Practical 7

PROPAGATION THROUGH SEEDS

EXERCISE 7.1: PROPAGATION OF FLOWER CROPS THROUGH SEEDS

Objective :

- To recognize the importance and methodology to raise healthy seedlings of ornamental flowers and plants.

Delivery schedule : 2 period

Student's expectations/ Learning objectives:

- To raise the seedlings of ornamental annual flowers and plants
- To raise the new hybrids developed through crossing different ornamental plants
- To prepare ideal type of growing medium for seed sowing

Pre-learning required : Knowledge about nursery raising of flower crops.

Handouts/material required/equipment's & tools: Spade, Khutti, Hand shovel, soil leveler, measuring tape, rope, watering can with fine rose head, leaf mould/ FYM, SSP, sand, soil disinfectant chemical, black polythene/ tarpaulin, fungicide (Bavistin/ Dithane-M. 45/ Captan/ Ridomil), insecticide (Fenvalerate dust/ chloropyriphos), seed material, dry grass/ thatch, flexible stick, transparent polythene sheet, etc.

Introduction:

Several horticultural crops primarily ornamental annuals and vegetable crops are grown through seed. Some horticultural crops like papaya which can not be grown through other vegetative means of propagation and for developing new cultivars of horticultural crops, these are also grown through seed. Seeds are normally sown in well- prepared nursery beds, but the costly and precious seeds are sown in the containers such as pots, trays, troughs and wooden pots. The nursery-raising in beds and containers results in easy management, better care and economy of seed.

Procedure:

- Select a site in south/ south-west/ south-east direction, which is sunny for most part of the day and is away from the shade of building or trees.
- Thoroughly dig-up the land to a depth of 30-40 cm. Break all clodes. Remove stones, pebbles, roots, debris, etc. and bring the soil to fine tilth.
- Prepare ideal nursery bed (1-1.5 m width, upto 3 m lengthy and 15-20 cm raised or the amount of nursery required or depending upon the seed to be sown)
- For disinfecting nursery beds formalin (Formaldehyde 40%) @ one litre in seven litre of water is drenched on the prepared nursery bed until thoroughly wet.
- Cover the nursery beds with black polythene or tarpaulin for about a week.
- After one week do light raking, so that remaining fumes of formalin gas comes out.
- For disinfecting nursery beds other chemicals like vapam, chloropicrin, methyl bromide, Captan (0.2%), etc. can also be drenched.
- Steaming of nursery beds, heating nursery soil, burning grass on nursery soil or solarization are other techniques to kill harmful microbes in the soil.
- Mix about 20-25 kg well rotten FYM, 200g SSP, 15g Dithane M. 45 and 15g Fenvalerate dust or 10 litre solution of chloropyriphos (0.05%) in the bed size mentioned above.
- Treat seed with Captan/ Thiram/ Bavistin @ 2-3g per handful seed.
- Sow the seeds in lines 5 cm apart at a depth of about 0.5 cm.
- For evenly distribution of the very small seeds, mix in sand or saw dust.
- The ideal seed sowing time for nursery of different season annuals is as under:

Season	N.I. Plains	Low Hills	Mid Hills	High Hills
Summer	Feb.	Feb. Mar.	Mar.-April	Mar.-April
Rainy	May-June	May-June	May-June	May-June
Winter	Aug.-Oct.	Sep.-Nov.	Sep.-Feb.	Sep.-Oct./ Feb.-Mar.

- Do seed sowing at fortnightly interval for regular supply of nursery for longer duration.
- For costly seeds at one time sow half of the seeds and remaining half at later stage after seeing the performance of first half seed sown otherwise seek expert's opinion.
- Cover the beds with dry grass/ heshion cloth until germination.
- Remove grass/ heshion cloth/ khas-khas after germination and do light hoeing/ raking to facilitate germination of left out seeds.
- During winter cover the nursery beds at night so as to avoid chilling or frost injury.
- Spray Dithane M. 45 (0.2%) and Ridomil (0.1%) alternatively at weekly interval to get rid off the diseases and Metasystox (0.05%) or Rogor (0.1%) for killing various insects feeding on the young seedlings in the nursery.
- Spray of Urea (0.1 %) is beneficial at 2-3 leaf stage.
- Spray Multiplex nutrient mixture for improving the health and vigour of nursery.
- Irrigate nursery beds with fine rose head watering can twice during summer and once during winter preferably in the evening so as to minimize the danger of frost injury to nursery during night.
- When there is likely possibility of frost then at sunset time collect all dried leaves and make smoke so as reduce the damage of frost to the plants in nursery.

Observations:

S. No.	Crop	No. of seeds sown	Seeds germination on different days					Total No. of seeds germinated	Germination (%)	Remarks
			7	15	21	28	35			
1										
2										

Precautions:

- Do not sow the seeds until all the fumes of formalin gas are removed
- Ensure treatment of seed before sowing.
- The depth of the seeds should be kept 2-3 times than the diameter of the seed.
- Mix the very fine seeds in sand/ saw dust for even distribution.
- Avoid thick sowing.
- Remove the dry grass or heshion cloth cover when the seeds start germinating.
- Irrigate the nursery beds/ seed pans copiously.
- Do not irrigate until the seeds germinate and during noon/ after noon on a sunny day

Nursery bed preparation

Seed sowing in lines

Nursery beds covered with dried grass

Flower seedlings become ready for sale at 4- leaf stage

EXERCISE :

7.2 SOWING OF DIRECT SEEDED CROPS

7.3 RAISING SEEDLINGS OF VEGETABLE CROPS

Objective :

- To impart knowledge of innovative nursery raising techniques and growing of direct seeded crops

Delivery schedule : 01 period

Student expectations/learning objective:

- Importance of nursery raising in vegetable crops
- Location for raising healthy seedlings
- Method for preparation of nursery seed bed
- Sowing methods for vegetable cultivation

Pre-learning required: Innovative vegetable raising technique

Handouts/material required/equipment's & tools: Paper sheet and pen to note down the instructions, different tools for land preparation, farmyard manure, fertilizers, seeds of vegetable crop, bavistin, herbicide, etc.

Introduction:

Majority of the vegetables are raised through seeds. The planting materials other than seeds which are used for propagation of vegetable crops are bulb (onion), tuber (potato), crown/suckers (asparagus, globe artichoke), root cutting (horse radish, globe artichoke), stem cuttings (moringa) etc. Vegetable crops propagated through seeds are either directly seeded or transplanted in the field by raising the seedlings first in the nursery beds. A nursery could be considered as a location where plants are cared for during the early stages of growth by providing optimum conditions for germination and subsequent growth until they become strong enough for planting in the open field conditions. The seeds of solanaceous vegetables, cole crops, onion etc. are first sown in the nursery.

Direct seeded vegetable crops

Various methods of sowing seed/planting material are as under:

- Broadcasting

- Drilling
- Dibbling

Procedure for direct sowing of different vegetable crops

- The direct seeded crops are grown on flat beds, raised beds or ridges.
- Prepare raised beds or ridges to a height of 15-20 cm.
- Separate two beds/ridges by making furrow of 30-45 cm width for providing irrigation.
- Leafy vegetables like spinach, mustard, amaranth, coriander, fenugreek etc. are sown by broadcasting the seeds. However, the crops sown in the rows grow better than the ones broadcasted.
- Growing of vegetables in rows is advantageous for taking up intercultural operations like hoeing-cum- weeding, fertilizer application, and irrigation along with easy harvesting.
- Apply fertilizers in the rows by mixing it thoroughly with the soil. The seeds should not come in direct contact with fertilizers.
- Treat the seed with fungicide(s) before taking up sowing to minimise the incidence of seed borne diseases
- Sow the seeds of garden pea, French bean, okra, beet leaf, spinach, cluster bean and cow pea etc. directly in the rows.
- Pre-soaking of seeds of pea, French bean and okra in water for overnight before sowing gives better germination. Discard the seeds which float on water surface.
- Sowing of seeds of root vegetables is generally done on ridges but sometimes on flat beds also. Mix seeds of root vegetables or any small seeded vegetables with fine sand to regulate their sowing.
- Pre-germinated seeds of cucurbits also enhance better crop stand.

Mechanical methods of sowing

- Most of the commercial vegetable growers use machine planter to sow the seeds.
- Machines do the sowing operations much better and more rapidly than hand sowing.

- The common seed drills open the furrows, drop the seeds and cover it simultaneously i.e. in a single operation.
- These drills can be regulated to sow at various rates and at desired depth.
- By regulating the seed rate mechanical methods, thinning can be reduced to the minimum.

Seed drill

Manual method of sowing

- Seed sowing by hand is commonly practised in home gardens as well as when the quantity of seed to be sown is less.
- A garden line or marker should be used to provide straight row furrows to do hand sowing.

Manual seed sowing
Source: www.flickr.com

- The furrows are made with the rake or with the corner of an ordinary hoe or with a heart shaped hoe attached with plough or teeth of a wheel hoe.
- The seed should be distributed uniformly in the furrow.
- The seeds should be covered immediately with the soil by trampling with the help of back of a hoe to prevent loss of soil moisture.

Exercise 1:

Prepare small area for raising vegetable crops. Keeping in mind the principles of establishing a kitchen garden, take up manual sowing at proper spacing and depth of any direct seeded vegetable crops. Write the steps in your practical note book as per data sheet along with your experience.

Data sheet

Name of the crop	
Season	
Aspect of the garden	
Slope of the garden	
Date of pre-sown irrigation, if needed Plot size	
Size of drainage channel	
Tools/Implements used	
Date of sowing	
Method of sowing (Flat bed/raised bed)	
Seed rate	
Seed treatment (mention the fungicide and rate)	
Fertilizers used and quantity applied	
Spacing	
Weedicide applied and its rate	
Any other operation	
State your experience	

Nursery raising:

Advantages of nursery raising in vegetable production

- It is very easy and convenient to look after the young tender seedlings growing in a small but compact area of a nursery.
- Favourable conditions of growth can be provided easily to the growing seedlings in a nursery.
- It eliminates the problem of seed emergence in heavy soils

- It provides temporary protection from extreme weather conditions.
- Timely and easy management of pests and diseases in short growing period of 4-5 weeks.
- Weed control is easy
- There is economy of land and more time is available for the preparation of land where transplanting is to be done.
- More uniform crop is possible
- Optimal use of expensive hybrid seeds by sowing in nursery beds.
- Sowing seeds in the nursery bed and then transplanting into the main fields help in eliminating a part of the unfavourable weather conditions and in getting early crops by adjusting suitable date of planting and there by securing a higher price for the produce.

Factors to be taken into consideration for raising nursery

Location of the nursery:

- Near the main field for transplanting
- Nursery area should receive sunlight right from morning till evening i.e. sunny south-west aspect is most suitable.
- Area must be free from water stagnation i.e. proper drainage must be provided.
- Well protected from stray animals and strong winds.
- The area should be near the water source for continuous supply of good quality water

Soil

- Soil should have good organic matter
- Soil texture should be neither too coarse nor too fine.
- Soil should be sufficiently porous and adequately aerated.
- It should have a fair degree of water holding capacity.
- Soil pH of nursery bed should be in the range of 6 to 7.

- Acidic and alkaline soils are not suitable for raising nursery rather, neutral soils are suitable.
- Soil should normally be rich in all essential nutrient elements, but this can be further improved by addition of manures.

Procedure

Nursery bed preparation:

- The soil of the nursery area should be fine and fertile with good water holding capacity. For the preparation of beds, the field should be ploughed and levelled well. Soil should be worked to obtain a fine textured soil free of clods and debris.
- Prepare raised beds to facilitate proper drainage of excess water. The level of the bed surface is also made little slanting on the two sides.
- The length of nursery bed should be 3-5 m but it can be increased or decreased according to the availability of land and requirement of plants but the breadth of the beds should not be more than 1.00 -1.2 m and the beds should be 15-20 cm raised from the ground surface.
- The standard size of nursery bed is 3m × 1m × 15 cm.
- A space of 20 - 25 cm should be left between two beds. This space can be utilized to perform intercultural operations such as weeding, disease and insect-pest management and also for draining out the excess rain water from the nursery beds.
- Add 20-25 kg well rotten farmyard manure in each standard size nursery bed along with 200g single super phosphate and 15-20 g each of fungicides and insecticides like mancozeb and dusts like methyl parathion.
- The number of nursery beds depends on the particular crop, season and growing area of crop for transplanting.
- The beds should be prepared in the east and west direction and lines/rows for sowing of seeds should be made from north to south direction on the beds

Seed Sowing

- Treat the seed with fungicides like bavistin or thiram or captan @ 3g/kg of seed to check the infection of soil borne diseases.

- Make rows at a spacing of 5 cm.
- Sow the seeds at 1 cm depth. The general rule for sowing depth is 2-3 times of the thickness of seed.
- Mix a little of sand in the seed for uniform distribution in the rows and cover it with soil or farmyard manure.
- Avoid broadcasting seeds in the nursery-bed. Thick sowing or sowing with broad casting also leads to increase in the incidence of damping off disease.
- If seeds are sown too deep nutrient reserves will be exhausted before the plant emerges or emerging plants will be weak or liable to die, if sown too shallow then it is likely to be eaten by birds or washed away by the splash of rains or irrigation water.

Use of mulch

- After sowing, cover the seed bed with a layer of dry grass.
- Apply water over the grass so that seed do not come up on the surface of the bed.
- Mulching maintains the soil moisture and temperature for seed germination.
- It protects the growing seeds/seedlings from direct sunlight and raindrops.
- It protects seeds against bird damage

Removal of mulch

- Due attention is given to remove the covered mulch from the seedbed.
- After three days onward, observe the seed beds daily.
- As and when the white thread like structure is seen above the ground, remove the mulch carefully to avoid any damage to emerging plumules.
- Always remove mulch in the evening hours to avoid harmful effect of bright sun on newly emerging seedlings

Use of shading nets or polysheets

- After seed germination during the seedling growth, if there is very high temperature ($> 30^{\circ}$ C), cover the nursery bed with 50% or 60% shading nets

(green or green + black coloured) about 60 - 90 cm above ground by providing suitable support.

- During winter season, cover the nursery bed over night with polythene sheet about 60-90 cm above ground by providing suitable support. Remove the sheet in the morning before the temperature rises. This technique protects young seedlings from severe winter frost or low temperature injury.
- During rainy season, cover the nursery bed with polysheet by providing proper support.

Watering

- The nursery beds require light irrigation with the help of rose can till the seeds germinate.
- During summers, irrigate the beds twice, once in the morning and once in the evening.
- During winters, irrigation once in a day is sufficient.
- Keep beds moist but not wet otherwise "damping-off of seedling" may appear.
- Excess rainwater or irrigated water should be drained out from the nursery bed otherwise plants may die due to excess of water.
- Watering in the beds depends upon the weather condition. There is no need to irrigate the beds during rainy days.

Thinning

- It is an important operation to remove weak, unhealthy, diseased, insect pest damaged and densely growing plants from the nursery beds keeping distance of about 0.5 to 1.0 cm from plant to plant.
- The thinning facilitates balanced light and air to each and every plant. It also helps in monitoring the disease and insect pest infestation.

Interculture and weed control

- Timely weeding in nursery is very important to get healthy seedlings. If there are some weeds in the seed bed, remove them manually either by hand or by hand hoe (thin forked Khurpi).

- Pre emergence herbicides can also be sprayed soon after seed sowing to control the weeds. Stomp @ 3 ml/litre of water should be sprayed on the nursery beds after the seed sowing and covering with mixture of farmyard manure, soil and sand.
- For good quality seedlings, spray urea @ 0.3 per cent when the plants are 8-10 cm tall.

Plant protection

- Adoption of plant protection measures in the nursery against the incidence of insect pest and diseases is very important task to get the healthy seedlings.
- Damping off is a very serious disease affecting seedlings in the nursery. The care for controlling them time to time is essential.
- Treat the seeds with bavistin or thiram or captan.
- If the disease appears after the seed emergence, drench the nursery beds with 0.1% solution of brassicol or 0.7% captan or thiram after germination.
- It will be better to remove and dispose off the affected seedlings from the beds to avoid further spread of disease and insect-pests.

Hardening of the plants in the nursery

- Withhold irrigation in the nursery beds 4-5 days before the date of transplanting but on the day of transplanting, first apply water to the nursery beds and then take out the plants for transplanting.
- Hardening should be gradual to prevent or check the growth.
- Warm season crops like tomato, brinjal and chillies cannot withstand severe hardening.
- Hardened plants withstand more efficiently unfavourable weather conditions like hot day winds or low temperature than non-hardened seedlings.

Transplanting

- After 4-6 weeks of sowing, the plants become 10-15 cm tall and are ready for transplanting.
- Select healthy plants for transplanting and always transplant in the afternoon.

- Before transplanting, the seedlings should be dipped in a solution of 0.25 per cent mancozeb and 0.05 per cent carbendazim.
- Fix the plants well in the soil and water them daily till they establish well in the fields.

Exercise

1. Prepare nursery beds and raise the seedlings of vegetable crops by protecting them from severe frost.
2. Prepare seed plots in a field by providing proper drainage channels and take up manual sowing of any vegetable crop at proper spacing and depth

EXERCISE :

7.4 RAISING SEEDLINGS AND ROOTSTOCKS OF FRUIT PLANTS IN NURSERY.

7.5 PRE-SOWING SEED TREATMENTS FOR GERMINATION

Objective :

- To multiply those fruit plants through seed, that can not be multiplied by other means of propagation
- To raise rootstocks for various grafting/budding purposes
- To overcome seed germination barriers such as hard seed coat, dormancy

Delivery schedule : 01 period

Student expectations/learning objective:

- Importance of multiplication of fruit plants through seed
- Pre-sowing seed treatments to overcome dormancy
- Techniques of propagation of fruit plants and rootstocks through seed

Pre-learning required: Knowledge of raising of fruit plants through seed and seed dormancy.

Handouts/material required/equipment's & tools: Paper sheet and pen to note down the instructions, different tools for land preparation, farmyard manure, fertilizers, seeds of fruit plants, File, wooden boxes, tin boxes, plastic containers, refrigerator, sterilized sand, sphagnum moss, mercuric chloride, gibberellins, thiourea, sulphuric acid, labels, hammer, nut cracker, bavistin, herbicide, etc.

Introduction: Nursery is a place where seedlings, cuttings and grafts are raised with more care before transplanting. Nursery is consequently the basic need of horticulture. Plant propagation techniques and practices is the core of horticulture nurseries. The planting material of horticultural crops is raised from seeds and vegetative parts.

Advantages of raising seedlings/rootstocks of fruit plants in nursery

1. It is very convenient to look after the tender seedlings
2. It is easy to protect the seedlings from pests and diseases
3. Economy of land usage (duration in the main field is reduced)
4. Valuable and very small seeds can be raised effectively without any wastage.
5. Uniform crop stand in the main field can be maintained by selecting healthy, uniform and vigorous seedlings in the nursery itself.
6. Seedlings and grafts are produced in nursery and the fruit orchards and ornamental gardens can be established with minimum care, cost and maintenance.
7. The nursery planting materials are available at the beginning of the planting season.
8. This saves the time, money and efforts of the farmers to raise seedlings.
9. There is a wide scope for fruit orchards, ornamental, vegetable, and landscape gardens at public gardens, highways and co operative housing societies.

Propagation by seed

Papaya, phalsa, kagzi lime and jamun are usually propagated by seeds. Seeds are also used to raise rootstock seedlings in many fruit crops such as citrus and mango. This method being the easiest and cheapest is generally employed on a commercial scale in the fruit crops. In mango and citrus, nucellar seedlings can be used to raise true-to-type plants. Seed propagation is essential for breeding new plant type, conserving gene pools. Propagation by seed requires a thorough knowledge of seed viability, its

storage, time of sowing, factors responsible for germination and care of germinated seedling is essential.

The condition in which the seed can germinate immediately upon the absorption of water in the absence of any internal germination barrier, the embryo (or seed) is said to be quiescent. While those seeds which fail to germinate even though the embryo is alive, moisture is absorbed and favourable condition are provided are known as dormant seeds.

In many fruit crops, seeds required pre-sowing treatments to overcome dormancy or to enhance germination rate. The dormancy in seeds of ber, guava and walnut is due to presence of hard seed coat which inhibits penetration of water and oxygen required for germination. Presence of chemical inhibitors (abscisic acid) is responsible for dormancy in seeds of most of temperate fruits (apple, pear, peach and walnut). Besides ABA, higher concentration of pectin, gum, tannin and amino acids (trypophan) are also responsible for dormancy in seeds of temperate fruits.

Seed dormancy due to hard seed coat can be overcome by softening the seed coat and other covering. It can easily be done either by scarification, stratification or by use of chemicals and hormones.

Scarification:

- It is the process of breaking, scratching, altering or softening the seed covering to make it permeable to water and gases. Scarification can be achieved mechanically, or by hot water and acid.
- In mechanical scarification, cracking of seed with hammer, rubbing with sand paper or cutting with a file without injury to embryo is generally employed to break the dormancy (ber, peach and walnut).
- Impermeable seed coat of guava can be softened by hot water scarification. Seeds are placed in hot water at 77°-100°C. They are immediately removed from hot water and allowed to soak gradually in cool water for 12-24hr.
- Acid scarification consists of treating guava seeds with concentrated sulphuric acid for 3 minutes, ber for 5-6 hr and strawberry seeds with 0.25% nitric acid or hydrogen peroxide results in higher germination.

Stratification:

- It is the method of handling of dormant seeds, in which, the imbibed seeds are subjected to a period of chilling to after-ripen the embryo. This term originated as the nurserymen used to place seeds in stratified layers interspaced

with a moist medium such as soil or sand out of door or in pits during winter. The term moist chilling has been used as synonym to stratification. Stratification can be achieved by refrigeration of dormant seed.

- Dormant seeds of temperate fruits like apple, cherry, pear and apricot are generally placed in layers of sand in a box at a temperature of 1°-5°C. Depending upon the seed type, treatment time varies from 1-5 months for breaking dormancy of seeds.
- Keep the fungicide treated soaked seeds in wooden boxes or in soil pits containing moistened sand in alternate layers (seed followed by sand and so on) maintained at a low temperature (below 7.2°C).
- Generally, it is done in the months of November-December. For small quantities of seed, use tin cases or rigid plastic containers (used ice cream or freezer containers). Make holes in their base and place the seed in alternate layer of stratification medium (sphagnum moss/sand/perlite).
- Keep the containers in a refrigerator/deep freezer maintaining temperature below 7.2°C for varied period depending upon the fruit crop.
- Ensure that the site of stratification is rodent - free, shady and adequate moisture is maintained. Prepare a map indicating which seed lot is in each box/pit container in addition to labels tagged on them.



The seed dormancy due to presence of growth inhibitors can be broken by placing the seeds in running water. It results in leaching of inhibitors. The freshly extracted seeds of strawberry and grape if placed in running water for 7-12 days result in increased germination.

Chemical treatments:

- Many freshly harvested dormant seeds usually respond to soaking in potassium nitrate solution. This technique is largely used in seed testing laboratories

where seeds are placed in petri-dishes containing 0.2% solution of potassium nitrate.

- The seeds of peach and grape, treated with 5,000ppm of thiourea show enhancement in their germination.

Use of hormones:

- The seed dormancy can also be overcome by the treatment of growth regulators.
- Treatment of seeds of apple, cherry, peach, strawberry and hazelnut with 100-500ppm of GA_3 for 24-48hr improves germination and better growth of seedlings.
- Ethrel (5,000ppm)-treated seeds of guava and strawberry also show better germination and growth of seedlings.
- Treatment of apple and peach seeds with 10-20ppm solution of benzyle adenine (BA) is effective for higher seed germination.

Seed sowing

- The fruit seeds are sown in seed bed, polythene bags or in situ.
- Seeds of tropical and subtropical fruits are sown during monsoon (June-July) or in the beginning of spring (February-March).
- Generally seeds of mango and jackfruit are sown during June-July while those of guava, ber and aonla during February-March.
- Seeds of temperate fruits are generally available during June-October and their sowing should be done after the dormancy period is over.
- In citrus, mango, loquat, litchi and jackfruit, seed viability is very less, so these should be sown immediately after extraction.
- In north India, seeds of different citrus types are available during winter months. Germination of seeds is low due to prevailing low temperature. Hence use of polythene sheet on seed beds during December-January is useful in increasing germination percentage and faster growth of seedlings.
- The seeds are usually sown at a depth 3-4 times of their size. It should be a little deep in light soils while shallow in heavy soils.

- Nowadays, sowing of seeds in polythene bags, earthen pots and pans is becoming popular. It is usual practice to sow papaya seeds in polythene bags. For epicotyl grafting, mango stones are also sown in polythene bags.
- While raising the plants in polythene bags, care should be taken that root system develops properly. It has been observed a number of times that the roots get twisted and there is difficulty in establishment of the plants in field due to poor anchorage.
- In-situ sowing: In walnut, pecan nut, jackfruit and ber, the tap-root system is very vigorous. So during the process of transplanting, root system is disturbed which ultimately affects their establishment in the field. Therefore, for these fruits, sowing of seeds in-situ is recommended. In rocky soils, in-situ sowing of mango seeds and grafting later on is recommended.

Procedure

1. Procure the seeds from well maintained seed orchards or from fruit processing industries. The former is a better source of seed. Seeds should be mature with uniform colour, size and shape.
2. Stratify or scarify the seeds, if required.
3. Prepare the seed beds in an area which is flat, fertile, well drained, irrigated, rich in organic matter and receives adequate sunshine.
4. Precondition the nursery beds by applying 60-80 tonnes FYM/ha, 60-120 kg N/ ha and 60-90 kg P2Os/ha.
5. Sow the seeds of small size (e.g. of apple and pear) at a depth of 3-5 cm, 5-6 cm apart in rows at a distance of 10-15 cm. Sow large seeds (e.g. of stone fruits) at a distance of 6-10 cm from seed to seed.
6. Cover the seeds with a thin layer of fine sand and mulch with dry grass or polythene sheet.
7. Irrigate lightly after the sowing of seeds.
8. Once the seedlings have emerged, these should be looked after properly, single stemmed to a height of 45-60 cm, so that the main stem is healthy.

- Acidic and alkaline soils are not suitable for raising nursery rather, neutral soils are suitable.

- Soil should normally be rich in all essential nutrient elements, but this can be further improved by addition of manures and fertlizers.

Exercise1: Evaluate scarification techniques and their effect on germination percentages.

Select 10 seeds for each of the four treatments and put in the four different containers provided.

a. Treatment 1- Control (no scarification)

b. Treatment 2- Seeds soaked in hot water

c. Treatment 3- Seeds soaked in acid (sulfuric acid)

d. Treatment 4- Mechanical scarification (use sandpaper, file, or clippers)

Record the seed germination data for your group and the entire class.

Exercise 2: Evaluate stratification techniques and their effect on germination percentages.

Select 100 seeds and put them under stratification in a box and keep it in refrigerator. Record your observations.