

## *Chapter - 7*

# PLANTING MATERIAL FOR HORTICULTURAL CROPS

### OBJECTIVES

After studying this chapter, you will be able to:

- Understand the need for quality planting material in horticultural crops
- Highlight the components of a model fruit plant nursery
- Perform important nursery practices in modern fruit plant nursery
- Start a fruit plant nursery based agri-business

### INTRODUCTION

It is always a matter of discussion among the scientists and farmers that although we are the largest producers of fruits (73.9 MT) and vegetables (139.8 MT) in the world but the productivity of most of the fruits and vegetables in our country is low in comparison to other countries of the world. Several reasons are quoted for low productivity but the major reason is that most of our orchards are old and declining, and quality planting material for new orchards is not available. In spite of having around 440 hundred fruit plant nurseries in our country, paucity of good plant material is really a matter of great surprise. What could be the reasons for it? We do not follow the rules and regulations or we do not use proper nursery production, protection tools for producing quality planting material. In this chapter, we will discuss about the management of modern nursery, nursery registration act, and nursery practices to be followed for producing a quality planting material.

### Present status of nurseries and planting material

Planting material is being produced by a number of government nurseries including SAUs and ICAR Institutes as well as private nurseries existing in different states. In India, more than 4409 fruit nurseries including 1575 under government sector and 2834 under private sector, are functioning, which have an annual target of producing 1387 million fruit plants. In view of growing importance of fruit crops, the demand

for quality planting material has increased manifold throughout the country in the recent past. However, the greatest bottleneck in the expansion of area under fruits is the non-availability of genuine and quality planting material in adequate quantity from reliable government nurseries. More often than not, the farmers depend much on the unregulated and unmonitored private sector nurseries and this practice is causing great harm to the fruit industry of the country. The existing nurseries lack modern infrastructure such as greenhouses, mist chambers, efficient nursery tools and gadgets, implements and machinery.

**Table1: Status of fruit plant nurseries**

Sr. No.	Sector	Number of Nurseries	
		India	H.P.
1.	Public	1575	70
2.	Private	2834	662
	Total	4409	732

Keeping in view the present area and the trends in expansion of area under different fruits in India and also the necessity of renewal of old and non-performing orchards, the requirement of nursery plants of different fruits in India would be very high, which can only be met after following standard practices in nursery for the production of quality planting material. .

### Propagules for different horticultural crops

In the previous chapter, you have read about different methods of propagation of horticultural plants. If you have read this chapter carefully, you might have come to know that most of the fruit plants are raised through vegetative methods of propagation such as cutting, layering, budding and grafting because fruit plants are highly heterozygous and propagation through seeds brings about greater variability in the progeny. To remind you about some of most important methods of propagation of fruits are: 'T' budding in citrus and *ber*, air layering in litchi and guava, hardwood cuttings in grape, epicotyl grafting in mango in Konkan region and runners in strawberry. So the above mentioned material is the planting material for these fruit plants. However, some fruit plants such as papaya, *jamun* and *phalsa* are still raised by seeds, because no method of vegetative propagation has been much successful. Similarly, rootstocks for budding and grafting in fruit plants are raised through seeds, yet few rootstocks (e.g. clonal apple rootstocks) are raised by vegetative means, primarily by stooling. Some horticultural plants are raised by micropropagation (papaya,

strawberry, banana etc.) and some by specialized vegetative structures such as corms, tubers, runners, offsets etc.

The planting material for most of annual flowers and vegetables crops is seed only. However, some vegetables such as asparagus, basella, garlic, potato, yam etc., are raised successfully through vegetative methods. Similarly, several ornamental, especially flowering annuals are propagated by seeds, whereas some ornamental plants such as canna (rhizomes), bougainvillea (hardwood cuttings), ferns (spores), dahlia (leaf cuttings), tuberose (bulb) are propagated by vegetative means. Further, ornamental trees and shrubs are propagated by seeds and several methods of vegetative propagation, which act as propagaule for them, respectively.

### **Model nursery management**

Nursery development has great scope for enhancing the production and profitability of fruit crops in India because of poor yields and overall low productivity, year to year fluctuations in production, poor quality of produce and non-availability of quality planting material. The modern era of horticultural development is known for effective utilization of hi-tech interventions for different aspects. Hi-tech interventions in nursery establishment are technological advancements, which are capital intensive, minimally environment dependent and useful in rapid multiplication of planting material of fruit plants.

Nursery management is a technical and skill oriented job, which require proper attention at different stages of production of quality planting material. Setting up of a fruit nursery is a long term and capital intensive venture. It needs lot of planning, expertise and efficient management for the production of quality planting material. Mistakes committed initially in the establishment of a nursery can not be rectified easily at later stages; moreover, it reduces the returns greatly as well, which results in wastage of time and energy. Therefore, careful planning is needed before establishment of a nursery. The nurseryman should prepare a layout of the proposed nursery, which should include allocation of plots/area to different components of the nursery such as mother orchards of different fruits/cultivars, rootstock banks, nursery beds, roads/paths, water channels, drainage system, buildings/other structures, etc. Provision of certain basic pre-requisites must be made for the establishment of a fruit nursery on modern lines.

### **Components of a model fruit nursery**

A genuine prospective nurseryman can earn reputation for production of quality planting material by considering following points before establishing a model nursery :

## Technical Knowledge

The knowledge on nursery management before establishing a nursery is pre-requisite for its success. Nursery management is highly skilled and technical job, which requires proper attention and expertise. Therefore, a person who wishes to establish a fruit plant nursery must have technical knowledge on every aspect of the nursery production.

## Nursery Registration

Considering the importance of production of planting material of fruit crops, Fruit Nursery Registration Act -1973 has been enforced in India. However, only few states in India have enforced it for quality production and regulation of planting material. As per this act, any nurseryman can not undertake the production and sale of nursery plants or planting materials without getting a nursery registration license. Under the provision of this act, the fruit nurseries are inspected periodically by the officials of Govt. and defects, if any, are pointed out to the nurserymen for rectification or for causing destruction of plants if found infected with certain infectious diseases and pests.

In order to regulate the quality of nursery plants, the fixing of nursery standards and to bring the fruit nurseries under the ambit of nursery certification is very important. Fixing of nursery standard and certification of nursery stock are the twin services, which are highly valuable from customer's point of view. While nursery standards ensure the supply of healthy, disease-free and commercial grade plants to the customers, setting of certified nursery stock protects the customers against planting poor quality and undesirable varieties.

Certification of nursery means that the nursery plants have been checked and identified as true-to-type by the competent authority. For the purpose of certification, the plants shall have to be propagated by using the scion wood and rootstocks material only from the registered trees maintained in the nurseries for the purpose. For producing certified nursery stock, the fruit nursery shall maintain a scion block and stool bed and shall have to use the propagation material only from these sources. For the production of certified nursery plants, certain minimum standards have been fixed for different fruits and the nurserymen are required to adhere to these standards. The general standards for different fruit plants are as under:

- Nursery plants should be true-to-type and raised from healthy, disease-free, high yielding progeny trees of good quality.
- Nursery plants should be raised on recommended rootstocks and should not be raised on old stock.

- The bud/graft union should be smooth and strong enough.
- The bud/graft union should be 15-25 cm from the ground level.
- Nursery plants should be of standard height (60-120) cm depending upon the kind of fruit crops.
- Root system should be well developed and there should be no damage while uprooting the plants from nursery.
- Nursery plants should be healthy and free from diseases and insect-pests.

Besides this, the quality planting materials produced in all the nurseries can thus be regulated under this act by:-

- i) Ensuring the maintenance of registered scion block, stool beds in fruit nursery to serve as sources of propagation material.
- ii) Rigorous checking and identification of fruit kinds and varieties for trueness and name/type through procedures as prescribed under certification programme.
- iii) Rigorous checking/indexing of nursery stock for freedom from viruses and diseases.
- iv) Rigorous inspection of nursery plants before sale to ensure the supply of only healthy and disease-free plants to the growers.
- v) Bringing the nursery registration and nursery certification programme under one agency and making their implementation mandatory for all the fruit nurseries in the state.

### Procedure to get nursery registration license

Any person interested to establish fruit nursery in the particular area are advised to meet the SMS/ Horticulture Development Officer of that area and shall make an application in writing in prescribed form and manner accompanied by the revenue papers of the land and license fee of rupees one hundred only. At present, the license is valid for three years. After the validity period, the license can be renewed on the application of owner with the renewal fee of rupees one hundred only, provided the licensing authority is satisfied after inspection with the conditions available.

### Layout of a model nursery

Layout is the arrangement of different essential features of a nursery including

the roads, paths, buildings, beds, irrigation channels, etc. It is prepared for effective utilization of inputs and to do things in proper manner. A location specific model should be designed for nursery establishment as per requirements. Certain important components should be taken into consideration and provision should be made for these during planning and layout of nurseries, which are as follows:

### (i) Fencing

Prior to the establishment of a nursery, a good fence with barbed wire must be erected around the nursery to prevent trespass of animals and theft. The fence could be further strengthened by planting a live hedge with thorny fruit plants.

### (ii) Roads and paths

A proper planning for roads and paths inside the nursery will not only add beauty, but also make the nursery operations easy and economical. This could be achieved by dividing the nursery into different blocks and various sections. But at the same time, there should not be wastage of land by unnecessarily laying out of paths and roads. Each road/ path should lead the customer to a point of interest in the nursery area.



Roads in nursery

### (iii) Progeny block/Mother plant block

The nursery should have a well-maintained progeny orchards or mother plant block/scion bank of commercial and recommended varieties. The mother plants for establishing progeny orchards should be obtained preferably from the original research institute from where these are released or from a reputed nursery. It is well realized that the success of any nursery largely depends upon the initial selection of progeny plants or mother plants for further multiplication. Any mistake made in this aspect will result in loss of the reputation of the nursery. A well managed progeny block or mother plants block will not only create confidence among the customers but also reduces the cost of production and increases the success rate of grafting/ budding/



Water storage tank in nursery

layering because of availability of fresh scion material throughout the season within the nursery itself and there will not be any lag period between separations of scion and grafting/budding.

#### (iv) Irrigation system

Nursery plants require abundant supply of water for irrigation. Hence, provision for assured irrigation facilities must be made well in advance to obtain better growth and success in the production of planting material. In areas with low water table and frequent power failures, water storage tanks/ rain water harvesting tanks should be constructed to provide life saving irrigation to the nursery plants. Since water scarcity is a limiting factor in most of the areas in the state, a well laid out PVC pipeline system will solve the problem to a greater extent. An experienced agricultural engineer may be consulted in this regard for layout of pipeline. This facilitates efficient and economic distribution of irrigation water to different blocks in the nursery and also reduces the seepage losses.



Use of sprinkler for irrigation in nursery



A view of office building in nursery

#### (v) Office cum store

An office-cum-store is needed for effective management of the nursery. The office building may be constructed in a place, which offers better supervision and also to receive customers. The office building may be decorated with attractive photographs and with important characters of fruit varieties propagated in the nursery. A store room of suitable size is needed for storing polybags, tools and implements, packaging material, labels, pesticides, fertilizers etc. There should also be a provision for separate sale counter.

#### (vi) Seed beds

In a nursery, this component is essential to raise the seedlings and rootstocks. These are to be laid out near the water source, since they require frequent irrigation. The beds should be raised 15 cm from the ground level to ensure good drainage.

These should be located in an open place which receives sufficient sunlight. Beds of 1-meter width of any convenient length are to be made. A working space of 60cm between the beds is necessary. This facilitates ease in sowing of seeds, weeding, watering, spraying and lifting of seedlings. Irrigation channels are to be laid out conveniently. Alternatively, sprinkler irrigation system may be provided for irrigating the beds, which offers uniform germination and better seedling growth.



Preparation of nursery beds

### (vii) Nursery beds

Seedlings are taken out from the seed beds and transplanted in the nursery beds. Nursery beds are required for establishing rootstock seedlings for grafting/budding as well as for planting of cuttings and layered plants. Such beds can be irrigated through sprinkler system.

### (viii) Propagation structures

There should be adequate provision for modern propagation structures like mist chamber, poly houses, net houses etc. These structures provide optimum conditions required for seed germination, rooting of cuttings and hardening of plants before transplanting them in the field.

### (ix) Potting mixture and potting yard

For better success of nursery plants, a good potting mixture is necessary. The potting mixtures for different purposes can be prepared by mixing fertile soil, well rotten farm yard manure, leaf mold, etc., in different proportions. The potting mixture may be prepared well in advance by adding sufficient quantity of super phosphate for better decomposition and solubilization. The potting mixture may be kept near the potting yard, where potting is done. Construction of a potting yard of suitable size facilitates potting of seedlings or grafting/budding operations even on a rainy day.



Preparation of mixes in the nursery

### (x) Packing yard

A packing yard is used for packing the plant material before sale/dispatch to outstations. The yard can be combined with the working shed. There should be plenty of space to enable a number of workers to sort out and pack the plants with care. On the packed bundles, description of the plant variety, name and address of customer should be properly indicated. Packing yard should be located near the sale counter.



Packing yard

### (xi) Compost unit

It is an important component of the nursery. A huge quantity of organic manure is required in the nursery for the production of healthy planting material. Therefore, it is advisable to construct vermi-compost pits, where the weeds and waste material can be utilized for the production of organic manure at the nursery site itself. It will reduce the expenditure to be incurred on the purchase of manures. It should be constructed near the potting shed.



Transport of nursery plants

### Linkages

Nursery production is a programme, which requires proper planning and monitoring for obtaining quality planting material and better returns. This can be performed by better coordination and linkages with the experts in Universities, State Department of Horticulture, reputed nurserymen as well as concerned stakeholders.



Packed bundles of nursery plants

### Finance

Nursery production for horticultural crops is capital intensive intervention. Therefore, nursery growers should be provided with financial assistance for efficient

and smooth working of various units of the nursery. It can be provided through Government sponsored schemes like National Horticultural Board, APEDA, National Horticulture Technology Mission or institutions like Nationalized Banks or Cooperatives.

### **Hi-tech interventions**

Hi-tech interventions like protected cultivation, micropropagation, micro-irrigation, fertigation, use of growth regulators, canopy management, organic farming, and automatic climatic controls measures etc. are used for efficient utilization of inputs and increasing production efficiency. Mechanization for enhanced efficiency is essential. There is need to adopt media sieve, media mixer, poly bags filler, automatic grafting machines and electrically/pneumatically/hydraulically operated secateurs etc. for enhancing the efficiency in the large scale production of quality planting material.

### **Marketing management**

The commercialization of nursery production is possible with efficient and organized marketing. This can be promoted by encouraging participation in Agri-fest, seminars and other market linkage activities.

### **Preliminary considerations for production of quality planting material**

Propagation of fruit plants is done by sexual and asexual (vegetative) methods. The propagation of fruit plants through vegetative methods makes them vulnerable to transmission of several diseases and pests. Thus, due attention on quality control must be given at various stages of production of planting material. Coordinated efforts by ICAR institutes, SAUs, KVKs, State Horticulture departments are required to meet the ever increasing demands of quality planting material in the coming years. The production and distribution of healthy, genuine and elite planting material of commercial/improved varieties of fruit crops in sufficient quantities will help in achieving the fruit production targets required to meet the increasing demand of fruit. No doubt, it is easy to maintain the purity in fruit plants propagated through vegetative means as compared to sexually propagated fruit plants, but a close monitoring at different stages in the nursery is required to avoid mixing with other varieties. Similarly, adequate plant protection measures are required to be adopted in the production of quality planting material free from diseases and pests.

A quality control mechanism is required to manage key production variables in the production of consistent quality planting material of the subtropical fruit plants. There is need to identify and control the variables in the production of nursery

plants; otherwise the quality of planting material would probably be erratic. There are several key steps to initiate a quality control mechanism for the production of planting material in fruit crops, which are given below:

### **I. Identification of potential areas and production targets**

The potential areas for the production of planting material of fruits should be identified and always set realistic production targets on the basis of available resources, particularly the genuine and certified scion /budwood and rootstock as well as skilled manpower.

### **II. Selection of location and site**

Selection of an ideal location and site is of utmost importance in order to achieve the level of sufficient growth to raise good quality plants in the nursery. Keeping in view the variation in the requirement of nursery production as well as to maintain quality, an isolated area is more desirable for nursery raising. The nursery site should be well connected with modern transport and communication facilities and should be located near a city or town, so that it is easily accessible and the customers can visit it conveniently. The area should be receiving adequate sunshine and should preferably be on 'north-western' aspect. It should have access to good water source, electricity, skilled and unskilled labour availability throughout the season as well as professionally qualified and competent manpower. Places with a mild climate, long growing season and even distribution of rainfall are most suitable for planting material production while areas with extremes of temperature or commonly subjected to dry winds, frequent flooding, hail, storms or known to be frost pockets should be avoided as they adversely affect the quality of planting material. Soil should preferably be light-to-medium in texture with good fertility, water holding capacity and drainage, ideally with a pH range of 6.0 to 7.0. Topography should preferably be plain with gentle slope (1 to 2 %); and in very sloppy areas terracing need to be done.

### **III. Develop flow chart of various nursery practices**

In order to meet the production target, develop flow chart of various nursery practices along with time scale involved in the production of planting material. The major considerations in this regard would be propagation method and its seasonal variations for success and quality of the final produce, rootstock to be used, and specifications for the scion / budwood including its genuineness and season of availability.

#### **IV. Requirements of inputs**

The inputs required at each stage of production should be identified and subsequently develop quantitative specifications and requirements for each input such as seed, rootstock material, nursery/ seed beds, containers, growing medium (sand, FYM, soil, sphagnum moss), fertilizer, irrigation water, plant growth regulators, fungicides/pesticides and herbicides, etc.

#### **V. Verification of specification standards**

The procedures for the verification of specification standards of each input should be developed. The information collected should be quantitative so that the variation can be assessed. The verification procedures should be critical, real time and an integral part of the routine production procedures.

#### **VI. Maintenance of nursery records**

Nursery records must be maintained properly by incorporating all the information about the production of planting material and the observations recorded at each stage of production. The nursery records include store/stock of inputs used, nursery raising of seedlings/rootstocks, grafting/budding/layering/cutting, stock and disposal of propagated material. These may be maintained either in the registers and / or in the computer using suitable software such as Excel or MS Access, for monitoring the quality control mechanism. This will prove useful to identify the probable flaws in the production of planting material retrospectively as well as to rectify them subsequently. It would be useful to establish continuous and effective linkage with research organizations for the latest technological development regarding the nursery management aspects to upgrade and perfect the quality control measures.

#### **VII. Labeling of planting material**

Planting material produced should be labeled properly as per the records, with necessary information such as crop, variety, rootstock used, date of production, name of the nursery etc., and the planting material may be got certified from the competent authority by constituting committee comprising of a horticulturist, pathologist and entomologist as a part of the quality control mechanism.

### **PROGENY TREES/MOTHER PLANTS**

The ultimate success of orcharding profession largely depends on the quality of planting materials, since nursery plants are the foundation of an orchard. The variation

in the nursery plant material in respect to selection of scion and rootstock used has great influence on productivity of an orchard.

Seeing that the scion maintains its characteristics after grafting/budding, therefore, it is important to take scions from plant, which has been correctly identified. Scion-sticks for multiplication of nursery plants should be taken from healthy and true-to-type progeny trees. These trees should be free from various viruses, diseases and insect-pests. The past history and performance of these trees must be known and records must be maintained in this regard. A nurseryman should have progeny trees of all the promising varieties of fruits that can be grown/multiplied in that particular locality or those, which are in great demand. The progeny trees of the commercial varieties of fruit plants to be propagated must be planted in the budwood orchards for taking scion sticks from these plants.

The progeny plants are the major source for spread of fungal and viral diseases. Thus, it is worthwhile having all parent plants carefully labeled or otherwise marked. Identified mother trees are used to develop progeny trees in large numbers near to the nursery site. They can be planted at closer distance. The trees are properly labeled and used for scionwood. Adequate plant protection measures should also be adopted to keep these progeny trees free from insect-pests and diseases.

### Criteria for selection of mother plants

- Mother plants of the variety should be genetically true-to-type.
- The plants should be healthy and free from diseases, pest infestations and physiological disorders.
- The plants should have known pedigree records regarding bearing potential, fruit quality and problems, if any.
- The plants should be precocious and prolific bearer.

### Nursery management practices

Nursery management is one of the important aspects of production of quality planting material. Various nursery management practices have been standardized and sufficient technical knowhow has been generated on the various nursery management practices such as plant nutrition, irrigation, moisture conservation, weed control, plant protection and other cultural practices. Since the nursery management practices play a significant role in the production of healthy and good quality planting material, the available technology should be followed for improving

the quality of nursery plants. Young nursery plants require intensive care to make them grow well. There are various practices which should be paid special attention as discussed hereunder :

#### **i) Mulching**

Mulching is an essential practice particularly in the areas of water scarcity in order to promote germination of seed as well as for better establishment of nursery plants. Immediately after sowing of seeds, seed beds should be mulched with 10-15 cm thick dry grass mulch, straw, pine needles, dried leaves or black polythene sheet. can also be used as mulching material. As the germination starts, the mulch from the seed bed should be removed to avoid damage to newly emerged shoots. Similarly, immediately after grafting, nursery plants should be mulched. This practice helps to conserve soil moisture, control weed growth, and maintains soil temperature in the nursery.

#### **ii) Manuring**

The commercial manuring and fertilization programme depends largely on the type and fertility of soil. Farm yard manure (60-80 tones/ha) should be mixed in the nursery beds before sowing of seeds or transplanting of plants into nursery beds. Nitrogen @ 60-120kg/ha, phosphorus @ 30 kg/ha and potassium @ 60-90 kg/ha should be added to the soil to get better growth of nursery plants. Half the dose of nitrogen and full dose of phosphorus and potassium should be applied at the time of nursery bed preparation whereas another half dose of nitrogen should be applied at the time of onset of monsoon during the month of July.

#### **iii) Irrigation**

Nursery stock and young plants require frequent irrigation to make them grow well. Therefore, provision of assured irrigation is essential for the success of a fruit nursery. In those areas where there is scarcity of irrigation water, it is essential to construct a water storage tank near the nursery area to ensure proper irrigation of plants. Plants should be watered at frequent intervals preferably in the evening, to avoid evaporation of water from the nursery beds. Irrigation may be given by constructing irrigation channel and sub-channels, plastic pipes, water cans and sprinkler irrigation system. However, sprinkler irrigation system has been observed to be the best for nursery plants.

#### **iv) Hoeing and weeding**

Nursery area should be kept free of weeds. For this, nursery beds should be dug 5-10 cm deep at least 3-4 times with the help of hand forks for loosening the soil,

removing the weeds and satisfactory growth of plants. If manual labour is not available, the pre-emergence weedicide (Simazine or Atrazine @ 6 kg/ha) is effective in controlling weeds in seedling stocks and grafted plants. Grammaxone @ 2 L/ha as post-emergence application along with pre-emergence application of weedicide reduces the cost by about 60% as compared to hand weeding.

#### **v) Removal of polythene strip**

It is very important that the tying material does not girdle the rootstock, as this will delay growth and lower the quality, therefore, the tying material from the grafted plants should be removed timely. This is an important operation of budded/grafted nursery plants, which must be done timely. After about one month of sprouting when the grafted plants attain 30-45 cm height and the graft union start swelling, polythene strips should be loosened by giving sharp cut on the back side of the graft.

#### **vi) Deshooting**

After grafting and budding, the shoots generally arise from the rootstock below the graft union. It is necessary to remove such shoots from the rootstock at regular intervals otherwise it may result in the failure of grafting/budding.

#### **vii) Staking**

After removal of polythene strip, staking of grafted or budded plant is must since the unions are tender in summer and the plants are blown off with slightly higher wind velocity in windy situations. Attachment to the stock remains weak and they get easily broken. To protect the plant from breaking and to ensure a single trunk, the plants should be staked with wooden stakes and tied at least at 2-3 places to ensure safety against heavy winds. Problem of breakage is less in much populated nursery beds. In unstaked nurseries, the losses may be as high as 20-30 per cent. Simple wooden stakes can be used for this purpose.

#### **viii) Single stemming**

It is necessary to regularly pinch the side shoots coming from the growing scions. Single stemming to a height of at least 45 cm should be done by allowing one sprout to grow properly and rapidly.

#### **ix) Uprooting and packing of plants**

The saplings of evergreen fruit plants such as mango, litchi, citrus, guava, papaya and *aonla* are uprooted from the nursery during rainy season (July-August) whereas, peach, apple, pear, plum, apricot and pomegranate during winter

(December-January) when they have entered into dormancy, after all shoot growth has stopped and most leaves have abscised. While uprooting, the nursery plants, care should be taken not to cause damage to the root system. Plants should be uprooted only after rains or after giving irrigation to the nursery beds. Before uprooting the plants, deep furrows should be made on both sides of plant rows. Plants should be uprooted manually without damaging the bud union and root system. After uprooting, the root system should be dipped in a solution of metasystox (1 ml/l water) for 30 seconds before packing. Plants should be properly labeled and packed cultivar-wise in bundles of desirable and convenient size. The roots should be covered with sphagnum moss grass and wrapped securely in gunny bags.

## Plant Protection

Nurserymen have to be careful for regular plant protection measures against diseases and pests (Table 1). The efficient management of diseases and pests which attack nursery plants is essential for the production of good quality nursery plants. In nursery, small outbreaks can bring nursery in disrepute and affect sales seriously. It is, therefore, largely a matter of prevention than cure and their management and control measures must be carefully observed.

**Table 1: Common insect-pests and diseases of nursery plants**

<i>A. Insect-pests</i>	<i>Management</i>
Scales	Single spray of rogor or metasystox (0.05 per cent) is quite effective. Repeat it after 15 days interval. Crude oil spray is also useful for controlling the scales.
Thrips	Two sprays either of metasystox or rogor (0.05 per cent) at fortnightly interval on new growth reduces the population of thrips considerably.
Mealy bugs	1. Collect and destroy the adults.
	2. Soil raking in December-January to kill the pupae.
	3. Spray dimethoate (0.05 per cent) on the crawling insects during February-March.
	4. Use ostico sticky bands or polythene sheet on the trunks of the mother plants.
White flies	Spray phosphamidon (0.02 per cent) or other systematic insecticide in the early stages of infestation.
Mites	Give two sprays of acaricides like dicofol (0.05 per cent) and wettable sulphur (0.2 per cent) at fortnightly intervals.

<i>A. Insect-pests</i>	<i>Management</i>
Leaf eating caterpillars	Spray sevin/carbaryl (0.1 per cent) at the first appearance of the caterpillars. Neem oil (1 per cent) is also effective.
Cut worms	1. Use light traps for catching the adults.
	2. Use poison baits consisting of malathion (0.1 per cent), wheat bran and jaggery.
	3. Spray malathion or quinalphos (0.05 per cent) before the expected attack of the worms.
Leaf miners	Two sprays of metasystox or rogor (0.05 per cent) at fortnightly interval on newly emerged growth flushes are sufficient for controlling the population of leaf miners in the nursery.
Snails and slugs	1. Hand picking and destruction is most effective method.
	2. Spray of common salt (2 per cent) is very useful in controlling snails and slugs.
	3. Use metaldehyde pallets.
<b>B. Diseases</b>	<b>Management</b>
Damping off	1. Treat seeds before sowing with ceresan, thiram or agrosan @ 2 g per kg seeds.
	2. Spray captan or bavistin (0.2 per cent) in the nursery.
Powdery mildew	Give one prophylactic spray of karathane or calixin or wettable sulphur (0.2 per cent). Repeat it again if cloudy weather persists for a longer period.
Leaf spots	Give a single spray of dithane Z-78 or bavistin (0.2 per cent)
Blights	A single spray of dithane Z-78 or bavistin (0.2 per cent) is very effective to check blight disease in the nursery plants.
Dieback	1. Prune the dead portion of the plant.
	2. Apply blitox or bordeaux paste to the cut portion.
	3. Spray benlate (0.2 per cent) as soon as the symptoms become visible



### ACTIVITIES/EXERCISES

- Visit a modern fruit plant nursery. Make a list of its components.

### CHECK YOUR PROGRESS

1. Describe briefly the present status of planting material and fruit plant nurseries in India.
2. Write the components of a nursery. Describe each component briefly.
3. Write important nursery management practices to be adopted for quality production of plant material.
4. What is mother plant? Write briefly about criteria to be kept in mind while selecting mother plant.

### WRITE TRUE (T) OR FALSE (F) FOR THE FOLLOWING STATEMENTS

- Grape plants from the nursery should be uprooted in December-January.
- The nursery beds should be little raised than the field.
- All shoots below the graft union should be allowed to grow.
- Simazine is a pre-emergence herbicide commonly used for control of weeds in nursery.
- The mother plant should be true to the type.
- There are about 4400 fruit plant nurseries in India
- Nursery registration act was enforced in India during 2013.

### SUGGESTED FURTHER READINGS

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