2 doses (once a week), another liquid fertilizer mixture (potassium nitrate 30g and urea 5g dissolved in 10 litres of water) are applied.

### 3.7 AFTER CARE

#### 3.7.1 Staking:
Staking is necessary to keep plants erect and maintain proper shape of plants and bloom. But all chrysanthemums do not require staking, especially, Bome compact cultivars. Stakes are prepared mostly from bamboos. Staking of plants is required for vertical support of the plants. Number of stakes to be used: "for a plant depends upon the grower. Only one stake is used when a grower needs single bloom/plant. If a grower needs 3 blooms/plant, he requires 3 stakes. In small-flowered, for profuse blooming 5-8 stakes are used. The stakes are inserted in the pot slightly slanting outward so as to provide sufficient
space for flower development at the top. When the bloom starts showing colour the surplus length of the stake is uniformly cut below the level of bud for uniform growth of bloom.

3.7.2 Pinching: If chrysanthemums are left on their own for growth after planting, the growth is mostly upward with very little branching. This gives the plant an appreciable shape with few flowers. To arrest such tall growth, pinching is done. It is done with thumb and forefinger, although knives and scissors can also be used. It is also called stopping. Only soft vegetative shoot tips half to one inch long are removed. Pinching refers to the removal of the growing tips of the plant to induce the growth of vegetative laterals. It is most essential for small-flowered chrysanthemums. Pinching is performed both in suckers and in cuttings.

3.7.3 De-suckering: During the vegetative growth phase, plants grow upwards. New suckers continue to develop from base of plants. For proper and vigorous growth of plants, suckers are removed from time-to-time.

3.7.4 Disbudding and dis-shooting: These operations are mostly performed for large-flowered and decorative chrysanthemums. Disbudding varies according to the type of chrysanthemum grown. Many of the varieties are disbudded or standard types, in which the largest terminal bud is reserved and all axillary buds are removed. Disbudding of spray varieties is very easy because in this case only the large apical bud is removed and the axillary buds are allowed to develop. There is no specific rule for disbudding of spray varieties, it varies with the type of spray produced. If growers want to develop 3 blooms/plant or one bloom/plant these operations are most essential. Disbudding operation is an important factor in the maintenance of high quality product.
For taking 3 blooms/plant (June planted cuttings), the first pinching is done in August. Three lateral strong shoots are allowed to grow and others are removed. Disbudding starts in October when all but the central buds on each lateral shoot are removed. Lateral buds and side shoots are removed at their early stage of growth from time-to-time.

For taking one bloom/plant (June/July planted cuttings) no pinching is done. Only the main stem is allowed to grow. Disbudding and ills-shooting of undesirable lateral buds and shoots are done as in the above mentioned case of 3-bloom type.

### 3.8 Irrigation

Chrysanthemums require frequent and thorough watering before monsoon. It is advisable not to irrigate pots after the sun gets hot. Open drainage system should be maintained in beds and pots as these plants are very sensitive to excessive water. There should not be water logging in beds and pots during the rainy season. The excess water at the top of the pot should be tilted out. If the water accumulation is due to clogging of drainage hole and faulty potting mixture, checking of drainage hole and changing of old potting mixture by new potting mixture is recommended. Excess water accumulation causes serious damage to the plant roots. The leaves become yellow and plants become sick. If proper care is not taken, there is considerable casualty during rainy season.

### 3.9 Harvesting and Postharvest Management

Chrysanthemums are mostly sold in market as potted plants, cut flowers and loose flowers. There is no specific period of harvesting. There are various types of varieties early blooming normal period blooming and late blooming. Therefore, they are harvested according to their blooming period. Different types of packing materials-newspaper craft paper corrugated paper and tissue paper-have been recommended for increasing the keeping
quality of cut blooms. For increasing the vase-life of cut flowers, preservative solution containing sucrose (1.5%) and 8-HQC (200ppm) is recommended.

Check Your Progress

Q.1 Write down the importance of Chrysanthemum crop.
Q.2 Write short notes on climate and soil requirement for Chrysanthemum crop.
Q.3 List down different Chrysanthemum crop.
Q.4 Explain propagation methods of Chrysanthemum crop.
Q.5 Elaborate cultivation practices of Chrysanthemum crop.
Q.6 What affect the growth of Chrysanthemum crop?
Q.7 Write down post harvest practices of Chrysanthemum crop.
Unit-4: ROSE

4.1 OBJECTIVES
After the completion of the chapter students will be able to

1. Understand importance of Rose cultivation.
2. Identify different varieties of Rose.
3. Understand propagation methods of Rose Cultivation.
4. Perform different cultivation practices of Rose.

4.2 INTRODUCTION

ROSE (Rosa Species) is the most ancient and popular flower grown the world over. It is a versatile plant adapted to varying climatic conditions. In India it is cultivated commercially for cut flowers, both for traditional flower market, and contemporary florist shops. Rose flowers without stem and loose flower petals are, used in traditional markets for
making garlands, for offering in temples, while the florist shops sell cut roses with stems mainly for bouquets and floral arrangements. In recent times, about 60 units have been established under joint ventures around Bangalore, Pune, Nasik, Mumbai, Hyderabad, Gurgaon (Haryana), Chandigarh and Saharanpur (Uttar Pradesh) for growing roses in greenhouses for export of flowers to Japan, Holland, Germany and other European countries. Besides, the, Damask rose (R. damascena) and Edouard rose (R. bourboniana) are cultivated for rose attar and other products, gulkand, gulabjal and pankhurj. The rose is grown in about 6,000 ha area. Karnataka, Tamil Nadu, Maharashtra, Bihar, West Bengal, Uttar Pradesh, Gujarat, Haryana, Punjab, Jammu and Kashmir, Madhya Pradesh and Andhra Pradesh are major rose-growing states.

4.3 CLIMATE AND SOIL

The cultural practice described here are only for growing roses in the open. Recently several Units have been established for growing roses in greenhouses under Joint ventures or on foreign consultancy. However, the agro-technology adopted in greenhouse is quite variable.

Roses are grown in cold climate of the hills as well as in the plains of northern and southern regions. Some of the best quality roses can be produced in the open in the cool season of northern plains like Chandigarh, Ambala, Patiala, Jaipur, Ajmer, Udaipur, Delhi, Meerut, Lucknow, Saharanpur, Dehradun. In eastern India, roses do well around Ranchi, Patna, Jamshedpur, Calcutta, 24 Parganas, Nagpur, Pune, Nasik, Indore, Bhopal and Gwalior. In south, Bangalore, Hyderabad which have a mild climate, roses grow quite well and flower over a longer period.
Well-drained, medium loam soil having a pH of 6.0”-7.5 is ideal for rose growing. Heavy clay soil is hot suitable for roses. There should be soft muram below 45-60m layer of soil for good plant growth. The plants do not thrive in saline sodic soils.

4.4 VARIETIES

Modern roses grown in gardens are Hybrid Teas, Floribunda (also Grandiflora), Polyantha, Climbers and Ramblers, Miniatures and Shrub roses. However, in the cut flower trade, the rose varieties are classified as large flowered, small flowered and spray types. There are 20,000 or more rose cultivars in the world. About 250-300 new varieties are added every year.

4.5 PROPAGATION

Hybrid Tea and Floribunda roses are generally propagated by budding, whereas climbers, ramblers, polyanthas and miniatures can be multiplied by stem cuttings. In West Bengal, inarching is also practised to multiply roses. The commonly used rootstock for budding is Edouard rose (R. bourboniana) in northern plains and R. multiflora in coastal areas, West Bengal, Bihar, Karnataka, Maharashtra, Andhra Pradesh, Tamil Nadu and sub-mountainers regions of Dehra Dun and Nainital (Uttarakhand); Another rootstock Rosa indica var. odorata has now become quite popular in northern plains. It is tolerant to powdery mildew and high soil pH. A few other rootstocks Dr Huey, R, canina, R. laxa, R. manetti, R. rugosa, R. fortuniana and Thornless are not better than the commonly used rootstocks. The rootstocks used in India are propagated by stem cuttings.

December-February is ideal time for budding (T-budding) in northern plains; October-November and January-March in the eastern region; February-April (or any other time) in Banplore and Pune, and February-March/April in the hills.
4.6 CULTIVATION

4.6.1 Planting

Roses require full sunlight or light at least for 6 hours preferably in the fore noon, if not during the whole day. Protection from strong winds is also necessary. The rose beds in the garden should be away from trees or hedges and well drained as the plants do not thrive in a wet or waterlogged soil.

The beds should be dug deep during summer and the open soil kept exposed to sun. It helps kill weeds, insects and other organisms present in the soil. About 2 tonnes of farmyard manure or cowdung manure along with 2kg superphosphate and 1kg BHC (5%) dust may be incorporated into the soil and bed levelled followed by watering/irrigation. The bed must be properly levelled and there should be no water logging in beds.

Generally, rose beds are rectangular but these may be oval, circular or of irregular shapes depending upon garden design. It is always better to plant roses in beds than growing these individually. If there is more than one bed in the garden, it is better to plant only one variety in a bed. If it is not possible, more than one variety may be grown in a bed, preferably of the same flower colour. The Hybrid Teas and Floribundas may be planted in separate beds as far as possible. While grouping the varieties in a bed, tall varieties should be put in the back row while dwarf ones in the front and those having intermediate plant height in the middle row. It is necessary to have harmonious and pleasing colour combinations if varieties have different flower colours.

The rose should be planted in pits of 60cm diameter and 60-75cm depth dug at appropriate distances in a bed. The distance of planting varies according to the type of rose. The Hybrid Teas and Floribundas are planted 75cm apart. A closer planting distance of 30cm x 60cm is ideal for obtaining cut flowers. Miniatures and polyanthas can be planted at a closer distance of 30cm and 45cm apart respectively. The standard roses are planted 1-1.5m apart
while the distance for climbers may be 2-2.5m. About 7-10 days before planting, 8-10kg of cow dung manure/farmyard manure/compost and bone-meal or superphosphate (225g) may be added to the soil in each pit; If the soil is heavy (clay), mix coarse sand in it to make it more porous. While planting the budded plants, the bud union is kept slightly above the ground level.

In northern plains; mid October is good time for planting. But it can be planted up to February. However, later planted bushes do not produce good flowers and the flowering is delayed. Roses may be planted from October to December and late-May to June in Karnataka and Maharashtra states. September-December or even up to February is ideal planting time in the eastern plains of Bihar and West Bengal. In northern hills, the planting may be taken up in October-November or March-April. As a general rule, planting should not be done in either very hot weather or during heavy rains.

4.6.2 Pruning

The rose bushes are pruned once a year during second or third week of October in the northern plains. After about 6-7 weeks of pruning, the plants start flowering. The time of flowering can be adjusted according to the date of pruning. The new or so-called "Maiden" plants are not pruned. These are generally tipped lightly before planting. In the 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. A slanting cut is made a little above an eye which is facing outwards. The Floribundas are pruned moderately. The climbing and rambling roses do not require any pruning, except the removal of unhealthy, dead and interlaced twigs. The Polyantha roses are pruned lightly, whereas the miniatures are generally not pruned. Hard pruning of Hybrid Tea and Floribunda, keeping only 3 or 4 shoots with 3 or 4 eyes from the base is practised for obtaining exhibition blooms. While in the northern plains, the pruning is done in October, it
is practised during late-October to early-November in West Bengal, November-end to early-December in Chennai, March-April in the hills, and twice a year during June and November in Bangalore and Pune. The pruning of Rosa *damascena* is generally done from December to mid-January for obtaining early flowering and higher flower yield.

### 4.6.3 Manuring and fertilization:

Rose being a perennial crop, it requires regular nutrient feeding through manures and fertilizers at the time of pruning, plant growth and at the end of flowering, besides during land preparation and planting of new bushes. The clay and sandy soils require more manures than the loam soil. The nutritional requirements of rose plants vary with the type and fertility of soil, cultivar and age, size and vigour of plant.

Farmyard manure, compost and cow dung manure are commonly used manures and are applied before planting new bushes and at the time of pruning. After pruning, the soil in the bed is dug up with a fork with due care to avoid any damage to the roots. About 8-10kg or 6-8kg of well rotten cow dung manure should be applied to each plant depending upon its age and size, and type of soil followed by copious watering of plants.

Oil cakes, preferably neem cake or castor cake @ 50g/plant or 15kg/100m² is applied at the end of the first flush of flowering. Poultry manure or sheep/goat droppings can be applied @ of one litre/plant. The oil cakes are quick acting organic manures, as their N becomes available to plants within a week of their incorporation in the soil. Farmyard manure or cow dung manure may be used if oil cake is not available.

Though it is not possible to follow any common fertilizer mixture in all regions, there are some fertilizer combinations suitable for many areas. A few fertilizer mixtures are commercially available in the market. However, fertilizer mixture having 1 part of urea, 3 parts of superphosphate and 2 parts of potassium sulphate is ideal. About 40g of this mixture
may be-applied as topdressing to each plant 3 times at 15 days intervals after pruning. The fertilizer mixture should not be stored for a long time. It is better to prepare it at the time of application. A topdressing of the fertilizer mixture may be given again in January-February after the end of the first flush of flowering in northern plains, similarly in other milder areas fertilizer application maybe practised after each flush of flowering.

Fertilizers can also be applied through foliar spraying. It is quite effective roses. About a month after pruning, foliar spraying may be taken up and repeated at 7-10 days intervals, It should stopped when the flower buds start opening. It must not be done in hot weather. A foliar spray of urea (1.25g) and Potassium di-hydrogen phosphate (1.25g) mixed in one litre of water is recommended for roses. To add a spreader like surf or any other detergent soap is obvious. Foliar application of urea alone (0.2-0.3%) in water is also useful. It can be applied mixed along with an insecticide like Malathion or Rogor.

Foliar application of micronutrients, eg. iron, magnesium and manganese corrects the deficiency of these elements. The spray solutions may be prepared by adding ferrous sulphate (2g) and slaked lime (1g) in one litre of water, magnesium sulphate (2-3g) in one litre of water and manganese sulphate (2g) and slaked lime (1g) in, one litre of water. These foliar solutions may be sprayed separately for correcting deficiencies of iron, magnesium and manganese. A mixture of manganese sulphate (15g), magnesium sulphate (20g), chelated iron (10g) and borax (5g) added to 25 litres of water (concentration 2g/litre) is also effective. The application of liquid fertilizers to rose plants growing in the open is not necessary if adequate quantities of appropriate fertilizers have been provided to them.

4.6.4 Irrigation

The frequency of irrigation depends upon the soil texture and climate watering is more frequent in sandy soils and hot weather than in clay soils and humid/ rainy or cool
season. During the rainy season in Eastern/southern or coastal areas it may not be necessary to irrigate the plants. The frequency of watering during summer may be about twice a week while in winter or cool season it may be only once a week or 10 days. The rose beds should receive well spread water but no water logging. Heavy watering at comparatively long intervals is more useful than frequent light watering. Drip irrigation is useful. Sprinkler irrigation should be avoided as it encourages infection of leaf diseases and often exposes the feeder roots of plants.

4.6.5 Weeding

Generally hand-weeding is practised. Monocot weeds can be effectively controlled with Glyphosate (1.0kg/ha) and dicot weeds with oxyfluorfen (0.5kg/ha) as pre-emergent treatment. A solution of Simazine (0.2%) and 2, 4D (0.5%) applied as pre-emergent spray is also useful.

4.6.6 Mulching

Rose beds may be mulched with straw, black polyethylene film, saw-dust and well rotten farmyard or cow dung manure. It helps conserve soil moisture, suppress weeds and produce more flowers of better quality.

4.6.7 Disbudding and pinching

The young vegetative bud in the leaf axils of basal and lateral shoots are disbudded to encourage branching at the base and to obtain long terminal shoots. For obtaining long stemmed quality blooms, it is necessary to do disbudding and pinching or removal of side flower buds. In Hybrid Teas often there is a terminal flower bud along with 2 smaller side
buds. It is, therefore, necessary to remove side buds so that the terminal flower bud produces quality bloom.

4.6.8 Suckers

The shoots or suckers of the rootstock emerging from the base of the plants should be removed as soon as they appear. They can be distinguished from those of the scion by the shape and size of their leaves.

4.7 HARVESTING AND POSTHARVEST MANAGEMENT

The rose flowers are cut while still in the bud stage after the sepals curl back and the colour is fully showing. In large-flowered roses, flowers along with the stem of prescribed length are cut when the first one or two petals start to unfold but do not open fully. The flowers in small-flowered clustered varieties are cut when these begin to open in the cluster.

In foreign market, the size of stem varies from 60-90 cm for large flowered red roses and 40-50cm or small-flowered ones depending upon the grade. The size of large-flowered bud is 3-3.5cm and 2-2.5cm for the small-flowered.

The flowers are harvested in early morning or late in the afternoon. The cut roses are kept in plastic buckets/containers filled with clean water having disinfectant and preservative (silver thio-sulphate) to enhance their shelf-life. These flowers are shifted to pre-cooling chambers having a temperature of 10°C, and kept there for about 12hr. The grading is done on the grading tables which have graduations marked on them, Automatic grading tables are also available. The flowers are graded for their stem length, quality and variety. The defective, damaged or bruised flowers are rejected.

The graded flowers are bunched with 10 or 20 stems in each bunch and sleeved with thick paper or plastic film, These flowers are then packed in telescopic corrugated cardboard
boxes of specified dimensions. The box size maybe 105cm x 45cm x 20cm for containing 200-300 stems, each of 40-50cm length and 135cm x 35 cm, x 20cm for 200-300 stems, each of 60cm-90cm length. The flower boxes are kept in cold storage at 2°-4°C temperature for 12-24hr. Nowadays the cut flower boxes are pre-cooled through vacuum cooling at 2°-4°C in much shorter time of about half an hour. The flower boxes are then transported to airport in refrigerated trucks, Efficient logistics management after flower production is important for export consignment which may include detailed planning of transportation by road and aircraft, maintaining effective cold chain, quarantine, customs and airline formalities and minimum time lapse in loading the flower boxes in the aircraft for direct flight.

Check Your Progress

Q.1 Write down the importance of Rose crop.
Q.2 Write short notes on climate and soil requirement for Rose crop.
Q.3 List down different Rose crop.
Q.4 Explain propagation methods of Rose crop.
Q.5 Elaborate cultivation practices of Rose crop.
Q.6 What affect the growth of Rose crop?
Q.7 Write down post harvest practices of Rose crop.