

Unit

2



Nursery Management

INTRODUCTION

Nursery is a place where planting material, such as seedlings, saplings, cuttings, etc., are raised, propagated and multiplied under favourable conditions for transplanting in prepared beds. The availability of quality and true-to-type planting material is the prerequisite of successful and remunerative ornamental crop production. Setting up of a nursery is a long-term venture, and requires planning and expertise.

In a nursery, plants are nurtured by providing them with optimum growing conditions to ensure germination. Nursery saves considerable time for the raising of the next crop.

Among flower crops, majority of the annuals are propagated by seeds and require a nursery for raising the seedlings. Herbaceous perennials need nurseries for sowing of seeds and planting of cuttings for rooting and establishment. Woody perennials are grown from seeds for multiplying the rootstocks from cuttings, layers and through grafts to perpetuate the same genetic properties.



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SESSION 1: NURSERY AND ITS IMPORTANCE

Nursery

It is an area, in which new saplings are raised and nourished until they are ready for sale or transplanting at a permanent place in a field. Raising of seedlings in a nursery is important for various reasons.

Importance of nursery

- It is possible to grow and maintain a large number of plants per unit area.
- Small and expensive hybrid seeds can be raised more effectively due to better care and management.
- When seeds are sown in seedbeds, their germination percentage increases and the vigour of the seedlings also improves.
- The management of seedlings can be done in a better way with minimum care, cost and maintenance as the nursery area is small.
- Manipulation of growing conditions for plants becomes easy.
- Better and uniform crop growth can be obtained in the main field by selecting vigorous and healthy seedlings.
- Off-season sowing of seeds becomes possible, which ultimately results in fetching more returns.
- The seed requirement of nursery raised crops is less as compared to direct seed sowing of the same crop due to better management.
- Sowing seeds in a nursery allows additional time for doing preparatory tillage in the main plot. Harvesting of the previous crop can also be prolonged, if needed.
- Management of insect-pests, diseases and weeds is easy in a nursery.

Selection of the nursery site

Several factors are responsible for the selection of a suitable nursery site. Some important considerations are as follows:



Location

A nursery must be located in a pollution-free environment—away from brick kilns, smoke-emitting industries and rough motorised roads as dirt and dust settle on plants, covering the foliage, which not only reduces the photosynthetic efficiency of plants but also gives them a dull look. It must be ensured that the nursery site gets adequate sunlight. However, care must be taken that the plants are protected against severe heat.

Topography of land

The topography of land at the nursery site must be even. If it is undulating, it must be levelled. In hilly areas, it may be divided into levelled terraces.

Soil

The soil must preferably be loam or sandy loam with large quantity of organic matter. The pH of the soil must be near neutral (6.5–7.5). It must have adequate water retention capacity and aeration.

Water

The quality of water used in a nursery is important for the growth of plants. Saline and polluted water must not be used. It must be ensured that there is adequate water supply for irrigation. Besides, the nursery must be located near a water source so that there is no water scarcity at any time in the course of raising plants.

Drainage

The nursery site must have adequate drainage facility and be free from waterlogging. Water must not stagnate at any time.

Transportation

The nursery site must be accessible by road. It must not be far from potential markets so that there is no damage to the seedlings during transportation.

Labour

As nursery work is labour-intensive, the nursery site must have enough number of labourers.

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Protection from animals

The nursery area must be protected by enclosures so as to prevent damage to the plants by stray animals.

Market needs and size

Market plays an important role in the success of nursery business. Various type of inputs like seeds, fertilisers, pesticides, fungicides, plant growth regulators, poly bags, agricultural implements, different type of spare parts and other miscellaneous items required in the nursery must be available in the nearby market. The nursery must be located near the city or an area from where people can purchase the plants. Alternatively, a mechanism to explore domestic and international markets must also be worked out for the success of nursery business.

Types of nursery

Nurseries are classified on the basis of duration, plants produced and structures used.

On the basis of duration

Temporary nursery

This type of nursery is developed only to fulfil seasonal requirements or a targeted project. Such a nursery is, usually, small in size and is set up for a short period after which it is abandoned. Temporary nurseries are mostly used for raising seedlings of vegetables and flower crops. Such nurseries are found near the main planting area.

Features

- It is constructed for a short period and is small in size.
- Intensive manuring and fertilisation is not necessary in such a nursery as it is constructed at a site rich in humus.
- As it is located near a planting site, the distance between the nursery and the actual planting site is less.
- No major transportation is required, and if any, the cost is less.



- Special supervision is not required in the maintenance of such a nursery. However, security aspects must be taken care of.

Advantages

- Mortality or injury due to shock of lifting and transportation of seedlings is negligible due to less distance between the nursery and actual planting site.
- Initial investment in a temporary nursery is less as compared to a permanent one.

Disadvantage

Because of its temporary nature, basic facilities like irrigation may not be adequate. Therefore, special arrangements need to be made in order to keep the plants and seedlings in healthy condition.

Permanent nursery

In this type of a nursery, the plants are nourished and kept for a longer period of time till they are sold out or planted permanently in a field. The area covered under such a nursery is larger than a temporary nursery and it has all features that are required in a permanent nursery.

Some of the important cultural operations carried out in the permanent nursery throughout the year are as follows:

- It requires a large area and must be well connected by road.
- Such type of a nursery requires intensive management and supervision.
- High initial cost is involved in the establishment of such a nursery.
- Permanent nursery comprises office, store, mother blocks, nursery beds, protected structures, irrigation source, electricity, transportation facilities, packing yard, manure, cattle and machinery shed.

Advantages

- Greater range of planting stocks, such as seedlings, grafted plant, budded plants, layers, rooted cuttings, etc., are available.

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- Being permanent in nature, it becomes a perpetual source for the supply of planting material for many years.
- Being concentrated at one place, its supervision and management is better due to the availability permanent staff.
- The initial production cost is reasonable but profits go up in the long run.

Disadvantages

- The initial investment cost is high.
- The transportation cost is more.
- Such a nursery needs intensive labour management.
- It must be backed by a large market for the sale of plants and seedlings.
- It requires skilled human resource round the year.

On the basis of plants produced

Ornamental nursery

Seedlings, rootstock and scion material of ornamental plants are raised and conserved for further use in such a nursery. It includes mother blocks of ornamental plants, which are used in layering, as well as, producing scion material for budding and grafting. The raised and flat beds of the nursery are occupied by seedlings of various annuals, perennials and rootstocks of ornamentals. A separate block of the nursery consists of vegetative and reproductive phase of bulb and tuber crops. Cuttings of different climbers and creepers are also planted here for rooting. An ornamental nursery also houses many indoor and outdoor potted plants. The blocks of seedlings of cut and loose flowers, seasonal, bonsai, climbers and creepers are managed individually here.

Vegetable nursery

Planting material like seedlings of vegetables, rooted cuttings (asparagus and sweet potato), rhizomes (ginger), tubers (potato) and bulbs (onion and garlic) are raised and conserved in such a nursery.



Fruit plant nursery

In this nursery, seedlings and cuttings of rootstocks, budded plants, grafts, layers and cuttings of fruit trees, such as mango, lychee, *ber*, *bael*, guava, sapota, etc., are raised and conserved. This nursery has mother blocks of different fruit crops, which are used as scion material.

Forest nursery

Different species of trees and climbers planted in forests and used in 'social forestry', for example plantation along roads, gram panchayat land, gardens, etc., are mostly propagated by seeds. In short, social forestry refers to forests or plantations set up by communities and tribes. Rootstock of different forest plant species and mother plants are raised in a forest nursery. Seedlings of big trees like margosa, gulmohar, *amaltas*, *kanchan*, tamarind, *amla* (gooseberry), oak, eucalyptus, etc., are commonly found in a forest nursery.

On the basis of structure used*Open field nursery*

Such a nursery is established in open areas without any permanent structure. Usually, raised, flat or sunken seedbeds are prepared. These are vulnerable to natural environmental conditions.

Hi-tech nursery

Such a nursery is established under protected structures. The protected structures in which the nursery can be successfully raised are as follows.

Thatched roof: In this type of nursery, a thatched roof is constructed over the nursery beds, which protects the seedlings from damage caused by extreme wind, rain, heat, etc.

Shade-net: Such a nursery is raised under shade-net houses. To give different amount of shade to plants based on their requirements, shade-nets of different colours and mesh sizes are used as covering material.

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Poly-tunnel: The nursery is covered with a plastic film or sheet to form a tunnel. It is miniature structure, which produces greenhouse-like effect. Besides not being expensive, it is easy to construct and dismantle. The seedlings are protected from cold, wind, storm, rain and frost. Due to modified conditions, there is better germination and plant growth.

Greenhouse or poly-house: It is a framed structure covered by poly-film or shade-net so that the plants can grow under partially or completely modified environment. Such structures are ventilated and may have temperature and humidity controlling devices. The seedlings are raised inside the structure on raised beds or in plug-trays, and also for hardening of tissue cultural plants.

Nursery bed

It refers to a land, which is made free from weeds, stumps, stones, pebbles, etc., and is used for sowing of seeds to raise seedlings and multiplication of different species of plants through asexual means.

Preparation of the nursery bed

Nursery beds can be prepared in three different ways.

Sunken bed

- The soil of the seedbed needs to be sterilised by soil solarisation or with chemicals to avoid contamination by pests and diseases.
- The soil of the nursery bed is thoroughly mixed with rotten farmyard manure.
- This type of nursery bed is prepared in dry and windy areas.
- In dry areas, the bed is kept 10–15 cm below the ground level, which helps in conserving water.
- Sunken bed facilitates the deposition of irrigation water or rainwater for a longer time.
- In case of water scarcity, this type of bed helps to conserve the moisture.



- Such a bed can be easily irrigated during dry season.
- A sunken bed provides protection to the seedlings during high wind conditions as they are covered.

Level bed

- The soil of the seedbed must be sterilised by soil solarisation or with chemicals to avoid contamination by pests and diseases.
- After soil preparation, the recommended dose of manure and fertilisers is mixed in the nursery bed.
- For efficient management, the whole area is divided into uniform size of small beds.
- Usually, a flat bed is 1-metre wide and has length according to the slope of the field.
- Irrigation channels are prepared between the rows of the beds through which each bed is connected. These also act as drainage channels in case of heavy rain or excess irrigation.
- Such a bed is prepared during non-rainy season (summer and winter) so that there is no waterlogging.
- Adequate drainage provision is made and preference for sandy or sandy loam soil is given when preparing a flat bed.

Raised bed

- Such a nursery bed is prepared during the rainy season.
- The land is levelled and made free of weeds, stumps, stones, pebbles, etc.
- The soil of the nursery bed is thoroughly mixed with 5–10 kg per sqm rotten farmyard manure.
- This type of bed is prepared about 15 cm high from the ground level. The width is kept at 1–1.5 m and length 3–5 m. This enables adequate drainage during rains and checks water stagnation.
- A space of 3–4 cm is left between two beds in order to carry out cultural practices smoothly.

NOTES

Precautions to be taken during the preparation of nursery bed

A nursery bed needs to be prepared carefully so that uniform and healthy seedlings are obtained for planting. The following precautions must be taken while preparing a nursery bed.

- The nursery bed is, generally, used to germinate sown seeds or for rooting of cuttings planted in the soil. Besides nutrition, sufficient moisture and aeration are important factors that affect seedling growth.
- The nursery bed must be prepared in fertile soil rich in organic matter content, having adequate drainage and aeration. Soil having more water retention capacity does not need frequent irrigation.
- Excess irrigation in sunken or flat bed may lead to rotting of seeds, seedlings and damping-off incidence. Watering of the bed depends on the type of soil. Sandy soil needs frequent watering.
- Soil-borne infections caused by nematodes, insect-pests and pathogens may be avoided by treating the soil in different feasible ways.
- Generally, the width of the nursery bed must not be more than 1 metre and the length must be according to the slope of the soil, so that when irrigated, the water reaches every corner of the bed and the whole bed gets irrigated.
- Since the seedlings are tender and prone to heat shock, the beds must be prepared at a site receiving partial shade. In tropical and subtropical India, direct sunlight facing site must be avoided.

Soil treatment

Soil or any planting medium used in the nursery may be contaminated by various pests. The presence of pests in the medium causes huge losses to the crop in the nursery, and the infection caused by the pests may be carried to the field through seedlings or adhering medium on the roots. It is, therefore, advocated that the medium used for the nursery must be free from infections. The different methods adopted for soil treatment are as follows.



Soil solarisation

It is an environment-friendly method to control soil-borne plant pathogens, including bacteria, fungi, nematodes, insect-pests and weeds. Solar energy increases the temperature of the soil, which helps control various soil-borne pathogens. The most appropriate time for soil solarisation is May–June when the temperature reaches 47 °C or above. This treatment causes physical, chemical and biological changes in the soil.

Procedure

- Dig soil at a site where seedbeds are to be prepared.
- Remove all weeds, stumps, stones, pebbles, etc., from the soil.
- Crush the clods and bring it to fine tilth.
- Level the plot for preparing seedbeds.
- Irrigate the site thoroughly and cover it with a black polythene film of 200 gauge for 5–6 weeks during summer as wet soil conducts heat better than dry soil and makes soil organisms vulnerable to being killed by heat generation.
- Make the covering airtight by covering the margins with compressed wet mud to check the loss of moisture and prevent the entry of air from beneath the polythene sheet.
- The nursery bed may be prepared at the treated site or soil may be used for filling pots or poly bags.

Formalin solution treatment

- Formalin solution is used to sterilise the soil. It is prepared by adding 2.5 ml commercial grade formaldehyde per litre of water and the soil is drenched @ 45 litre of solution per m² to saturate the top soil surface up to a depth of 15–20 cm.
- The drenched area is covered with a polythene sheet of 200 gauge so that the fumes of formalin penetrate into the soil to kill the pathogens.
- The polythene cover is removed after 48 hours.
- The soil is raked so that the fumes of formaldehyde gas escape from it.

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- If poly-house, soil is treated with formalin, the doors and side covers of the poly-house must be opened to allow formaldehyde gas to escape.
- The bed is kept open for 7–10 days prior to seed sowing. It must be ensured that there are no fumes of formaldehyde gas prior to seed sowing.

Soil treatment by fungicide

- Fungicides like *captan* or *thiram* @ 5 g/m² are used to control soil-borne pathogens.
- These fungicides can also be used as soil drench by preparing a solution of 2.5–3 per cent and drenching @ 4–5 litre/m².

Soil treatment by insecticide

- Insecticide, such as *chloropyrifos* @ 2 ml/litre of water is applied to a depth of 15–20 cm in the soil to kill insects, including ants, white ants and their eggs, nematodes, etc.

Use of bio-agents

- Certain biological agents like *trichoderma* are used to control soil-borne pathogens.
- Bio-agents @ 10–25 g/m² are mixed in the soil, and after 2–3 days, the seeds are sown.

Seed treatment

To keep the seeds free from pathogens, fungicides like *captan*, *thiram* or *carbandazim* are applied @ 2.5–3 g/kg seed, and mixed thoroughly in the seeds to disinfect the surface of the entire seed lot.

Mother block

Various plant parts, such as bud, branch, etc., are used as propagating material for vegetative propagation. The plants from which the plant parts are collected for propagation are known as 'mother plants'. To get healthy and true-to-type planting material, it is mandatory that the mother plants are maintained. Thus, it is necessary to establish the mother plant block. Progeny tree, which is



true-to-type in nature, healthy, free from diseases and insect-pests, and is high yielding in nature, and stock plants are maintained in the mother block area of the nursery. An adjoining block can maintain healthy disease-free rootstocks, which can be used in propagation.

NOTES

Practical Exercises

Activity 1

Demonstrate soil solarisation technique.

Material required: Water, harrow and polythene film of 200 gauge

Procedure

- Plough the land thoroughly with the help of a harrow during May–June.
- Prepare the seedbed by making it free of weeds, stumps, stones, pebbles, etc.
- Level the soil, irrigate and cover it with a black polythene film of 200 gauge for 5–6 weeks during summer.
- The side margin of the polythene film must be buried in the soil using wet soil (compressed mud) to check the loss of moisture and prevent the entry of air from beneath the polythene film.

Activity 2

Prepare a raised nursery bed.

Material required: Seedbed, spade, seeds, rotten farmyard manure, *khurpi*, watering can, mulching material (dried leaves)

Procedure

- Select a plot, which is sterilised by soil solarisation technique or with chemicals.
- Level the land and make it free from weeds, stumps, stones, pebbles, etc.
- The soil of the nursery bed is thoroughly mixed with 5–10 kg per sqm of rotten farmyard manure.
- Prepare drainage channels to drain out excess water.
- Prepare seedbeds about 15 cm high from the ground level. The width is kept 1–1.5 m and the length 3–5 m.
- A space of 30–40 cm is left between two beds in order to carry out cultural practices smoothly.
- The treated seeds are sown width-wise in lines.
- Cover the seedbeds with mulching material and water them lightly using a watering can having a fine nozzle.

NOTES

Check Your Progress

A. Fill in the Blanks

1. Nursery is a place where planting _____ are raised.
2. A nursery must be located in _____ environment.
3. Temporary nursery is developed to fulfil _____ requirements.
4. Sunken beds are prepared in _____ and windy areas.
5. Raised beds are prepared about _____ high from the ground level.
6. Soil _____ is an environment-friendly method for controlling soil-borne pathogens.

B. Multiple Choice Questions

1. For seed treatment _____ is a suitable fungicide.
(a) *carbendazim* (b) monocrotophos
(c) copper (d) zinc
2. The soil for a nursery should preferably be _____.
(a) clayey (b) sandy
(c) sandy loam (d) black
3. The nursery must be free from _____.
(a) waterlogging (b) organic matter
(c) fertiliser (d) irrigation water
4. A _____ type of nursery protects seedlings from extreme weather conditions.
(a) thatched roof (b) shade-net
(c) poly-tunnel (d) None of the above
5. The type of nursery bed prepared during the rainy season is _____.
(a) sunken (b) raised
(c) flat (d) furrow

C. Subjective Questions

1. Describe different types of nursery.
2. What criteria will you follow while selecting a nursery site?
3. Describe the precautions to be taken during the preparation of a nursery bed.



D. Match the Columns

A	B
1. Bio-agent	(a) soil sterilisation
2. Thiram	(b) Protection to seedlings during high wind
3. Sunken beds	(c) Initial cost is high
4. Formalin	(d) Seed treatment
5. Permanent nursery	(e) <i>Trichoderma</i>

NOTES

SESSION 2: GROWING MEDIA

Growing medium

The material in which plants grow in pots is known as 'potting material', while the substrate or medium used to grow plants is called 'growing medium'. The choice of the type of potting material is important as the growth of plants largely depends on it.

Functions of growing medium

- It supplies nutrients, air and water to the roots of plants.
- It retains necessary water in the soil, while excess is drained out.
- It provides physical support to plants.
- It facilitates maximum root growth.

Characteristics of growing medium

- The medium must have adequate aeration, drainage and water-holding capacity.
- It must not be too heavy to lift.
- The medium must be slightly acidic to neutral, i.e., pH of 6–6.5 being satisfactory in most cases.
- It must be free of weeds, pests and pathogens.
- It must be easily available.
- It must not be too expensive.

Types of growing medium

The main function of growing medium is to supply nutrients, air and water to the roots of a plant. It supports the plant physically and holds it in upright position, allowing growth against the gravitational force. For the above two functions, it is necessary that the medium facilitates the growth of roots within it. The chemical composition, as well as, physical structure of the medium favours the growth of the plant. Different types of growing medium are used as per the requirement of plants.



Fig. 2.1: Garden soil

Garden soil

Light and sandy loam soil must be used as growing medium, while silty or clayey soils are not preferred due to poor aeration and stickiness. The soil contains both organic and inorganic matter. When the soil is used as a medium, it may contain disease-causing pathogens, along with weed seeds, which is a serious problem in growing crops. The soil is easily available and comparatively a cheaper medium used in a nursery (Fig. 2.1).



Fig. 2.2: Sand

Sand

Large particle size makes this medium more porous, aerated and well-drained. The water-holding capacity of this medium decreases with an increase in the size of the particles. The usual size of sand is 0.05–2 mm. Quartz sand is a useful growing medium but it lacks in nutrient content. It is relatively inexpensive and heavy. Generally, it is mixed with soil and used as a well-drained porous medium (Fig. 2.2).

Compost

Compost is formed due to the decomposition of organic matter. Leaves, grass clippings, bagasse, litter, wood waste, rice husk, sawdust and farmyard manure are some of the common ingredients used for preparing compost. Compost contains nutrients that plants need for growth. Vermicompost is a supplement that is added to a growing medium.



Sphagnum moss

Commercial sphagnum moss is a dehydrated by-product of bog plants of genus *Sphagnum*. Commonly used moss grass is comparatively light in weight, acidic in reaction, sterile in nature and has sufficient water-holding capacity. Hence, it is commercially used as a rooting medium in air layering (Fig. 2.3).



Fig. 2.3: *Sphagnum moss*

Peat

Peat consists of residues from marsh swamp and organic nitrogen. It helps in fast vegetative growth and is commonly used for growing newly rooted cuttings or newly germinated seeds (Fig. 2.4).



Fig. 2.4: *Peat*

Coir peat or coco peat

Coir peat is obtained from coir's fibre dust. It is acidic in nature and has a pH of about 5. It has a high water retention capacity (Fig. 2.5).

Vermiculite

Vermiculite is chemically hydrated magnesium aluminum iron silicate. It is produced by heat treatment of mica. It is porous in nature and light in weight. It has adequate water-holding capacity (Fig. 2.6).

Perlite

Perlite is a natural mineral of volcanic origin, which is light in weight. Its pH is, usually, neutral to slightly alkaline.

Sawdust

It is the by-product of sawmills. It is easily available and cheap. It is poor in nutrient content but can be used after adding nitrogen.



Fig. 2.5: *Coco peat*



Fig. 2.6: *Vermiculite*

NOTES

Plant bio-regulators

These are compounds that are organic in nature but other than nutrients. These promote, inhibit or otherwise modify physiological processes in plants even when used in small amounts.

Type of plant bio-regulators

- (i) Auxins : IAA; IBA; NAA; 2, 4D; 2, 4, 5T
- (ii) Gibberellins : GA_3
- (iii) Cytokinins : Kinetin, aminopurine
- (iv) Ethylene : Ethrel (Ethepon)
- (v) Inhibitors : Melic hydrazide (MH), ABA, 2, 3, 5 Triiodobenzoic acid (TIBA)
- (vi) Retardants : Cycocel Chlormequat Chloride (CCC), alar, phosphon-D, B-Nine, etc.

Classes of plant growth regulators

Auxins

In plants, auxins are synthesised in the apical portion of stem and root. Auxins control growth through cell enlargement and influence developmental responses, such as apical dominance. Indole acetic acid (IAA), Indole butyric acid (IBA), Naphthalene acetic acid (NAA), and 2, 4-Dichlorophenoxyacetic acid (2, 4D) are some examples of auxins (Table 2.1).

Cytokinins

Cytokinins help transport amino acids in plants. They promote cell division and senescence. Examples are kinetin and benzyladenine.

Gibberellins

These control cell division and elongation in plant shoots. Gibberellic acid (GA_3) is an example.

Ethylene

Ethylene is a gaseous hydrocarbon and known as 'ripening hormone', e.g., ethepon, ethrel.



Absciscic acid (ABA)

Absciscic acid is, generally, considered as a growth inhibitor because of its effects on growth inhibition or senescence. It causes metabolic activities in plants, such as abscission of leaf, response to environmental stress, fruit ripening, etc.

Biological effects or physiological role of plant bio-regulators (PBRs)

Auxins

- Apical dominance
- Cell expansion
- Shoot and root growth
- Parthenocarpy
- Tropism

Gibberellins

- Cell growth
- Flower induction
- Fruit set and development
- Seed development and germination
- Parthenocarpy

Cytokinins

- Cell division
- Anti-ageing or anti-senescence effect
- Anti-stress effect
- Gall or nodule formation

Ethylene

- Senescence
- Fruit ripening
- Abscission
- Environmental stress

Absciscic acid

- Seed development
- Growth control
- Water stress
- Abscission

Growth retardants

- Reduce plant height
- Improve resistance to environmental stresses
- Reduce water consumption

Application of PGRs

Growth regulators may be applied in powder or paste form or as spray solution. It applied at low concentrations, i.e., in parts per million (ppm) (one milligram in one litre of water gives 1 ppm solution).

Table 2.1: Application of PGRs in flower crops

S. No.	Name of PGR	Crop	Concentration (ppm)	Effect on plants
1. (i)	Auxins IAA or NAA	Dahlia Orchids	100–200 90–100	Delays flowering Promotes root growth
(ii)	IBA	Bougainvillea Geranium	2 1000–2000 200	Increases shoot length Induces rooting
2.	Cytokinins	Orchids	500	Enhance shoot growth
3.	GA₃ (Gibberellic acid)	Antirrhinum Chrysanthemum Dahlia Gladiolus Petunia Rose Tuberose	25 100–400 100–150 100–200 500 100–400 100–500	Induces early flowering Increases plant height, internodal length and flower stalk length Induces flowering and weight Improves corm yield Improves germination percentage Improves stem length and quality Improves bulb yield and rooting
4.	Ethrel	Gladiolus	500–1000	Breaks corm dormancy
5.	Ethephon	Carnation	600–800	Promotes branching
6.	Benzyladenine	Chrysanthemum	600–1000	Breaks apical dominance
7.	B-Nine (Daminozide, Alar, Kylar)	Geranium Carnation	1000–2000 4000	Increases adventitious roots Induces early flowering Improves flower quality
8.	MH	Bougainvillea	1000–2000	Encourages compact bushy growth
9.	CCC (Cycocel)	Marigold Carnation	3000 100	Causes uniform and bushy growth, more branching Induces flowering and more flower yield

Practical Exercises

NOTES

Activity 1

Prepare potting media.

Material required: Sand, soil, rotten farmyard manure, pot, spade

Procedure

- Collect the required ingredients.
- Measure the volume of sand, soil and farmyard manure (FYM) as per need.
- Mix sand, soil and FYM thoroughly.
- Store the potting media in a shady place away from direct sunlight.
- Make a heap of the potting mixture for future use.

Activity 2

Identify different type of growing media.

Material required: Sand, compost, coir peat, vermiculite, perlite, sawdust, practical file, etc.

Procedure

- Collect different type of growing media available nearby.
- Identify and label them.
- Write the use of each type of growing media.

Check Your Progress

A. Fill in the Blanks

1. Compost is formed due to the decomposition of _____ matter.
2. Natural mineral of volcanic origin, which is light in weight, is known as _____.
3. Sand is a useful growing medium but it _____ in nutrient content.
4. Substrate that is used to grow plants is commonly called _____ medium.

B. Multiple Choice Questions

1. The soil that must be used as growing medium is _____.
(a) clayey (b) sandy loam
(c) red soil (d) acidic
2. Sphagnum moss is commercially used as a rooting medium in _____.
(a) air layering (b) budding
(c) grafting (d) cutting
3. Organic compound, which promotes or inhibits the growth of the plant, is known as _____.
(a) PGR (b) nitrogen
(c) boron (d) vermicompost

NOTES

C. Subjective Questions

1. Describe the types of growing medium used in a nursery.
2. Describe the characteristics of a potting material.
3. What is the role of PGR in flower crops?

D. Match the Columns

A	B
1. Sphagnum moss	(a) Coconut husk
2. Coco peat	(b) Sufficient water-holding capacity
3. Auxins	(c) Supply nutrient
4. Potting media	(d) Apical dominance

SESSION 3: SOWING OF SEEDS AND PLANTING MATERIAL

Methods of seed sowing

Broadcasting

In this method, seeds are broadcast on nursery beds, after which the beds are covered with sieved farmyard manure (FYM) or decomposed compost. However, this method has disadvantages too, such as the seeds cannot be placed at a desired place and comparatively more quantity of seeds is required.

Line sowing

It is an appropriate method of sowing seeds in a nursery. Sowing in lines improves germination and quality of seedlings. In this method, each seed gets independent space, and grows healthy and vigorously. Here, the diseased seedlings and weeds can be easily managed.

Procedure

On a leveled bed, shallow trenches of certain depths are made with the help of a stick width-wise at adequate spacing. This depends on the size of the seeds. Small seeds are sown at shallow depths and low spacing



between rows and vice versa. The seeds are, generally, sown at a depth of 3–4 times of its diameter. They are placed singly in rows. Small seeds are mixed with sand for even distribution. The trenches are then covered with fine soil. The beds require light irrigation from sowing to transplanting by means of a fine rose can. Mulching of seedbeds by polyethylene sheet, paddy straw, etc., helps in quick and uniform germination of seeds. Mulches must be immediately removed after germination.

Seed sowing in plug-trays (pro-trays)

High-value and hybrid seeds are preferred to be sown in plug-trays (pro-trays) instead of open field nursery beds. Pro-trays are made of soft plastic having shallow plugs. These plugs are filled with planting medium. Coco peat, a by-product of the coir industry having high water-holding capacity, is commonly used as a medium in pro-trays.

Procedure

In this technique, plugs are filled with coco peat. Depressions of 0.5 to 1 cm are made at the centre of the plugs with the help of fingertips for sowing the seeds. One seed is sown in each plug. The seeds are placed in the depressions and covered with coco peat.



Fig. 2.7: Seed sowing in plug-trays



Fig. 2.8: Seed sowing by machine in plug-trays

These pro-trays are covered with a polythene sheet and kept like that for few days or till germination starts. After germination, the polythene sheet is removed and water is sprinkled with a fine nozzle can. Annual seeds are commonly sown in pro-trays filled with coco peat or other growing media.

Precautions taken during seed sowing and planting

During seed sowing

- The seeds must be healthy and free from infection.
- Small seeds are sown after being mixed with sand for equal distribution.
- The seeds must be sown at the right depth.
- The seeds must be sown at adequate spacing to avoid overcrowding. It also ensures that the seedlings get sufficient nutrients, water, sunlight and air. Besides, the soil must neither be too dry nor too wet to avoid drying or rotting of the seeds or seedlings.

During planting

- Healthy and uniform seedlings must be selected and planted late in the afternoon at recommended spacing, followed by watering.



- The seedlings must be treated with fungicides to avoid soil-borne infections.
- Transplanting must not be carried out in dry, hot, sunny, windy and humid conditions.

Potting, de-potting and re-potting

Pots

Ornamental plants are grown in a variety of pots, depending on the choice of a person, including plastic, clay, cement, ceramic, etc. Pots are used for growing house plants (indoor and outdoor). Clay pots are the most popular, easily available, highly porous and cheaper than other type of pots. Size is an important factor while selecting pots. For specimen plant display, the pot size needs to be at least 30 cm in diameter. The size of the plant and its growth habit are to be considered before selecting a pot. Potting refers to transferring of plants from seedbed or poly-bags to pots, containing the potting mixture.

Potting mixture

The potting mixture must be light in weight and have adequate water-holding capacity. It must allow drainage and supply adequate nutrients to plants. The mixture needs to be free from insect-pests and soil-borne pathogens. For ferns and bulbous plants, the mixture needs to be highly porous in nature, comprising coarse sand, light garden soil and leaf mould. Neem cake and bonemeal may also be used in small quantities as nutrients.

Potting of rooted cutting and young seedlings: 1 or 2 part sand + 1 part loamy soil + 1 part peat moss or leaf mould

Potting general container grown nursery stock: 2 part sand + 4 part loamy soil + 2 part peat moss or leaf mould + 1 part rotten FYM

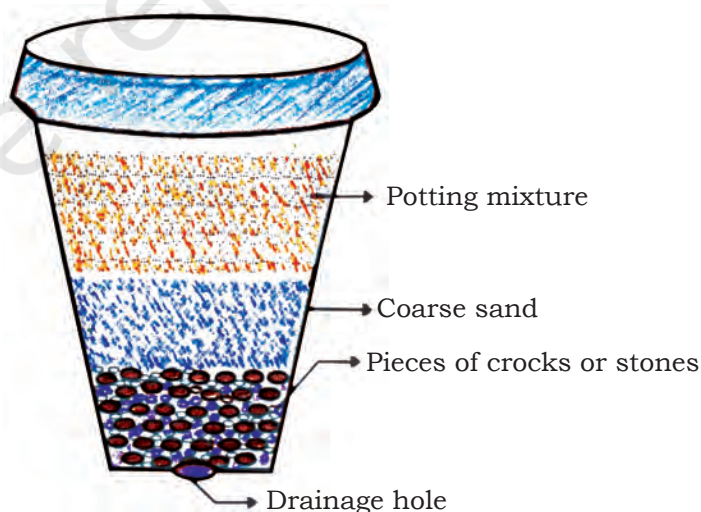


Fig. 2.9: Potting mixture

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Potting

Potting is the process of planting new plants in pots containing suitable mixture for their growth and establishment. It is a simple operation but requires a certain degree of skill and practice. The following points must be taken care of while potting a plant.

- The size of the pot must be suitable to set the plant.
- Before filling the pots, crocks of 3–5 cm must be placed at the drainage hole to avoid clogging, followed by a 5–8 cm layer of coarse sand.
- The pot is filled with the potting mixture, leaving 2.5 cm from the rim, for holding water.
- The pot can now be used for sowing seeds, potting of plants or cuttings.
- For planting, a healthy and well-rooted plant is carefully dug out from a nursery bed.
- The plant is placed with the ball of earth in the centre of the pot.
- Fill potting mixture all around the ball of earth, and press it firmly and uniformly. Care must be taken that the ball of earth is not pressed too hard as it will break and damage the roots.
- Water the plant with a fine nozzle can immediately after planting.
- Place the potted plant in a cool and shady place for establishment.
- Staking is also provided, depending on the plant type, to support the plant.
- Deciduous house plants are planted in February–March, while evergreens are planted in July–August.

De-potting

De-potting is the removal of a plant from a pot for planting in soil, bed or another pot. As roots are sensitive and prone to injuries, care needs to be taken while de-potting the plant. It is better to de-pot the plant along with the soil attached to its root system. This soil, if needed, can be removed carefully after de-potting.



Procedure

The pot needs to be watered before de-potting. The pot is lifted by the right hand palm spread over the top of the soil, holding the stem between the second and third finger, and the thumb along the side of pot. The pot is then turned upside down. If necessary, a gentle tap is given on the rim of the inverted pot against a solid base or on the edge of bench to loosen the earth ball. The whole earth ball with the intertwining roots of the plant will come out as a single piece and kept outside carefully. Before transferring the plant to a new pot, the lower old and finer roots along with some old potting mixture are removed (Fig. 2.10).

Re-potting

The first step in re-potting is de-potting. A de-potted plant needs to be re-potted in a fresh pot. For better growth of house plants, re-potting and transplanting of the established plants are done once in a year or two, depending on the type of plants and their growth habit. Re-potting is done when the plants have become pot-bound or overgrown, and also the potting mixture has become devoid of essential nutrients, resulting in poor growth of the plants. Depending on the plant type, it is done in February–March or September–October. During re-potting, the old potting mixture is replaced and the overgrown roots are pruned.

Procedure

- Prune the plant lightly before re-potting to remove excess shoot growth.
- All adhering crocks along with some amount of the old mixture must be carefully removed from the base of the earth ball.
- Decayed, dead, dried, twisted and unwanted roots are removed with a sharp knife or secateurs.



Fig. 2.10: De-potted plant



Fig. 2.11: Plant with earth ball

- The plant is placed in a new pot at the same depth in soil at which it was in the old pot. The pot is filled with fresh potting mixture, and then watered.

Application of manures and fertilisers

Types and methods of manure application

Timely application of fertilisers and manures in adequate quantity is important for the growth of plants. The manner and method of manure application depends on the type of the plants.

Bulky manures

Farmyard Manure (FYM) or other bulky manures must be broadcast over the entire area and mixed well with the soil by harrowing. The application of manures depends on the season to avoid leaching of nutrients. In areas receiving light rainfall, the manures may be applied during monsoon, whereas, it must be done after the monsoon in areas receiving heavy rainfall.

Concentrated manures

Oil cakes, fish manure and blood meal are known as 'concentrated organic manures'. These manures must be applied well in advance as they are not easily available and have to be broken down by soil microbes to be made available to plants.

Fertiliser application

Time of application

Generally, organic manures are applied while preparing the land so that they improve the structure and water-holding capacity of the soil. Fertilisers are, normally, applied just before or soon after planting. The frequency and amount of fertiliser application depend on the crop, soil and season.



Application of solid fertilisers

Broadcasting

Basal application: Depending on the crop, broadcasting of fertiliser is carried out prior to sowing or planting just before the last ploughing is carried out in a field.

Top dressing: When fertilisers are broadcast in a standing crop, it is known as 'top dressing'. In this method, usually, nitrogenous fertilisers and micronutrients are applied in a dense sown flower crop.

Placement

Place the fertiliser in prepared soil before sowing, irrespective of the position of the seeds. There are three types of fertiliser placement.

Plough furrow or single band placement: The application of fertilisers in narrow bands beneath and by the side of crop row or furrow is called 'band placement'. This is done during the process of ploughing. This method can be adopted:

- (i) in case of low fertility of soil.
- (ii) when the fertiliser reacts with soil constituents, leading to the fixation of nutrients.
- (iii) in places where volatilisation loss is high.

In single band placement, fertilisers are applied on the side of the planted row. Double band placement happens when the fertiliser is applied in two bands, i.e., on both sides of the planted rows.

Deep placement: It is, generally, practised for the application of nitrogenous and phosphatic fertilisers and in fields. It is commonly recommended in dry land agriculture.

Ring placement: The quantity of fertiliser per plant is calculated and applied at some depth around the plant circle. This method is mostly practised in case of orchard crops.

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Application of liquid fertilisers***Foliar application***

This method can be used with fertiliser nutrients readily soluble in water. It is also used when there is a soil fixation problem. In this method, it is difficult to apply sufficient amounts of major elements. Nutrient concentration of 1–2 per cent can be applied without causing injury to the foliage. Foliar application, therefore, is commonly used only to apply minor elements or to supplement the major elements.

Fertigation

This refers to the application of fertilisers through irrigation water. Nitrogen is the principle nutrient that is commonly used. Potassium and highly soluble forms of zinc and iron can also be readily applied in this technique. When an element forms a precipitate with another substance commonly found in the irrigation water, it is not advisable to use this method. Phosphorus and anhydrous ammonia may form a precipitate in water with high calcium and magnesium content. So, they are not used in fertigation. Normally, this system is used through drip irrigation. Liquid fertilisers, containing all three major nutrients, are used.

Care and management of nursery plants**Handling of plants**

Since plants grown in a nursery are tender, care must be taken in nourishing them in order to ensure their growth and development. Timely and effective preventive measures against pests and diseases must also be taken. The production of quality seedlings depends on how well the following activities have been executed in the nursery.

Shading

Newly grown saplings must be protected from adverse weather conditions. Shade can be provided by using shade-nets or polythene sheets.



Thinning

It is important to maintain plant density in rows so as to ensure adequate light and air to the plants. During this process, weak, diseased or damaged plants are pulled out, allowing the growth of healthy seedlings.

Watering

Nursery beds must be watered carefully with the help of a fine rosé can. After the establishment of plants, watering must be done as per the requirement of individual plants.

Weeding

Weeding refers to the removal of all unwanted plants (weeds) from the nursery. Periodic removal of weeds is beneficial for the growth and development of seedlings as it prevents competition with the main plants for sunlight, water, air and nutrients. It also acts as secondary host for insect-pests and disease-carrying organisms. Thus, the nursery area must be kept free from weeds. Hand weeding and hoeing are the most common practices to remove weeds. To control a large number of weed species, pre-emergence herbicides can also be sprayed just after the sowing of seeds.

Hardening of seedlings

Seedlings must be hardened-off (acclimatised) in partial shade before being planted in the main field so that they can survive the harsh open climatic conditions. Generally, hardening is done before transplanting in the open field by gradually exposing the seedlings from lower to higher temperature. Over-hardening of the seedlings must be avoided.

Staking

Staking is a practice to support plants growing straight and saving them from bending or lodging. This is done at a time when the plants are not too tall. It saves the plants from being blown over due to wind and rain, and also because of the weight of its stems when in bloom. It is useful in potted plants, as well as, grafted and budded plants. Bamboo is the most

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common plant where staking is used. Other than this, the branches of shrubs and trees, i.e., neem, *subabool*, *phalsa*, eucalyptus, etc., can also be used for this purpose.

De-shooting

De-shooting refers to the removal of all side shoots (offshoots, offsets or keikis) emerging from the base of a plant. The main purpose of de-shooting is to divert the energy of the plant towards the development of its shoots or buds.

Disbudding

Disbudding is the removal of floral buds when a large flower on a plant is desired, for example chrysanthemum and dahlia. The energy saved by disbudding is diverted towards the development of the retained bud so that the flowers become large and vigorous. Generally, it is followed in large flower varieties. In carnations, disbudding is practised to obtain long stalks with larger blooms.

Pinching

It refers to the removal of growing tips of vegetative buds to promote bushy growth for more lateral formation and precocious flowering as in case of chrysanthemum. It is the removal of 3–5 cm growing tips when the plants are 8–10 cm tall, i.e., when they are about one-month old. The second pinching takes place about three weeks after the first pinching. Pinching is also a common practice in carnation and marigold.

Pruning

The planned removal of twigs, branches, shoots, limbs or roots in plants is termed as 'pruning'. Pruning is done to increase the usefulness of the plants.

Common diseases in nursery plants

Damping-off

It is a common and serious disease in nursery plants, which can even cause their death. Damping-off is



a pre-emergence and seedling disease caused by fungi, such as *Pythium*, *Phytophthora*, *Rhizoctonia* and *Fusarium*. These fungi attack at the time of seed germination. In this disease, girdling takes place near the base of the seedlings and the infected seedlings collapse due to rotting in the collar region. Damping-off is favoured by high humidity and damp soil surface, coupled with hot and cloudy weather, vis-a-vis, dense planting. One of the best preventive measures is to maintain a dry soil surface, which helps reduce the sowing density and thins out the seedlings, leading to improved aeration. Other methods include treating the nursery bed either by soil solarisation or soil sterilisation with formalin @ 2 per cent, drenching with Copper oxychloride @ 2g/l or seed treatment with thiram or carbendazim @ 3g/kg.

Wilt

Plants often show discoloured and wilted appearance. Leaves become yellow. The disease is controlled by drenching the soil with Copper oxychloride @ 2g/l or carbendazim @ 2g/l or by applying *Trichoderma harzianum*.

Leaf spot

One can often notice small to big black or brown spots on leaves. The disease is controlled by spraying mancozeb @ 3g/l.

Insect-pests in nursery

Nursery plants are tender and vulnerable to attack by various insect-pests. Various insect-pests, which infest the nursery plants are given in Table 2.2.

Table 2.2: Common insect-pests in nursery

Insects	Characteristics or symptoms	Control
Aphids	Small green, brown or black sap-sucking insects, which secrete honey dew that attract ants and develop sooty mould	Dimethoate 2 ml/l Neem oil 4–5 ml/l
Thrips	Tiny black or yellow coloured sap-sucking insects, which infest young portions of plants and flowers	Dimethoate 2 ml/l Neem oil 4–5 ml/l
Scales	Small immobile sucking insects that are covered by wax mainly infesting the stems of plants	Dimethoate 2 ml/l
Mealy bugs	Small sucking pests covered by white filamentous hair	Chlorpyrifos 20 EC @ 2.5 ml/l 5% Malathion dust @ 25 kg/ha
Mites	Microscopic insects on the under surface of leaves producing webs and galls	Dicofol 18.5 EC @ 2.5 ml/l Wettable sulphur @ 5 g/l
Leaf miner	Leaf mining insect that produces serpentine (snake-like) white shining lines on leaves	Triazophos 0.25 ml/l
Termites	Tiny white ants that mainly infest dead parts of the plant and stay underground	Chlorpyrifos 0.3% (active ingredient) emulsion

Practical Exercises

Activity 1

Demonstrate seed sowing in plug-trays.

Material required: Plug-trays (pro-trays), potting mixture, seeds and fine nozzle can

Procedure

- Clean the pro-trays. Make sure that the drainage holes of the pro-trays are not blocked.
- Fill the pro-trays with coco peat.
- Make small depressions (0.5 cm) at the centre of the plugs with fingertips for the sowing of seeds.
- One seed is sown per cell and is covered with coco peat.
- Cover the pro-trays with a polythene sheet and keep it like that for few days or till germination starts.
- After germination (5–6 days), the polythene sheet is removed and water is sprinkled on the plug-trays with a fine nozzle can.



Activity 2**Demonstrate the potting of ornamental plants.**

Material required: Pots, crocks, potting mixture, *khurpi*, watering can and towel

Procedure

- Select a pot as per the requirement of your plant.
- Before filling the pot, crocks of 3–5 cm must be placed at its drainage hole to avoid clogging.
- Fill the pot with 5–8 cm layer of coarse sand, leaving 2.5 cm from the rim for holding water.
- Carefully dig out a healthy and well-rooted cutting or plant from the nursery bed and place it with the ball of earth in the centre of the pot.
- Fill the potting mixture all around the ball of earth, and press it firmly and uniformly.
- Water the plant with a fine nozzle can immediately after planting.
- Place the potted plant in a cool shady place for its establishment.
- Staking is also provided, depending on the plant type, for support.

Check Your Progress**A. Fill in the Blanks**

1. Line sowing an appropriate method of seed sowing in a _____.
2. _____ pots are the most popular as they are easily available, highly porous and cheaper.
3. The first step in re-potting is _____.
4. Evergreen house plants are planted in the month of _____.
5. Watering the plant must be done _____ after planting.
6. Generally, _____ seed rate is required if seeds are sown by broadcast method.

B. Multiple Choice Questions

1. High value annual seeds are, generally, sown _____.
 (a) by broadcasting (b) in line sowing
 (c) in pro-trays (d) in pots
2. The common growing medium in plug-trays is _____.
 (a) coco peat (b) sand
 (c) vermiculite (d) soil

3. Removal of plants from pots for planting is called _____.
 (a) re-potting (b) de-potting
 (c) potting (d) None of the above
4. Application of fertilisers through irrigation water is known as _____.
 (a) surface application (b) sub-surface application
 (c) fertigation (d) top dressing
5. _____ is the most common disease in a nursery.
 (a) Powdery mildew (b) Damping-off
 (c) Leaf spot (d) Blight

C. Subjective Questions

1. Discuss the care and maintenance of nursery plants.
2. Describe different methods of fertiliser application.
3. What do you mean by potting and re-potting? Describe their procedure.
4. What are the common insect-pests in a nursery?

D. Match the Columns

A	B
1. Top dressing	(a) Done before transplanting
2. Foliar application	(b) Water soluble fertiliser
3. Weeding	(c) Fertilisers are broadcast on standing crop
4. Hardening	(d) Practised in orchard crop
5. Ring placement	(e) Removal of unwanted plants

