Crop Production Level – II

Based on Version 3 March 2018 OS.

Training Module –Learning Guide 45-49

Unit of Competence: **Assist to Establish and Maintain Nursery Plants**

Module Title: - Assisting to Establish and Maintain Nursery Plants

TTLM Code: -AGR CRP 2-M10 2019V1

October 2019

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TTLM Code: -AGR CRP 2-M10 2019

This module includes the following Learning Guides

LO-1:-Select nursery site

LG Code: AGR CRP2 M10 LO1-LG-45

LO-2:-Prepare nursery beds

LG Code: AGR CRP2 M10 LO1-LG-46

Lo3:- Establish nursery

LG Code: AGR CRP2 M10 LO1-LG-47

LO4:- Maintain the nursery environment& plants

LG Code: AGR CRP2 M10 LO1-LG-48

LO5:- Complete nursery plant maintenance operations

LG Code: AGR CRP2 M10 LO1-LG-49

INSTRUCTION SHEET 1	Learning Guide 45

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics –

- Selecting site according to site selection criteria
- Clearing the land
- Conducting survey and nursery plot design

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, you will be able to –

- ❖ Select site according to site selection criteria and nursery guidelines
- ❖ clear the Land from any vegetation according to nursery guidelines
- ❖ Survey and plot design of nursery soil

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Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described
3. Read the information written in the information “Sheet
4. Accomplish each “Self-check respectively.
5. If you earned a satisfactory evaluation from the “Self-check” proceed to the next or “Operation Sheet
6. Do the “LAP test”

INFORMATION SHEET -1	Selecting site according to site selection criteria

Whatis nursery ?

A nursery couldbeconsiderd as a location where plants are cared for during the early stages of growth , providing optimum condition for germination and subsiquentgrowth , untilthey are strongenough to beplanted out in their permanent place .The term nursery to samehorticulturists, alsoincludesgrowingsomeornamental plants(mainlyannuals and beinnials) and vegetaablecrops for seedproductionTreecropssuch as citrus , mango , etc., alsorequire a field nursery whereroot stocks are raiseduntiltheyreach the stage of optimum growth for budding and grafting . Plants remains in the field nursery for furtherperiod of year or more , untilthey are raedy for transplanting to the permanent site, or sold. Nursery raising: a nursery bed is an area where seed are sown densely to germinate and to emerge. Buds, roots or other propagules are allowed to sprout and produce roots. They are nourished for period to enable them to grow in to seedlings or transplants or other planting materials until they are ready for transplanting in the field. The nursery bed may dry or wet or may be raised flat or flat with furrows

Advantages of nursery raising and transplanting

- It is easy, convenient and consume less time and input to nourish the young and tender seedling in the small but compact area of nursery bed
- Weak and diseased seedling can be removed at the time of transplanting
- Easy to maintain de3sired plant density with pure, true to type, healthy, strong and stocky seedling.
- Transplanting provide enough time for ripening, after maturity of previous crop in the field and land preparation for succeeding crop in intensive cropping.
- Transplanting helps to escape from adverse atmospheric condition during germination, emergence an establishment of the crop in comparison with direct seedling or sowing.
- Greater uniformity, higher yield of produce with precise quality can be obtained

Disadvantages of Nursery bed and transplanting

- Total duration of the crop may be higher
- It increases labor and power requirement to raise the crop
- It increases cost of land preparation, uprooting and transplanting the seedlings

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1.1, Basic requirements for selecting nursery site

Factors to be considered when locating a nursery are determined by the nature of the nursery business and the extent to which it is to be developed .In other words, it will depend up on the kind of operation s one intends to carry out. If ornamentals and vegetables are to be raised for seed production and planting stocks for tree crops are to be produced on a commercial scale, then an extensive area would be required.

Essentially, a nursery should have continuous source of water and a shaded area where young plants are protected from the sever heat of the sun. A nursery location should also be protected from strongwinds, because tropical winds often cause extensive damage to plants and structure if this are adequately protected.

Availability of water throughout the year and its controlled supply is most essential in nursery practice. Cultivars of horticultural plants can be propagated throughout the in tropical climate, provided the water supply is assured. A nursery should have its own supply of water either from a bore hole or surface well with pumping and storage facilities. It is very unwise to depend solely up on external source for water, whether the nursery is small or big. A surface tank built close to the field nursery will serve as the reservoir. The source of supply to the tank could either be from a bore hole or deep surface well. A small scale sprinkler could be operated as well from a facility such as this or water could be fed to the field by the gravity. The protection of tender nursery from direct sunlight is most important as the heat and glare of the sun, especially during the middle of the day, can harm the plants in the nursery. If natural shade is not already available in the site selected, trees preferably of leguminous species such as Albezzia, Cassia, etc., should be planted. *Cassia siamea* is selected from the other species of cassia due to its fast growing characteristics, giving reasonably good shade within a short time. Nursery plants that would benefit most from natural shade are potted plants. Compost, which the main source of organic manure for well managed nursery, will also require shade for its preparation in tropical conditions.

Trees planted at the boundaries around the nursery will protect the nursery plants from strong winds. Excessive wind causes dryness of the foliage under dry climatic conditions.

Wind breaks help to prevent this and also maintain arelatively constant temperature around the plants. Two or three rows of closely spaced Eucalyptus, a row of cashew,mango or whistling pine can serve as a good wind break.

Generally, nurseries in the tropicsdealingwith a variety of horticultural plants wouldrequièreselectedvariety of treecropssuch as mango , citrus , etc. to serve as source of scion materials.Onewouldthusfinditideal to plant them at the bouderies to serve as Wind breaks.

1. 2, selecting available slope and soil fertility for nursery site

1. 2.1, Aspect of slope

A poorly sited vegetable garden may produce inferior crops even though sound methods of cultivation are used. This is because the microclimate of a site is greatly influenced by its slope. Lands which slope steeply can be difficult to cultivate and erosion of the top soil can become a series problem in regions with heavy rainfall. A level site is generally suitable, but slight slop can be an advantage because it assists drainage and hence prevents water logging.

1. 2.2, Soil

Deep, fertile, light to medium loamy soils are the most suitable for vegetable production. Therefore, before buying or renting land for establishment of a vegetable garden, it is essential that the soil should be inspected in order to estimate its suitability. Information on the structure and physico-chemical content will enable the grower to take any necessary steps to improve the fertility and will serve as a guide for further cultivation.

Although most vegetable crops can in practice be grown on a much wider range of soil types, it is as well to be aware of particular crop requirements when selecting a site for specialized production. For example, root crops are more suited to sandy soils and the presence of stones is particularly disadvantageous.

Tropical soils vary widely as regards texture, organic and mineral content and general fertility , but a great deal can be done to improve land if intensive methods of cultivation are practiced .These includes the regular application of organic fertilizer s, crop rotation and conservation measures. Other routine practices such as mulching, irrigation and disease and pest control will contribute to an increase in soil fertility. Generally, it is possible to correct nutrient levels and PH to suit particular crops but soil texture is more difficult to modify.

1.2.2.1. PREPARE THE SOIL

The ideal soil should be deep, well-drained, fertile, contain plenty of organic matter, and retain moisture well. It should also be friable (easily worked) and reasonably free of stones. Soils vary in texture (size of soil particle) from sandy (course particles) to clay (fine particles). Silts fall between sandy and clay textures, while loams are mixtures of all the above. Sandy soils tend to be low in fertility and do not hold water well. Clay soils often drain poorly, crack severely when dry, and become very sticky when wet. Sandy loam soils are ideal for producing most vegetables. Adding organic matter to almost any Southwestern soil will improve its structure. Most soils in New Mexico are low in organic matter.

Adding organic matter to a sandy soil improves both its water-holding capacity and its cation exchange capacity, or the ability of the soil to retain nutrients for plant uptake. Adding organic matter to clay soils aerates these soils and improves their drainage. One of the easiest ways to add organic matter to your garden soil is to apply livestock manure at a rate of 50-100 lb/100 ft2. Use lighter rates when applying chicken manure, as it tends to be”hotter" manure (higher in nitrogen) than manure from larger livestock like cattle and horses.

Fresh manure should only be applied in the fall so it has the time to break down in the soil. Heat-treated or composted manures are preferred because fresh manure can introduce weed seed into the garden. Fresh manure applied in the spring often burns young seedlings due to the high salt content of the manure. Large amounts of organic matter can be added to the soil using "green manure" crops. A green manure crop is any crop grown specifically as a source of forage that can be incorporated back into the soil as a source of organic matter. The most popular green manure crops are winter wheat, barley, oats, and rye. Seed can be obtained from most local farm feed stores and liberally scattered around the garden in late summer or early fall. Rake the seed into the soil around existing vegetables, then water. After first frost, pull up frost-damaged summer vegetables, leaving a "carpet" of green grass to develop in late fall. A little nitrogen fertilizer applied the following spring will speed growth. Approximately one month before planting your garden, the green manure crop should be thoroughly rototilled into the soil. A little extra nitrogen fertilizer will help microorganisms in the soil rapidly break down the organic matter.

Most gardeners find the easiest way to add organic matter to the soil is to apply compost. Compost is often made from leaves, grass clippings, food wastes, and garden vegetable waste from the previous growing season. A 1- to 2-inch layer of well-decomposed compost can be incorporated into the soil before planting. Most New Mexico soils tend to be

alkaline, which makes some soil nutrients like phosphorous, iron, and zinc unavailable for plant uptake. Well-decomposed compost (often called humus) contains humic acid, and when added to alkaline soils, helps to make these nutrients more available for plant uptake. Compost and manures also contain a wide variety of nutrients. Because the nutrients are in an organic form, they tend to be more stable in the soil and more available for plant uptake over a relatively long time. They do not, however, occur in large quantities, thus most gardeners rely on commercial fertilizers for optimum plant growth.

SELF CHECK-1	Written test for self-evaluation

Name; ---------- date ----------

Direction; answer the following questions, pay attention in each activity and try to answer to the point.

1. What is nursery? 5 point
2. List factors considered during nursery site selection?5 point
3. What are Basic requirements for selecting nursery site? 5 point

Note: **Satisfactory rating - 3 and 5 points Unsatisfactory - below 3 points**
You can ask you teacher for the copy of the correct answers.

Name: _____ Date: _____

INFORMATION SHEET-2	**Clearing The Land**

2.1 SITE CLEARING

The Contractor shall submit a site clearing method for all areas where the Contractor is required to, or intends to, clear vegetation, either within the road reserve or at the other designated construction areas outside the road reserve. The method statement shall clearly indicate chain age or land references and shall detail any search and rescue and/or seed collection to take place, what is to be cleared and how this will be done, where and how cleared material would be stored or disposed of, etc.

2.2 Vegetation clearing

No vegetation clearing shall take place without written approval of the method statement by the organization. No vegetation clearing shall take place until a search and rescue of conservation-worthy plants has been under taken. No vegetation clearing shall take place until seed collection has been undertaken in the area, unless the area is not deemed suitable for seed collection. Before clearing of vegetation, the Contractor shall ensure that all litter and non-organic material is removed from the area to be cleared. Vegetation clearing shall take place in a phase manner in order to retain vegetation cover for as long as possible. Vegetation clearing in watercourses and wetland areas shall be conducted by hand. No heavy machinery shall be permitted in watercourses to clear vegetation. Vegetation cleared from watercourses shall be removed from the watercourse immediately to prevent flooding. All indigenous plant material removed from cleared areas shall be stockpiled for mulching. All remaining vegetation shall be removed and disposed of at an approved landfill site.

2.3. Topsoil

The Contractor shall remove topsoil from all areas where topsoil will be impacted on by

construction activities, including temporary activities such as storage and stockpiling, etc. Stripped topsoil shall be stockpiled in areas agreed with the organization for later use in revegetation and shall be adequately protected. Topsoil is considered to be the natural soil covering, including all the vegetation and organic matter. Depth of topsoil stripped may vary Topsoil stockpiles shall be convex and no more than 2 m high. Stockpiles shall be shaped so that no surface water ponding can take place. Topsoil stockpiles shall be protected from erosion by wind and rain by providing suitable Storm water and cut off drains and/or by establishing suitable temporary vegetation. Stockpiles shall not be covered with materials such as plastic that may cause it to compost or would kill the seed bank. Topsoil stockpiles shall not be subject to compaction greater than 1500 kg/m2 and shall not be pushed by a bulldozer for more than 50m.Topsoil stockpiles shall be monitored regularly to identify any alien plants, which shall be removed when they germinate to prevent contamination of the seed bank. Before topsoil is to be re-used the stockpiles shall be analysed by a suitably qualified landscape contractor / horticulturist and, if necessary, upgraded before use. Any topsoil contaminated by hazardous substances shall not be used but shall be disposed of at approved landfill site.

The Contractor shall be held responsible for the replacement, at his own cost, for any unnecessary loss of topsoil due to his failure to work according to the approved method statements.

2.4, ploughing of land for nursery bed preparation

2.4.1, Soil Preparation

Nursery bed preparation is an important step in crop management because it largely affects crop stand and its performance at field level. Therefore, soil should be worked to a fine tilth by repeated ploughing and spading. Dead plant parts which are seem to be dwellers of pathogens and pests should economized through nursery. Nursery production help in maintaining effective plant stand in shortest possible time through gap fillings.Be collected, removed and burnt. Well decomposed organic manure 40-50 kg/10sqm, should be mixed thoroughly in the soil.

2.4.2, **Soil treatment**

Soil treatment is an essential step in a successful nursery management because it the base for seedlings stands, source of nutrition and pathogens. In humid Islands damping-off caused by soil borne fungi like Pythium, Rhizoctonia, Phytophthoraetc, is a common disease in the nursery beds. Besides, pests like snails, cutworms and termite and mites areal so damages young seedlings.

There are various measures for soil treatment like soil solarization, chemical treatment, bio-control treatment etc. Soilsolarization can be done with transparent polythene of 25-100mm thickness during the hot and dry periods. For this soil should be moist before mulching because it increases latent heat and thermal sensitivity for resting of soil borne pathogens, harmful pests and weeds which can be reduced to a sustainable level. Chemical treatment of nursery beds can be done by Formalin solution (1:100:: Formalin: water) 5 lt/sqm. The treated area should be covered with polythene sheets for 7-8days and after that it should be remained open for next 7-10days for facilitation of formalin emission. Besides, the nursery beds and seeds can be treated with some fungicides like Ceresan or Bavistin 2g/litre before sowing. The insect-pests can be controlled by treating soil with Chlorpyriphos or Sewin dust powder (20-25g/sqm) before sowing and or at the time of nursery preparation. Presently a large number of bio agent's likeTrichoderma, Pseudomonas and Bacillus formulations areavailable for soil as well as seed treatment which performs as antagonist to harmful microorganisms. Some of botanicals like NSK, Neem cake, Karanj cake etc. also can be used for nursery bed treatment.

2.5. Soil leveling and pulverizing for nursery bed preparation.

For good crop growth, it is necessary that seed should be placed at uniform depth. This is only possible when fields are kept fairly leveled. The leveling also reduces run off which is very common in slopy and undulated fields. By preventing run off, washing away the nutrient along with water and soil can also be checked. In areas where irrigation and drainage channels are to be constructed, leveling is an important aspect for uniform distribution of water. The implements which can be used for leveling are planker, ridger, roller, scraper and bund former.

The nursery area is a fraction of the transplanted area and it is to prepare land. Repeated ploughing and harrowing followed by planking make the soil friable and well pulverized. In weed infested areas, weeds should be first scrapped from soil before starting other operations. The nursery bed should be tilled shallow so that roots cannot penetrate too deep. This will help in tile uprooting of seedlings during transplantation. The deeply penetrated roots cause breakage of tender shoots and the recovery of quality seedlings per unit area decreases.

2.6, Preparing seed bed based on the types of crops and environmental conditions.

Before sowing seeds the beds should be leveled and pressed gently to make it firm. Nearly 15-20 cm raised beds of 45-50 cm width are always preferred for raising nursery. However, its length should be made according to the requirements or size of plots but should not exceed 5-6 m. In between beds, drains of about 30-45 cm width are prepared and connected to the main drain for removal of excess water during heavy pour. This space facilitates easy movement during intercultural operations and acts as physical barrier for inoculums spread. The drains are flooded during dry period to modify microclimate of nursery beds in favor of seedlings. In recent years various advancements have been made in nursery management for bed preparation to avoid possibilities of pathogen spread like use of soil less media, plug tray technique, perforated poly trays etc.

SELF CHECK-2	Written test for self evaluation

Direction; answer the following questions, pay attention in each activity and try to answer to the point.

1. How nursery bed can be prepared?5 point
2. List advantages of nursery site clearing?5point

3. List advantages of soil treatment?5 point

Note: **Satisfactory rating - 8 and 15 points Unsatisfactory - below 8 points**
You can ask you teacher for the copy of the correct answers.

Name: _____ Date: _____

INFORMATION SHEET-3	Conducting survey and nursery plot design

2.1 What is site surveying?

a method of assessing and conducting analysis to collect necessary information about nursery site to design the correct plot. a practice of measuring distances on the ground so that they can accurately plotted.Design is a plan of field for nursery site preparation and bed lay out. Plot is a small area of ground covered by specific vegetation.

Surveys

Control stakes are the responsibility of Surveys. The construction survey shall be performed in cooperation with the Resident Engineer and the Structure Representative.

The following are the responsibilities of Surveys:

a. Ensures statewide conformity.

b. Performs State-furnished construction staking prior to contract award as determined necessary by the Resident Engineer.

c. Performs all State-furnished construction staking that requires the use of a survey party.

d. Determines the methods and procedures to accomplish the State-furnished construction staking.

e. Checks data furnished by the Project Engineer for completeness and discrepancies.

f. Checks the conformity of planned lines and grades with existing conditions at pavement "conforms", curb and gutter joins, inlets and outlets of drainage facilities, etc.; advises the Resident Engineer of any problems; makes minor adjustments to lines and grades under the direction of the Resident Engineer.

g. Advises the Resident Engineer of all discovered design issues (problems) regarding lines and grades, and records the problems in daily Survey Party Reports.

h. Keeps the Resident Engineer informed of pertinent construction staking issues; accepts construction staking requests only from the Resident Engineer; and keeps adequate records of State-furnished construction staking efforts (work accomplished, dates, time and resources required, survey data and restaking).

i. Sets lath when normal staking is hidden by vegetation.

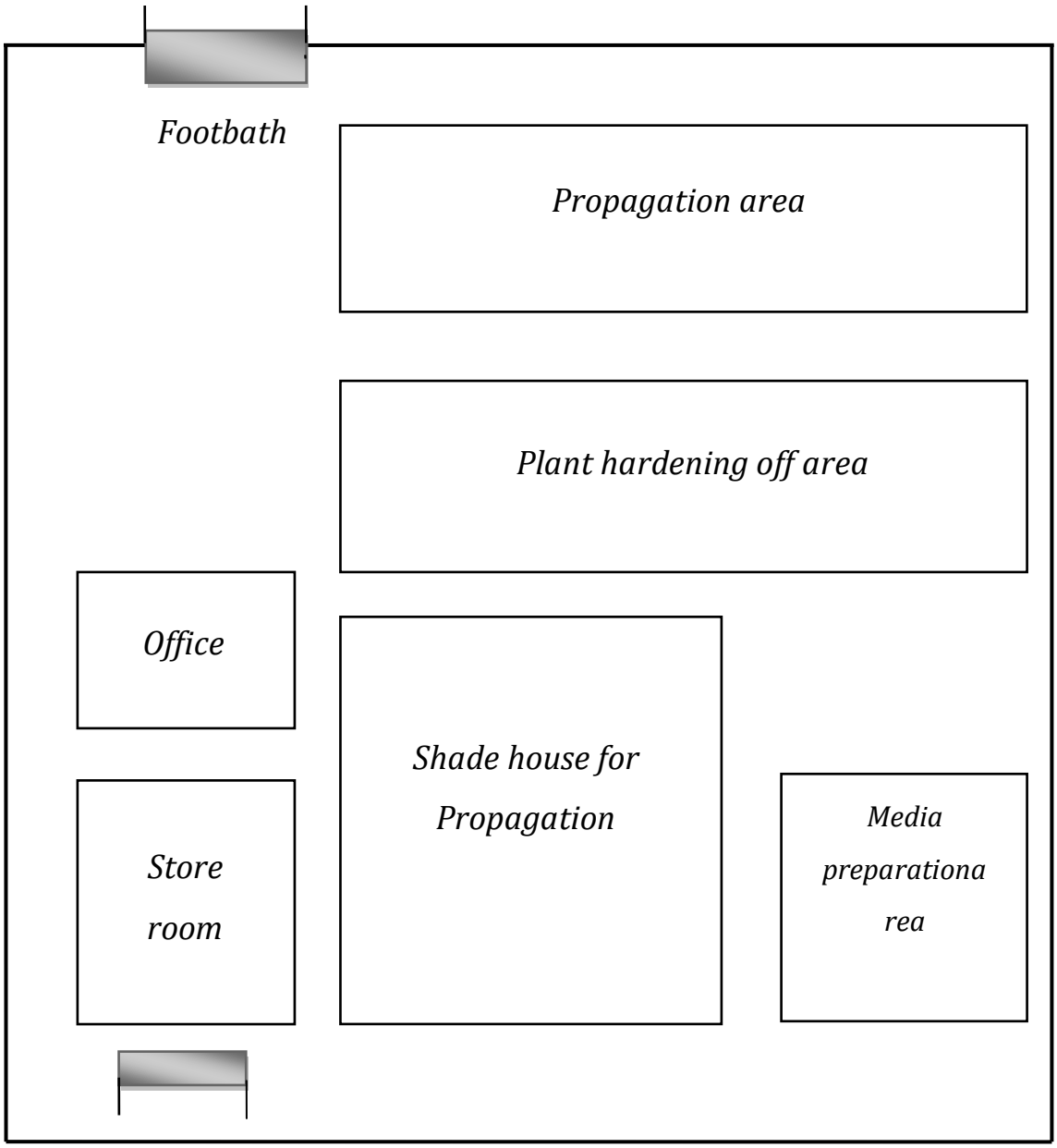
j. Communicates with the Structure Representative on the availability of safety-related protection equipment for work on superstructures.

Nursery Design and Layout

In the design of a commercial nursery, all the nursery structures and other facilities are arranged to ensure a constant flow of activities. The layout of the nursery depends on:

- Climatic and environmental conditions.
- The type of scheme in operation.
- The type of propagation structure in use.
- The resources available.
- Other factors unique to each individual situation.

The figure below is a ground plan of a simple commercial nursery showing some of the major structures and facilities.



The size of land to be selected for nursery depends on –

1) Morphological characteristics of the plant species.
2) Size of the stock to be planted
3) The annual production target
4) Method of raising the seedlings
5) The degree of permanence of the site.

For intermediate nursery, the area actually occupied by the seedlings plus the access roads and storage sheds constitute the nursery area. In a permanent nursery, additional room has to

Figure 1. Ground plan of a simple commercial nursery.

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be provided for crop rotation in order to maintain the organic matter and nutrient status of the soil. Where mechanical equipment is to be used, equipment maintenance and storage centers have to be provided for in the nursery.

SELF CHECK-3	Written test for self-evaluation

Name; ---------- date ----------

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Direction; answer the following questions, pay attention in each activity and try to answer to the point.

1. What is site surveying? 5 point
2. what is site design ?5 point
3. discus on the responsibilities of Surveys?5point

Note: **Satisfactory rating - 10 and 15points Unsatisfactory - below 10 points**
You can ask you teacher for the copy of the correct answers.

Name: _____ Date: _____

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics –

- Ploughing the land
- Pulverizing and leveling the soil
- Preparing seed beds based on types of crops and environment

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, you will be able to –

- Plough the land according to
- Pulverize and level the soil
- Prepare seed beds based on types of crops and environment

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 to 6.
3. Read the information written in the information “Sheet 1, Sheet 2 and Sheet 3”.
4. Accomplish the “Self-check 1,Self-check t 2 and Self-check 3” **in page -18, 20 and 23**respectively.

Information sheet-1	Ploughing the land

1.1, ploughing of land for nursery bed preparation

1.1.1, Soil Preparation

Nursery bed preparation is an important step in crop management because it largely affects crop stand and its performance at field level. Therefore, soil should be worked to a fine tilth by repeated ploughing and spading. Dead plant parts which are seem to be dwellers of pathogens and pests should economized through nursery. Nursery production help in maintaining effective plant stand in shortest possible time through gap fillings.Be collected, removed and burnt. Well decomposed organic manure 40-50 kg/10sqm, should be mixed thoroughly in the soil.

1.1.2, **Soil treatment**

Soil treatment is an essential step in a successful nursery management because it the base for seedlings stands, source of nutrition and pathogens. In humid Islands damping-off caused by soil borne fungi like Pythium, Rhizoctonia, Phytophthoraetc, is a common disease in the nursery beds. Besides, pests like snails, cutworms and termite and mites areal so damages young seedlings.

There are various measures for soil treatment like soil solarization, chemical treatment, bio-control treatment etc. Soilsolarization can be done with transparent polythene of 25-100mm thickness during the hot and dry periods. For this soil should be moist before mulching because it increases latent heat and thermal sensitivity for resting of soil borne pathogens, harmful pests and weeds which can be reduced to a sustainable level. Chemical treatment of nursery beds can be done by Formalin solution (1:100:: Formalin: water) 5 lt/sqm. The treated area should be covered with polythene sheets for 7-8days and after that it should be remained open for next 7-10days for facilitation of formalin emission. Besides, the nursery beds and seeds can be treated with some fungicides like Ceresan or Bavistin 2g/litre before sowing. The insect-pests can be controlled by treating soil with Chlorpyriphos or Sewin dust

Information sheet-2	Pulverizing and leveling the soil

powder (20-25g/sqm) before sowing and or at the time of nursery preparation. Presently a large number of bio agent's likeTrichoderma, Pseudomonas and Bacillus formulations areavailable for soil as well as seed treatment which performs as antagonist to harmful microorganisms. Some of botanicals like NSK, Neem cake, Karanj cake etc. also can be used for nursery bed treatment.

2.2. Soil leveling and pulverizing for nursery bed preparation.

For good crop growth, it is necessary that seed should be placed at uniform depth. This is only possible when fields are kept fairly leveled. The leveling also reduces run off which is very common in slopy and undulated fields. By preventing run off, washing away the nutrient along with water and soil can also be checked. In areas where irrigation and drainage channels are to be constructed, leveling is an important aspect for uniform distribution of water. The implements which can be used for leveling are planker, ridger, roller, scraper and bund former.The nursery area is a fraction of the transplanted area and it is to prepare land. Repeated ploughing and harrowing followed by planking make the soil friable and well pulverized. In weed infested areas, weeds should be first scrapped from soil before starting other operations. The nursery bed should be tilled shallow so that roots cannot penetrate too deep. This will help in tile uprooting of seedlings during transplantation. The deeply penetrated roots cause breakage of tender shoots and the recovery of quality seedlings per unit area decreases.

SELF CHECK-1	Written test for self-evaluation

Name; ---------- date ----------

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Direction; answer the following questions, pay attention in each activity and try to answer to the point.

1. What is Soil treatment? 5 point
2. what is Soil Preparation?5 point
3. what is the nursery area ?5point

Note: **Satisfactory rating - 10 and 15 points Unsatisfactory - below 10 points**

You can ask you teacher for the copy of the correct answers.

- **Ploughing**: -

The activity of making the area of land ready for seed bed preparation.

It is the activity of digging and turning over soil; especially before seeds are sown.

- **Pulverizing**: - the activity changing soil in to a fine powder.
- **Leveling**: - the activity of making the land level. It is the task of making the height difference equal using line level.
- **Ditching**: - it is the activity of making the sides of land to hold or to take away water. It is the activity under take to make along channel dug at the side of the fields.
- **Performing proper mixing of soil to nutrient ratio**

Different crops response differently in different soil and nutrient and they also require different ratio of soil and nutrient. The soil ready for spice production should be well fertile with alternative nutrient and organic manures. Top soil rich in humus and organic manure is essential for cultivation of most crops. In order to make the soil proportional in ratio;

2.1. Soil leveling and pulverizing for nursery bed preparation.

For good crop growth, it is necessary that seed should be placed at uniform depth. This is only possible when fields are kept fairly leveled. The leveling also reduces run off which is very common in slopy and undulated fields. By preventing run off, washing away the nutrient along with water and soil can also be checked. In areas where irrigation and drainage channels are to be constructed, leveling is an important aspect for uniform distribution of water. The implements which can be used for leveling are planker, ridger, roller, scraper and bund former.

The nursery area is a fraction of the transplanted area and it is to prepare land. Repeated ploughing and harrowing followed by planking make the soil friable and well pulverized. In weed infested areas, weeds should be first scrapped from soil before starting other operations. The nursery bed should be tilled shallow so that roots cannot penetrate too deep. This will help in tile uprooting of seedlings during transplantation. The deeply penetrated roots cause breakage of tender shoots and the recovery of quality seedlings per unit area decreases.

SELF CHECK-1	Written test for self- evaluation

Information sheet-3	Preparing seed beds based on types of crops and environment

Name; ---------- date ----------

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Direction; answer the following questions, pay attention in each activity and try to answer to the point.

1. What is Ploughing? 5 point
2. what is Leveling?5 point
3. define Pulverizing?5point
4. discus on nursery area?5point

Note: **Satisfactory rating - 10 and 20points Unsatisfactory - below 10 points**
You can ask you teacher for the copy of the correct answers.

Name: _____ Date: _____

3.1 **Preparing seed bed based on the types of crops and environmental condition**

Before sowing seeds the beds should be leveled and pressed gently to make it firm. Nearly 15-20 cm raised beds of 45-50 cm width are always preferred for raising nursery. However, its length should be made according to the requirements or size of plots but should not exceed 5-6 m. In between beds, drains of about 30-45 cm width are prepared and connected to the main drain for removal of excess water during heavy pour. This space facilitates easy movement during intercultural operations and acts as physical barrier for inoculums spread. The drains are flooded during dry period to modify microclimate of nursery beds in favor of seedlings. In recent years various advancements have been made in nursery management for bed preparation to avoid possibilities of pathogen spread like use of soil less media, plug tray technique, perforated poly trays etc.

1. Nursery Preparation

• Plough & pulverize the soil thoroughly. Prepare nursery bed measuring 1 m wide and 15-20 cm high and of convenient length (3-5m).
• Treat seeds with Bavistin (Carbendazim) @ 2gm/ kg seed, against Phytopthora and other seed borne diseases.
• Seed rate is about 0.5-1 kg of quality seed per acre with minimum germination of 75%.
• Sow seeds about 2 cm deep in lines at cm apart.
• In mid-elevation areas, raised nursery in polytunnel for early chilli production and normal open nursery for main season chilli production.
• In high-elevation areas, sow the seeds in plastic tunnel. This will bring forward the growing season by one month.
• The seedlings are ready for transplanting in about 30 to 60 days after sowing depending on the elevation under ambient conditions or when the seedlings attained 12-15 cm height.

2. Field Preparation

• Cultivate, pulverize and level the field after bringing soil to a good tilth.
• Raise 1m wide, 15-20 cm high beds and any convenient length(3-5m). Proper levelling of

field and beds is important for water and disease management
• Raised bed and drainage is important for chilli wilt management
• Apply 10-12MT of well rotten FYM and 20:30:15 NPK kg/acre as basal dose.
• Apply all FYM during field preparation. Apply all the basal fertilizer at about 9-10gm of fertilizer mixture per planting hill and mix them into the soil with the help of a hand hoes.

3. Transplanting

• Transplant seedlings of 12-15cm high, preferably during evening time and water immediately to avoid transplanting shock.
• Transplant the seedlings at 45 cm between rows and 30 cm between plants in a row or a population of at least 25,000 plants per acre.
• Top-dress the crop with 10 kg of additional nitrogen after 30 and 60 days after transplanting. Split the top dressing fertilizer in two halves in very light soils.

Benefits nursery raising:

The soil is well prepared and all operations required to raise seedlings are carried out in most
efficient manner.
Large number of seedlings can be produced from an unit area
Sowing seeds in nursery allow additional time for preparatory tillage in the main field and if needed, the harvesting of previous crop can be prolonged
Off season sowing of seeds becomes possible which ultimately fetches more return.
Over crowding of plants in the main plot can be checked or thinning operation can be avoided
Discarding of week seedlings become possible
It reduces the seed rate and cost of cultivation

Types of nursery beds:

There are 3 types of beds, viz., flat bed, raised bed and hot bed.

i)Flat bed:

This is an old but popular type of bed commonly used by the farmers in villages. The width of the bed is adjusted to approach its centre conveniently. This types of bed is prone to over watering and thus decaying of seedlings. It is not recommended specially during rainy season.

ii) Raised bed:

This is the most common type of nursery bed which has been widely accepted by the vegetable growers. The height of the bed is kept to 20 cm and width from 80-100 cm with the convenient length as the requirement of the main field. In raised bed, the remain loose over watering is avoided and root growth gets intensified. It also facilitates the air and light penetration, intercultural operations, pests and diseases managements.

Hot bed:

This is not very common.

SELF CHECK-3	Written test for self- evaluation

Direction; answer the following questions, pay attention in each activity and try to answer to the point.

1. How nursery bed can be prepared?5 point
2. List types of nursery beds ?5point
3. List Benefits nursery raising?5 point
4. List benefits of nursery raising?5 point

Note: **Satisfactory rating - 10 and 20points Unsatisfactory - below 10 points**
You can ask you teacher for the copy of the correct answers.

Name: _____ Date: _____

LO-3:- Establish nursery

Instruction Sheet	**Learning Guide -48**

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics –

- Preparing planting media
- Preparing planting material
- Doing sowing/planting
- Establishing nursery

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, you will be able to –

- prepare Planting media according to the climatic condition
- preparePlanting material according to the requirement
- Do Sowing /Planting according to the requirement
- Establish Nursery according to market requirements and enterprise guidelines

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 to 6.
3. Read the information written in the information "Sheet 1, Sheet 2, Sheet 3 and Sheet 4".
4. Accomplish the "Self-check 1,Self-check t 2, Self-check 3 and Self-check 4" **in page -32, 44, 49 and 60**respectively.

Information sheet-1	Preparing planting media

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 FYM, leaf mold, oil cakes etc. in different proportions. The potting mixture may be prepared well in advance by adding sufficient quantity of superphosphate for better decomposition and solubilization. The potting mixture may be kept near the potting yard, where potting/ pocketing is done. Construction of a potting yard of suitable size facilitates potting of seedlings or grafting/ budding operations even on a rainy day.

Characteristics of a good substrate (potting mixture)

A good nursery substrate has the following properties;

- It is light in weight to facilitate transportation.
- It holds cuttings and seedlings in place and does not shrink or swell in way that damages the plant.
- It has a good water draining capacity.
- It retains water but allows proper drainage and aeration of the roots.
- It contains the necessary nutrients to allow plant growth and development.
- It does not contain pathogens (weed seeds, fungi, bacteria, and insects) and can eventually be sterilized without changing its characteristics.

Such substrate is usually a mixture of site or forest soil, well decomposed organic matter and some other material that will enhance its physical characteristics. As a rule of thumb the following ratio can be proposed;

For heavy soils:	1 soil: 2 sand: 2 well decomposed organic matter
For medium textured soils	1 soil: 1 sand: 1 well decomposed organic matter
For light textured soils	1 soil: 0 sand: 1 well decomposed organic matter

Filling poly pots

When the mixture of soil/ sand/ compost is ready you can fill the poly pots by hand. A scoop made from an old half-liter plastic bottle will help speed up the process. Make the mixture very slightly moist, but keep it loose so that you can easily pour it. Fill the pot in three or four stages, firming down the mixture after each stage. Do not fill the whole pot and then try to firm all the soil at once, because this leaves air pockets. Fill the pot completely. Allow the mixture to settle for about four weeks. Do not allow the pots to dry out during this period.

Water them periodically to permit the development of micro-organisms. This is especially important if the soil has been stored dry for some time. The pots are then ready to take seeds or transplants.

Figure 2. Preparation of media in a nursery. Topsoil and other components of media mix are sieved to obtain relatively uniform size of grain.

Figure 3. Filling poly pots with potting mixture.

The substance must have appropriate physical and chemical properties. They must retain sufficient water and air. They must allow sufficient drainage. The substance must be free from weed seeds, nematodes, fungi, bacteria and insect pests. The acidity or alkalinity should

be in optimum for different species. The medium must be sufficiently firm and dense to hold the cuttings or seeds in place during rooting or germination. Its volume must be fairly constant when either wet or dry. It must be capable of being sterilized. The rooting media should support the cuttings to avoid lodging. This is particularly important whenever larger level cuttings are used under mist chamber conditions Selection criteria for media. Always consider utilizing local products to save transportation costs. Check the quality of the product before buying. Check for the grade or particle size and freedom from impurities such as silt and harmful salts. Obtain local guidance of agricultural officers for selecting appropriate media. The pH of the media should be checked. An optimum pH for the rooting medium should be 5.5 - 6.5, with a range of 4.0 - 5.0. Select a rooting media which has optimum air filled porosity range of around 34%. The media must provide sufficient oxygen to the base of cuttings. Ensure that the product is well graded. Select a media which can retain structures during rooting particularly where mist and fogging units are used for mist propagation. Select a medium which does not require any mixing.

Media for propagation and growing nursery plants

There are several media and mixtures of different kind are available for use in propagation such as in seed germination, rooting of cuttings and for growing container stock. Commonly used media with a brief description of properties are given below:

I. Soil:

A soil is composed of materials in the solid, liquid and gaseous states. These materials must exist in the proper proportions for satisfactory plant growth. The texture of a soil depends upon relative proportions of sand, silt and clay. Maintenance of a favorable granular and crumb soil structure is very important.

II. Sand:

Sand consists of small rock grains (0.05 to 2.0 mm) formed as result of the weathering of various rocks. Its mineral composition depends on type of rock. Quartz sand is generally used for propagation and plastering grade is used for rooting of cuttings. Sand should be preferably sterilized before use.

III. Peat:

There are different types of peats available because of mode and circumstances of its formation, the plant species from which it is formed. Peat consists of the remains of aquatic,

marsh, bog or swamp vegetation which has been preserved under water in a partially decomposed state. Composition of peat varies widely depending upon the vegetation, decomposition and degree of acidity. The main advantage of moss peat is that it is a uniform product. It is free from pests, diseases and weed seeds. Useful for growing rooted cuttings or seedlings. Peat is easily compressed and can be purchased in polythene covered bags. Peat is the material most commonly used and forms the basis of many different propagation media when mixed with other components. Peat can be mixed, with either fine or coarse sand, perlite or vermiculate, sawdust. Peat is formed by the partial decomposition of plants in areas of high rainfall and the types of peat can vary considerably in color and structure. A medium grade sphagnum peat is generally recommended

IV. Sphagmum moss:

The sphagmum moss is the dehydrated remains of acid bog plants of the genus Sphagmum. It is relatively sterile, light in weight and has a very high water holding capacity and contains specific fungistatic substances. It is very popular media per propagation of pomegranate in Maharashtra by air layering.

V. Vermuculite:

It is a micaceous mineral which expands markedly when heated. It is chemically a hydrated magnesium - aluminium - iron silicate. It is very light in weight, neutral in reaction with good buffering properties and insoluble in water. It can absorb large quantities of water. Normally has pH range between 6.0 - 6.5, has a buffering action. Vermiculate will not re-expand if excessively firmed or compressed. It is normally mixed with peat moss, because vermuculite alone will not support the cuttings. It is suitable for rooting cuttings intended for export to overcome specific plant quarantine regulation.

VI. Perlite:

It is a gray white material of volcanic origin mined from lava flows and has neutral reaction with no buffering and no cation exchange capacity and no mineral contents. Chemically perlite is made up of alumino - silicates. It is light, sterile, contain no nutrients. It has pH of 6.0 - 7.5 range. It may be used alone but is best used with peat moss for woody ornamentals. Since it is light in weight, it is useful for mist propagation benches because there is little

chance of damages to the structure from weight stress. It is a useful material for rooting and shipping cuttings when there are specific plant quarantine regulations.

vii) Pumice:

It is a gray or white volcanic rock, which is originally frothed by gases to give it sponge like and porous character. It is made up of aluminum silicate and also contains small quantities of potassium and sodium. It provides good aeration and drainage to the media.

VII. Leaf mold:

Maple, Oak, Sycamore and elm are among the leaf types suitable for leaf mold. This material is little used in modern large scale propagation procedures. Leaf mold is easily available in India. It has a very low bulk density i.e. 0.1 - 0.25 gms/cm3.

VIII. Sawdust and wood shavings:

These are used mostly for propagating media. A byproduct formed during the processing of wood material. It is free from harmful substances, free from salts, and is nitrogen deficient. If sawdust is excessively composted, there is a problem of drainage. Controlled release of fertilizers can be used along with sawdust.

IX. Cocopeat:

It is also called cocodust. A byproduct of cutting and sifting coconuts for fibre production. It is the most popular growing media available these days. Cocopeat has excellent aeration of 15 to 25% because of its fine structure. Coco substrates are expected to degrade slower than substrates such as peat moss. Do not add potassium to media as it is already available in coir. In cocopeat media add more nitrogen as microorganism in coco peat need to break down the few easily degradable substances present in peat.

Potting Mixture for Rooted Cuttings and Young Seedlings

Soil mixtures for container growing in propagation procedures, young seedlings or rooted cuttings are sometimes planted directly in the field but frequently they are started in a soil mix in some type of container such as peat or plastic pots or clay flower pots or metal cans. The general potting mixture for rooted cuttings and seedling is 1 or 2 parts of sand, 1 part of loam soil and 1 part peatmoss or shredded bark or leaf mold. For container grown general nursery stock, it is 1 part sand, 2 parts loam soil and 1 part peat moss or shredded bark of leaf

mold is generally recommended potting mixture. General standards of media / substrate water content (% by weight) maximum 80% organic content (% of dry matter) minimum 90% pH of water - maximum 4.5 Ec (mS/cm at 25° C in the 1:1.5 volume extract) maximum 0.5.

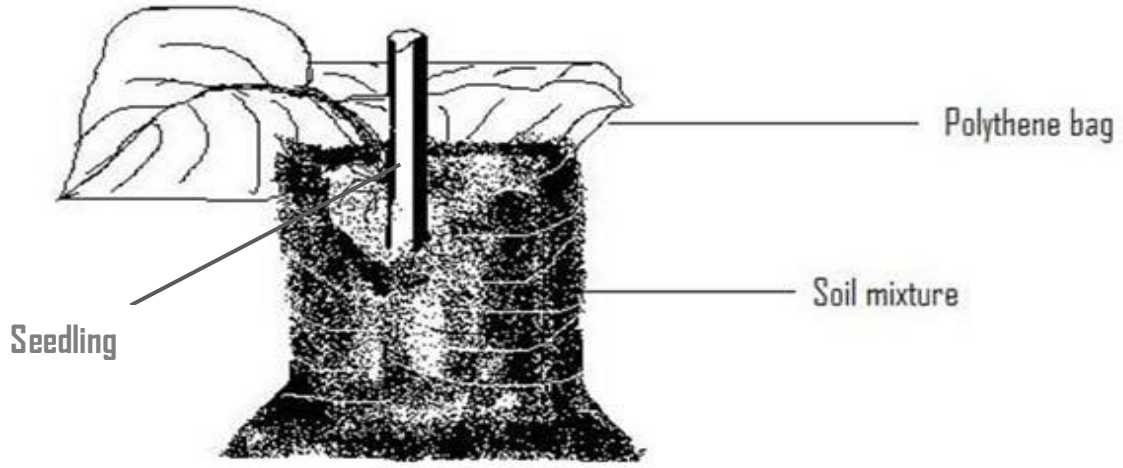


Figure 4. Potting mixture within a polythene bag.

Self – Check 1	Written Test

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

1. What is the need of preparing soil/ media?

   _____.

2. List the methods of soil treatment.

   _____.

3. List the three types of nursery beds. Explain the appropriate situation to use them.

   _____.

4. What are the characteristics of a good potting mixture?

   _____.

5. What is the ratio of forest soil, sand and well decomposed organic matter that is recommended for heavy, medium and light textured soils respectively?

   _____.

6. Which type of seedling is recommended for on farm nurseries?

   _____.

7. List the common types of containers used in nurseries.

   _____.

Note: **Satisfactory rating - 10 and 20points Unsatisfactory - below 10 points**
You can ask you teacher for the copy of the correct answers.

Name: _____ Date: _____

Information sheet-2	Preparing planting material

1.3. Preparing planting material

Sourcing seed and pre-treatments

Sourcing tree seed: It is important to try and use ***good quality seed in*** planting. Seed can be collected from trees locally – ***from farms, forest or public land***

During seed tree selection, some of the ***criteria's are;-***

- High yielding
- Resistance to drought
- Resistance to diseases and pests
- Well mature
- Physiological fitness
- True to name
- True to type
- Widely adaptable
- Vigorous
- Tolerant to stress

Pre-treating seed: it is important to treat seed before it is planted, in order to improve on the ***level, speed and uniformity of germination***.

The most common methods for ***pre-treatment*** are:

- ***Soaking seed in hot water*** until the seeds look swollen.
- ***Soaking seed in cold/cool water***. This method is recommended for seeds that have soft seed coats

Procedure:

- ✓ Soak the seeds in cold water which is 2 times its volume
- ✓ Remove all floating seeds
- ✓ Sowing the remaining seeds at the bottom in containers in the nursery or direct sow directly in the field after

- ***Cracking*** the seed shell method. This method is used for tree species with a hard coat .The cracking is done to allow water penetration for easy germination Cracking is done using a sharp knife, a stone or a cracking machine
- **Nicking-cut slightly the seed at one tip to allow water penetrate**

It is important that fine seed is mixed with sand and uniformly broadcast on the seedbed to avoid overcrowding that can lead to damping off. Do not sow the seed too deep in the soil; the depth of holes should depend on the size of the seeds (usually 5 mm to 1 cm). Sowing too deep is likely to prolong seed germination period or seeds may lot. Put a seed in each hole; gently cover with soil equal to the size of the seed itself. Water the pots.

Make a light shade with grass (netting material) to cover the pots or the seed bed after sowing. Water the sown seeds twice a day, early in the morning before 9.00 am and in the evening after 4.00 p.m. If this is not possible then water in the evening only since most of the water at this time is taken-up by the plant since there is very little evaporation

1.4. Establishing Nursery

How to establish a nursery

Site selection

A ***good site for a tree nursery*** should have the following features:

- *Reliable, nearby water supply*
- *Source of soil*
- *Access to market for seedlings.*

In addition it is desirable to have:

- A well-drained soil with a gentle slope
- A natural shelter, such as tree cover, to provide shade for nursery workers.

Soil

A good soil for use in tree nurseries can be made by mixing:

- ***3 basins*** of soil collected from under vegetation cover, such as ***in forests*** or under large trees
- ***2 basins of clay soil***
- ***1 basin of sand***.

To test the mixture, roll a damp sample in your hand. A good mixture should roll and hold its shape but break if the roll is bent.

- If it does not break, then it has too much clay.
- If it crumbles before you can roll it, then it has too much sand.
- To ensure adequate fertility of the soil, add one basin of sieved manure or compost to every three or four basins of the standard mixture.

Size of a nursery: - this depends on the number of seedlings to be raised annually, but also on the production site.

There are different factors that determine the size of nursery.

(1) ***Number and type of seedlings to be raised***: The more seedlings are raised, the larger the size of nursery is required.

(2) ***Production techniques and the size of containers used***

(3**)** ***Availability of infrastructures***

Propagation of Crops

There are 2 major methods of propagating crops. These include:

a) Vegetative or asexual means
b) Seed or sexual methods

Clonal (asexual/ vegetative) propagation

Vegetative propagation aims at the identical reproduction of plants with desirable features such as high productivity, superior quality, or high tolerance to biotic and/or abiotic stresses, and as such, plays a very important role in continuing preferred trait from one generation to the next. Whereas; sexual reproduction by seeds provides opportunity for variation and evolutionary advancement.

The concept of vegetative propagation is that an exact copy of the genome of a matter plant is made and continued in new individuals. This is possible because plants, - unlike animals or humans, - have meristematic, undifferentiated cells that can differentiate to the various organs necessary to form a whole new plant. A piece of plant shoot, root, or leaf, can therefore, grow to form a new plant that contains the exact genetic information of its source plant.

Vegetative propagation refers to the propagation of new plants directly from existing ones and not from seed. The most important vegetative propagation techniques for crop species are the propagation by cuttings, layering, budding, grafting and micro propagation. The most important reasons for vegetative propagation are:

- Maintaining superior genotypes
- Problematic seed germination and storage
- Shortening time to flower and fruit
- Combining desirable characteristics of more than one genotype into single plant
- Controlling phases of development
- Uniformity of plantations

Grafting or budding

This involves the joining of a piece of stem or bud (the scion) to another plant (the rootstock) to provide root systems for detached pieces from a selected plant. Grafting and budding may be done for the following reasons:

- To propagate varieties that cannot readily propagate by other means as cuttings or layering.
- Obtaining the benefits of the rootstock
- Changing the cultivars of existing plants
- Hastening the reproductive maturity of the plant
- Repairing damaged parts of tree crops

Scion

This is the short piece of the shoot containing several dominant buds which when united to the rootstock will comprise the upper part of the grafted plant.

Rootstock

This is the lower part of the graft, which develops into the root system of the grafted union.

Layering

This is a propagation method where roots are caused to form on the stem whilst the stem is still attached to the parent plant. The rooted stem is then detached to become an independent plant growing on its own roots. Layering is mainly used for the following reasons:

- Propagation of plants whose cuttings do not root easily
- Production of large sized plants in a short time
- Production of plants with the minimum propagation facilities
- Production of plants that reproduce naturally by layering (blackberries, black raspberries)

Cutting

This is usually done by encouraging roots to form on a piece of stem. The rooted cutting will later become an independent plant. Cuttings can either be softwood or hardwood. Softwood cuttings are taken from soft shoots; these dry up faster and they need to be kept in humid poly propagator or under mist until they root and can take up sufficient water.

Hardwood cuttings or leafless cuttings are larger and firmer wood, they don`t dry up fast and can survive in moist soil till roots are formed. It is easier to root leafless cuttings; pieces of stems are just pushed into holes dug in the ground, preferably in moist lightly shaded conditions. If necessary, course sand, saw dust or vermiculite may be placed over them in a hot dry weather.

Collecting cuttings

Collecting good planting material is an integral part of the nursery establishment. In most crops, poor sprouting or low vigor stands may drastically reduce yields.

- Cuttings should be selected from disease and inset free stems of 8 to 12 months old plants having a thickness of 20 to 30 mm in diameter.
- Fresh cutting from the standing matured plants if available is desirable.
  Those stems stacked or stored in erect position should be chosen as planting material.
- Cuttings should be taken early in the morning before the sun is high, as this will keep transpiration and thus drying out of cutting low.
- Trim leaves before the shoots are detached from the stock plants as this reduces water-loss. Leaf areas for optimum rooting vary with species.
- Use a polyethylene bag that is moistened inside to carry the cutting materials.
- Keep the collected shoots under shade, without throwing or squeezing the bags.
- If the cutting materials should be carried over a longer distance, keep them in a cool box – but ensure that the shoots do not directly touch the cooling elements.

Quick; rooting of cutting depends on several factors, the following are important:

a) Turgid cuttings root better than wilted cuttings.
b) Rooting media must be moisture retaining but open and well drained.
c) Most cuttings root more quickly when given bottom heat.
d) Shade to reduce transpiration until rooting begins.
e) Use rooting hormones and tree sealants.

Making and inserting the cutting

- ❑ Use sharp tools.
- ❑ Two third of the cutting to be inserted into the media
- ❑ Bottom of the cutting need to be flat and the top to be at an angle.
- ❑ Water every time, mist irrigation is most suitable.

When the cuttings have rooted (as indicated by shoot elongating) they must be transported to nursery media in pots for further development before they are transported to their place.

Figure 5 Conventional single node cuttings.

Figure 6Pluckable shoot stem cutting in tea.

Selection of Seeds

For successful cultivation of crops, selection of good seeds is essential. Good seed comprises of high percentage in purity, improved type, free from diseases, weeds and inert matter, ability to grow successfully. Besides, the germination percentage of the seed should be very high. Otherwise; this will reduce the quality of the seeds. Before sowing seeds it is essential to test the germination percentage of the seed in question. Germination percentage is the ratio of seeds germinated to the total (G = No of germinated seeds ÷ total No seeds sown). This can be done mainly by two ways.

1. By printing the counted seed on moist blotting paper in rows and then it is covered with another wet sheet of blotting paper.
2. Sowing the seeds in rows; in shallow box containing good planting medium. Sufficient moisture is provided for proper germination of seeds.

After few days or so depending on the type of seeds, they sprout. The seed that germinate quickly and uniformly are supposed to be healthy seeds. Good seeds have 75 to 85% germination in most of the cases.

Treating and preparing planting material (Seed)

Seed treatment is an aid in controlling damping off and the rotting of the seed if germination is delayed. Before sowing, seeds should be treated with chemical and/or with hot water etc. Treated seeds have better germination. To enhance germination, seeds may be treated with hot water, cold water and with chemicals.

Figure 7. Seed germination in plastic box placed in a green house.

Hot water treatment

Seeds with hard coats may be soaked in water for 18-24 hours at room temperature depending upon the kind of seeds. It is advantageous if seeds are soaked in lukewarm` water. Some seeds take longer time for germination and produce weaker sprouts if are not soaked, especially if the soil becomes crusted after drying.

Seed treatment with chemicals

- Seed treatment with chemicals is done to prevent seeds from diseases and to enhance germination.

- It is commonly done with dust or in solution of the fungicide chemicals.
- The common seed dressers are ceresin, thiramcaptan, agrosan G.N. However, compounds like ceresin as seed treatment are known to cause damage to some seeds so care should be taken.

When seeds are treated with dust of a chemical, required amount of dust (2-3gm of chemical powder per kg. of seed) should be placed in a container which is closed tightly and shaken vigorously to assure even coating of every seed.

Self-Check 2	Written Test

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

1. What are the two major propagation methods? Explain the concepts behind.

   _____.

2. What are the most important reasons for vegetative propagation?

   _____.

3. What are the types of vegetative propagation?

   _____.

4. What are the basic differences b/n budding and grafting?

   _____.

5. Define the following terms.

   a) Scion: _____.

   b) Rootstock: _____.

6. Define the term layering.

   _____.

7. Define the term cutting.

   _____.

8. Differentiate b/n softwood and hardwood cuttings.

_____.

9. What are the methods of collecting cuttings?

_____.

10. List the factors affecting quick rotting of cuttings.

_____.

11. What are the procedures for making and inserting the cuttings?

_____.

12. A nursery manager performs germination test of a certain crop and found out the following results. 450 seeds were sown in a plastic box out of which 418 did not germinate.

_____.

Note: **Satisfactory rating - 30 points** **Unsatisfactory - below 30 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating: _____

Name: _____ Date: _____

Information sheet-3	Doing sowing/planting

3.2.1. Seeding

There are two different methods of crop establishment. One is by directly sowing seeds in the main field and the second is by raising seedlings in the nursery and transplanting them to the main field when they reach at a desired stage.

1. Direct seeding

Direct seeding may be done by broadcasting, drilling and dibbling or planting.

Broadcasting: In broadcasting method, the seeds are spread uniformly over well prepared land. It may be done by hand or mechanical spreader. Broadcasting is suitable for close planted crops that do not require specific crop or plant geometry.

Disadvantages of broadcasting

Although broadcasting is simplest and popular sowing method to farmers and other seed multiplier bodies, it has number of disadvantages:-

- Seeds at shallow depth emerge early and seeds fallen deep in the soil may not germinate.
- There is a lot of wastage of seeds.
- Agricultural operations like weeding, hoeing, and ear thing-up and bullock-drawn implements cannot perform well.
- Plant population become sparse at some places and overcrowded at other.

Drilling: Drilling is the practice is of dropping seeds in rows or lines.

Advantages of drilling

- It maintains uniform plant population per unit area.
- Reduce competition between plants.
- Reduce seed rate.

❖ **Disadvantages of drilling**

It requires more time, energy and cost.

Dibbling or planting

This method consists of putting or placing individual seed or seed material in a hole or pit, made at pre-determined depth and spacing.

Advantages of dibbling or planting

- It requires less seeds
- It gives rapid and uniform germination with good seedling vigor
- Disadvantages of dibbling
- It is more laborious
- It is time consuming
- It is expensive compared with broad casting and drilling

2. Nursery raising and transplanting

Under intensive cropping and other situations when more than one crop is grown in a year on some piece of land, the field is not vacated by the crop at appropriate time to plant the next crop. On the other hand, taking care of germinating seeds or seedling over a large area of land/field is a problem with regard to application of water, weed control, pest control etc . Therefore seeds are sown in small area called nursery, to raise the seedlings. When seedlings attain proper size and age, these are pulled out from nursery and transplanted in well-prepared field. The nursery raising and transplanting is completed in three steps. i.e. Nursery raising, uprooting or pulling-up of seedlings and transplanting.

- **Advantages of nursery raising and transplanting**
  - ✓ It is easy, convenient and consume less time and input to nourish the young and tender seedling in the small but compact area of nursery bed
  - ✓ Weak and diseased seedling can be removed at the time of transplanting
  - ✓ Easy to maintain de3sired plant density with pure, true to type, healthy, strong and stocky seedling
  - ✓ Transplanting provide enough time for ripening, after maturity of previous crop in the field and land preparation for succeeding crop in intensive cropping.

Disadvantages of Nursery bed and transplanting

- Total duration of the crop may be higher
- It increases labor and power requirement to raise the crop

- It increases cost of land preparation, uprooting and transplanting the seedlings

Determining the time and depth of sowing

A. Time of sowing

Early sowing is the most cost effective way of increasing crop yield because it minimizes cost of production.

Factors that affect sowing time

Temperature: Time of sowing is crucial in temperate region, but in tropics appreciable importance only at high altitude where soil is warms enough to permit rapid germination.

Rain fall: Long duration annual crop must be sown at the beginning of rainy season, but short season crop like maize and cow pea may be delayed.

Occurrence of disease and pests: The strategy is usually to adjust the time of planting so that the crop is on the field during the time when disease and pests are less prevalent.

Day length: Crop should be planted at a time that allows the appropriate photoperiod to exist at the flowering or tubering stage.

Marketing: This is true for vegetables or other perishable crops. Planting is so adjusted when crop is ready for harvesting, then its demand in the market should be highest so that farmers can get best price.

Cropping system: The place of crop in the rotation or in an intercropping system may determine at what time of cropping cycle is planned.

Time taken for maturity: This determine the time between sowing and maturity

Availability of labor and equipments: At the time of sowing, we have to get enough number of workers and equipment to accomplish sowing at desired time. If we cannot get desirable number of workers and equipments that are basically important for sowing operation, the time of sowing may be delayed and the crop will be exposed to disease and pests.

Sowing depth

Proper sowing is also an important aspect of establishing a good crop stand. Shallow or deep sowing results in lesser plant population as all seeds do not germinate.

- **Factors that influence sowing depth.**

Seed size: Crop with large seed like ground nut, castor, and sun flower can be sown even up to 6cm. Small-sized seed like tobacco and teff have to be sown at shallow depth. The optimum depth for most of field crop is 3-5cm.

Moisture status of the soil: it is common to sow seeds deep in dry soil in order to place the seed in contact with moisture. Therefore, small-sized should be watered frequently incase of shallow sowing in dry soil to insure germination.

Soil type: Seeds will emerge from greater depth on sandy soil than in clay soil, and warm soil than in cold soil.

Type of germination: Those seeds which have epigeal type of germination should be sown at a shallow depth where as seeds those have hypogeal type of germination are sown deep in to the soil.

Deciding recommended seeding rate

Seed rate is the amount of seed required to cover a specific area. It can also be the number of plants per unit of land. Optimum number of plants per unit area or plant population per unit area required to utilize efficiently the available light, water, and carbon dioxide for better yield.

Factors that influence plant population or seed rate

Size of cultivar: Crops having tillering characteristics require less seed, dwarf cultivars require more seeds and tall cultivars-less seed since they are subjected to lodging.

Size of seed: Large seed-more seeds/ higher seed rate where as less seed rate for small-sized seeds.

Amount of moisture available: For soil with good moisture status-less seed rate is recommended.

Fertility status of the soil: good fertility-less seed rate

Germination capacity of the seed: High germination capacity-less seed rate and vice versa.

Sowing time: timely sowing require less seed rate than delayed sowing

Self – Check 3	**Written Test**

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

1. What is Seeding and what are types of seeding**?**

   _____.

2. List the Disadvantages of broadcasting**?**

3. _____.

4. discus on Factors that affect sowing time?

5. List Factors that influence sowing depth?

Note: **Satisfactory rating - 10 and 20points Unsatisfactory - below 10 points**
You can ask you teacher for the copy of the correct answers.

Name: _____ Date: _____

Information sheet-4	Establishing nursery

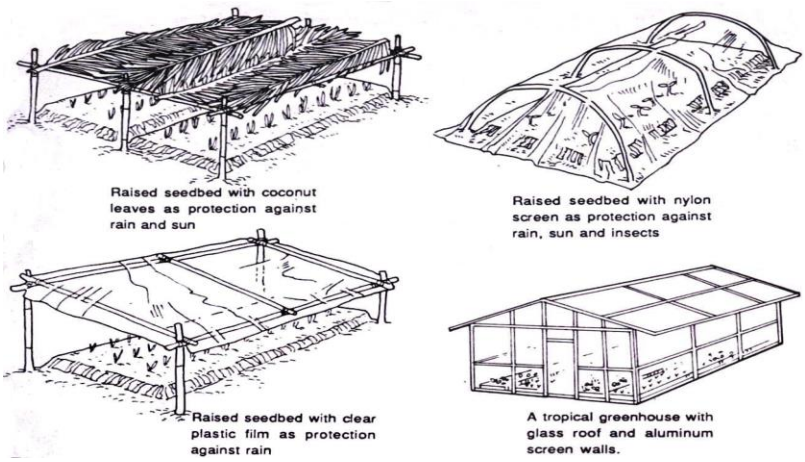
A nursery is ***an area where young plants can grow with special care and protection***. It produces seedlings for forestation and tree planting. Seedlings are usually needed in large numbers and young trees of most species do not survive well if directly grown on plantation site. It is therefore easier and cheaper to grow seedlings in one place – the nursery – and plant them only when they need less care and protection

Nursery is a place where seeds and cuttings are grown with special care and protection up to the point where the young seedling is able to establish and flourish under field condition.

The need of nursery establishment

- ***Provide seedlings with improved soil structure*** and contour the soil moisture for better development of seedling.
- ***Protection from pests, including higher animals***, such as chicken.
- ***Protection from rain and sun***.
- ***Protection against temperature*** extremes.

- To ***apply optimum growing conditions*** to the plant during the very early development stages
- To give ***better conditions for germination***.
- To ***economize seeds*** that are expensive, especially hybrid seeds
- To ***eliminate weak and diseased plants***, to get strong seedlings and even stand in the field.
- To obtain large number of plants (seedlings) from a small area.
- To raise seedlings to rain fed fields.
- To ***produce seedlings in adequate quantity and quality***.
- To raise root stock for grafting or budding.



Types of nursery

A tree nursery can be classified into different categories based on time duration. The nursery is supposed to be serve (for few or many years) and ***scale of production*** (***small or large number***) which is related to size of the area to be afforested. In general, **we have two types of nurseries**. These are:

A. Permanent nurseries:

- Large centrally located nurseries that are established where there is a ***demand for a large number of seedlings for long period of time*** (more than five years).
- Usually it has ***permanent workers*** including trained foreman or foresters
- It has a ***better control*** in most activities and produces quality seedlings.
- Annual plant production exceeds 500,000 and
- Requires ***bigger capital*** to establish and run them.
  - E.g. Government nurseries.

B. Temporary/flying/satellite nurseries:

- Annual plant production is less than 500,000
- Establish for a ***short period*** (<5 years).
- Require lesser capital to establish and run them.
  - E.g. Ethiopian Farmers Nurseries.

1.1. Site selection.

Selecting the best possible site based on preliminary survey of areas is essential. Because no potential site is perfect, site selection inevitably requires a compromise between different factors.

The major factors to be considered in nursery site selection are:

- The availability of water supply
- The proximity of nursery to the plantation site
- Favorable climatic, soil and land features
- Legal framework

a) The availability of water supply

Water: is one of the best criteria for choosing nursery site.

- ✓ The nursery site should be next to the area where water is available all the year.
- ✓ Near ponds; springs; rivers; lakes…
- ✓ On average **50 litters is required for 1000 seedlings per day**.

➪ **The proximity of nursery to the plantation site**

Location of the nurseries should be situated at the ***nearest*** possible site to the plantation or market it serves. Good transportation facilities, good communication (roads, telephone lines), electric supply, housing for staff and laborers is important if a large permanent nursery is established

- If we are establishing a permanent nursery especially, the site selected should be near the **main road** and should be connected to the main road by any means.
- These should have **transport facilities** (also), **electricity supply** and **housing facilities** for the workers near the nursery (if possible).

➪ **Favorable climatic, soil and land features**

- **Climate:** includes climatic factors mainly ***rainfalls, temperature, and wind***
  - **Select** a nursery site with similar climatic condition as that of the planting site.
- **Select** a nursery site with similar temperature and rainfall condition as that of the planting site.

Avoid areas with extremes of climatic condition: Hightemperature; High rainfall; High ice, storms

- **Topography:Select** an area with gentle slope (**2~3% slope**).If hilly, it's very hard for management. Earth & fertilizer or manure will be easily flow away. In the long run, the hilly place is hard for mechanized farming.

Avoid areas with ***rocky and stony areas***; hill tops (because hill tops are exposed to wind and would be too dry); valley foot areas (because water logging may be problems); flooding areas (where flooding is supposed to occur at any time of the year).

- **Soil** Is one ofthe most important factors for selecting nursery site (especially for the production of bare rooted seedlings using the native soil. But if seedlings are to be raised using pots, adequate source of soil mixture should be available in the near areas (helps to reduce transport distance and saves cost).

The chosen nursery site should have ***appropriate soil texture, depth, soil PH value***

The texture of the soil should be **neither sandy nor clay**. The best soil for planting is **loam.**

The PH of the soil should be between **5~7** for broad-leaved plant (most indigenous) and between 4.5~6 for conifers (most exotic species).

A valuable guide in selecting a potential productive site is to look at the past agronomic history and **native vegetation.**

- **Land availability:**
  - The site selected should be **large enough** to allow the production of intense number of seedlings. If possible, try to avoid selecting the land, which has been claimed by many individuals.
- **Legal framework**

Legal requirement for a commercial production employment practices, ***land ownership***

1.2. Land/growing media preparation

Nursery Site preparation

When to start raising seedlings: The time to start work in the nursery depends on when field planting is planned. It is important to allow sufficient time for seedlings to grow to a size where they will survive well in the field (normally 30 to 45 cm, though this depends on the species, where seedlings will be planted in farms, and how they will be managed). The initial labor needed to establish a nursery – in bed construction, soil collection, fencing, the procurement of tools, etc. – can take considerable effort but can be done some time in advance of raising seedlings. The sourcing of seeds or rootstocks that will be used to establish nursery plants will also often need to be done in advance.

Soil collection: The soil used to raise seedlings should be

- ***Fertile and should drain well***.
- ***Clear the surface of weeds, leaves and other litter***,
- ***Dig out the topsoil to a depth of about 10 cm deep***.
- ***Remove any stones and roots***,
- ***Then mix 2 parts of soil with 1 part of manure or compost and 1 part of sand***

Nursery operations

Tree nursery operations involves various activities such as,

- Seed sourcing
- Seed bed preparation
- Sowing seeds
- Potting
- Pricking Out
- Shading
- Watering
- Weeding
- Root pruning
- Application of additional fertilizers or manure

Seed bed preparation: nursery beds can be arranged in different ways.

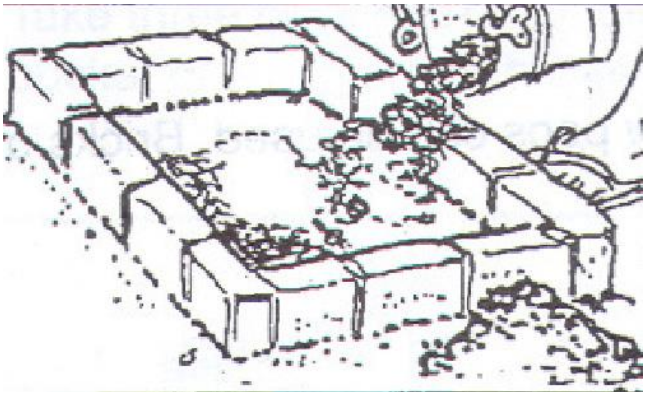
Types of beds

Depending on ***weather condition and soil type*** seed beds in the nursery could be;

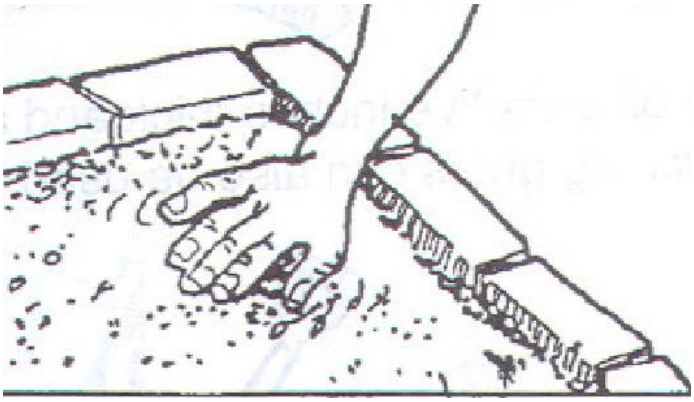
A Raised bed

On well cultivated field, area is demarcated having ***1.0 to 1.5 meters*** width and length as per need. However it does not exceed 5-6m. Number of beds depends on the kind of crop and area

on which the crop is planned to raise. In side demarcated area, soil is drawn from the sides so that the level of bed is raised to ***15–20cm*** from the natural level of the plot. The surface of nursery bed is made smooth and should be slight raised in the center with a little slope on two sides for draining excess water from the middle of the bed. In between two raised beds an alley of about ***50-60cm*** is left which is used for conducting agricultural operations like watering, weeding, spraying of insecticide, uprooting of seedling for transplanting and for draining out the extra water in the event of heavy rains. **The furrows 2-3cm deep and 5-7cm apart, across the width of the bed are opened and seeds are sown.**



Filling a raised bed made form bricks with a mix of soil and manure



Leveling the soil of a raised bed, to a depth of about 2 cm from the top

Advantage of raised bed

- ***Facilitates proper drainage*** of excess H_2O

- ***Prevent creation of an aerobic conditions*** and thus over comes microbial rotting of seeds and proliferation of denitrifying bacterial.
- Watering of seedlings can be done as per their needs
- Used for conducting essential operation like, weeding, watering, spraying insecticides
- Surface of bed becomes soft and therefore, uprooting of seeding results in minimum root damage

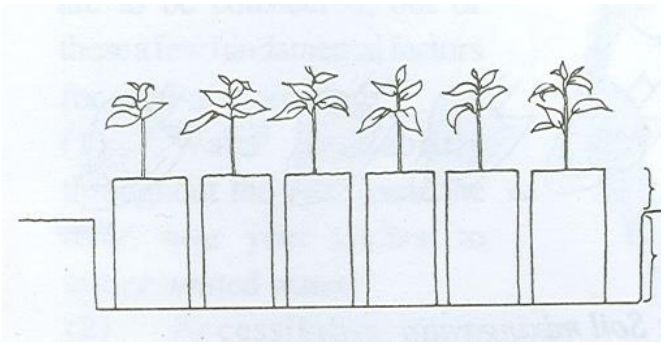
Disadvantage of raised bed

Require labor and additional cost

A. Sunken bed

Usually constructed in areas where there is ***low rain fall and soil moisture***.

An example of a sunken bed



B. Flat bed

During ***spring – summer***, seedlings are raised in flat bed. Further, in areas where rainfall is not so heavy and field is well leveled and drained, flat bed is preferred. Soil is dug 15-20cm deep and all clods are broken and irrigation channel runs in between two tows of the beds and each bed is connected with it.

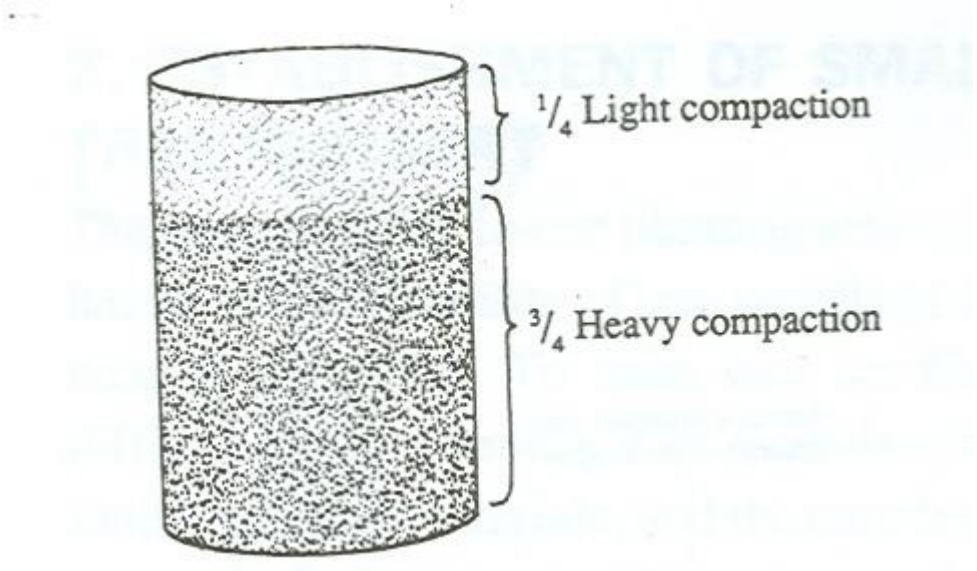
Advantage of flat bed

1. Flat bed is easy to produce or prepare
2. Cost for preparation is less

Disadvantageof flat bed

1. More chances of getting excess irrigation H_2O which is always harmful to the plants.
2. ***Soil becomes more compact***, and results in root purring when seedlings are up rooted

Potting: Potting mixture (soil, sand and compost/manure) should be moistened and then pressed into containers to a depth of about ***three-quarters of the height of pots***. Pots should then be topped up more loosely with mixture and pressed down slightly to about 2 cm below the top. ***Heavy compaction should be avoided at the top of pots because it will inhibit root penetration***.



Before planting seed, containers should be watered lightly. Sometimes, more than one seed can be planted in a pot and then, if more than one germinates, seedlings can be removed to leave a single individual. This approach might be used if germination rate is expected to be quite low

1.4. Preparing planting material

Sourcing seed and pre-treatments

Sourcing tree seed: It is important to try and use ***good quality seed in*** planting. Seed can be collected from trees locally – ***from farms, forest or public land***

During seed tree selection, some of the ***criteria's are;-***

- High yielding
- Resistance to drought
- Resistance to diseases and pests
- Well mature
- Physiological fitness
- True to name
- True to type
- Widely adaptable
- Vigorous
- Tolerant to stress

Pre-treating seed: it is important to treat seed before it is planted, in order to improve on the ***level, speed and uniformity of germination***.

The most common methods for ***pre-treatment*** are:

- ***Soaking seed in hot water*** until the seeds look swollen.
- ***Soaking seed in cold/cool water***. This method is recommended for seeds that have soft seed coats

Procedure:

- ✓ Soak the seeds in cold water which is 2 times its volume
- ✓ Remove all floating seeds
- ✓ Sowing the remaining seeds at the bottom in containers in the nursery or direct sow directly in the field after

- ***Cracking*** the seed shell method. This method is used for tree species with a hard coat .The cracking is done to allow water penetration for easy germination Cracking is done using a sharp knife, a stone or a cracking machine
- **Nicking-cut slightly the seed at one tip to allow water penetrate**

It is important that fine seed is mixed with sand and uniformly broadcast on the seedbed to avoid overcrowding that can lead to damping off. Do not sow the seed too deep in the soil; the depth of holes should depend on the size of the seeds (usually 5 mm to 1 cm). Sowing too deep is likely to prolong seed germination period or seeds may lot. Put a seed in each hole; gently cover with soil equal to the size of the seed itself. Water the pots.

Make a light shade with grass (netting material) to cover the pots or the seed bed after sowing. Water the sown seeds twice a day, early in the morning before 9.00 am and in the evening after 4.00 p.m. If this is not possible then water in the evening only since most of the water at this time is taken-up by the plant since there is very little evaporation

1.4. Establishing Nursery

How to establish a nursery

Site selection

A ***good site for a tree nursery*** should have the following features:

- ® *Reliable, nearby water supply*
- ® *Source of soil*
- ® *Access to market for seedlings.*

In addition it is desirable to have:

- A well-drained soil with a gentle slope

- A natural shelter, such as tree cover, to provide shade for nursery workers.

Soil

A good soil for use in tree nurseries can be made by mixing:

- ***3 basins*** of soil collected from under vegetation cover, such as ***in forests*** or under large trees
- ***2 basins of clay soil***
- ***1 basin of sand***.

To test the mixture, roll a damp sample in your hand. A good mixture should roll and hold its shape but break if the roll is bent.

- If it does not break, then it has too much clay.
- If it crumbles before you can roll it, then it has too much sand.
- To ensure adequate fertility of the soil, add one basin of sieved manure or compost to every three or four basins of the standard mixture.

Size of a nursery: - this depends on the number of seedlings to be raised annually, but also on the production site.

There are different factors that determine the size of nursery.

(1) ***Number and type of seedlings to be raised***: The more seedlings are raised, the larger the size of nursery is required.

(2) ***Production techniques and the size of containers used***

(3**)** ***Availability of infrastructures***

Self-Check 4	**Written Test**

Name: _____ Date: _____

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

1. What condition should be considered during site selection? (5 pts)

2. List seed selection criteria? (5pts)

3. Discuss the importance of nursery establishment? (5pts)

4. What are the types of nursery? (5pts

5. Mention criteria's for establishing nursery location? (5 pts)

Note: **Satisfactory rating - 12points and above** **Unsatisfactory - below 12 points**

You can ask your teacher for the copy of the correct answer

Crops production -II

Learning Guide-49

Unit of Competence: - Assist to Establish and Maintain Nursery Plants

Module Title: - Assisting to Establish and Maintain Nursery Plants

LG Code: - **AGR CRP2 M11 0919**

TTLM Code: - **AGR CRP 2 0919-TTLM112019**

LO-4:- Maintain the nursery environment

Information	Learning Guide – 49

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics –

COMPILED BY ATVET, SEP, 2019

- Identifying, risks assessing and reporting OHS hazards
- Selecting and using tools and equipments for maintenances
- Clarifying plant growth and healthy requirements
- Undertaking nursery operations
- Servicing and repairing or replacing faulty parts of irrigation system components
- Applying treatments to assist plant growth
- Undertaking seedling hardening off practice

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, you will be able to –

- ❖ Identify risks assess and report OHS hazards
- ❖ Select and use tools and equipment's for maintenances
- ❖ Clarify plant growth and healthy requirements
- ❖ Undertake nursery operations
- ❖ Service and repair or replace faulty parts of irrigation system components
- ❖ Apply treatments to assist plant growth
- ❖ Undertake seedling hardening off practice

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 to 6.
3. Read the information written in the information "Sheet 1, Sheet 2, Sheet 3, Sheet 4, sheet 5,sheet 6 and sheet 7".
4. Accomplish the "Self-check 1,Self-check t 2, Self-check 3,Self-check 4, Self-check 5, Self-check 6 and Self-check7"**in page -65, 69, 73, 77 and 80**respectively.
5. If you earned a satisfactory evaluation from the "Self-check" proceed to "Operation Sheet 1, Operation Sheet 2 and Operation Sheet 3 "**in page 15.**
6. Do the "LAP test" **in page – 16** (if you are ready).

Information sheet-1	Identifying, risks assessing and reporting OHS hazards

1.1. Identifying OHS Hazards

OHS hazards

Chemicals and hazardous substances, dust and pollen, incorrect manual handling, moving equipment, machinery, and vehicles, noise sharp hand tools and equipments, slippery or uneven surfaces, soil-born microorganisms, solar radiation, wet working environment, including electricity.

Hazard identification

Hazard identification is a process used to identify all possible situations where people may be exposed to injury, illness or disease, the type of injury or illness that may result from these and the way in which work is organized and managed.

Hazard: a situation at the workplace capable of causing harm (i.e. capable of causing personal injury, occupationally related disease or death).

Risk: the chance of a hazard actually causing injury or disease. It is measured in terms of consequences and likelihood.

Risk Management: The overall process of risk identification, risk analysis, control of risks and risk evaluation.

Risk Control: that part of risk management which involves the implementation of policies, standards, procedures and physical changes to eliminate or minimize adverse risks.

Reporting Hazards and Accidents

Employees are required to report any situation or occurrence in the workplace that may present a risk or have the potential to affect the health and safety of employees or others in the workplace

1.2. Selecting Suitable personal protective equipment (PPE)

Any tree maintainance activity that requires spraying, or pressure release of fluid requires personal protective equipment that includes gloves, gown, mask with eye shield to prevent exposure to debris and aerosolization of microorganisms. Splash shield devices will still require wearing of gowns, and face protection due to splash potential.

Personal protective equipment (PPE) is used to protect an individual from hazards associated with their work tasks or environment.

Some of the commonly used PPE include the following:

- Eye protection
- Hand Protection
- Body Protection

- Ear and Hearing Protection
- Respiratory Protection

1.3 Selecting treatment methods and equipment

There are a number of methods and equipments used to treat an infected plant. But selecting the most economical and environmental friendly method is the crucial point.

From these methods the following are the common ones.

- ❖ pruning,
- ❖ repair of damaged material,
- ❖ application of pesticides,
- ❖ application of fertilizers,
- ❖ treatment of soil,
- ❖ Reducing compaction/improving aeration and drainage.

1.4. Identifying environmental implications of undertaking the treatment program

The environmental implications of implementing tree maintenance program in a range of locations should be identified.

- ❖ work using a variety of chemical application tools and pieces of equipment that are suitable for the task, while minimizing environmental impact
- ❖ dispose of plant and equipment debris in an environmentally aware and sensitive manner, such as sorting plant and paper-based waste for recycling
- ❖ dispose of chemical substances and their containers to minimize environmental impact.

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

1. What is OHS hazards? (5 pts)
2. What is Hazard identification**?** (5pts)
3. List Personal protective equipment **(PPE)**? (5pts)
4. What are the **treatment methods of equipment's?** (5pts)

Note: **Satisfactory rating - 12points and above Unsatisfactory - below 12 points**

You can ask your teacher for the copy of the correct answer

Name: _____ Date: _____

Information sheet-2	Select and use tools and equipment's for maintenances

2.1 Selecting and preparing machinery, equipment and tools

CROP PROTECTION IMPLEMENTS

Sprayers:

Sprayers rely on some form of liquid, usually water, to ***act as a carrier for the chemical***. The chemical as such may be in the form of powder or granules that can be mixed in water or the chemical may be already in the form of a liquid and may be or may not be diluted with water.

Uses of a sprayer

- ***Application of herbicides, insecticides and fungicides*** to control weeds, insects, and fungal diseases respectively.
- ***Application of micronutrients*** such as manganese.
- ***Application of chemical***

Spray parts and their functions

Tank: it has a filler hole fitted with a filter to pour chemical in to the tank. The tank should have rounded corners and bottom to facilitate easy cleaning through a drain plug.

Pump: is needed for the atomization of spray fluid. This pump is used to pressurize the spray fluid to discharge through nozzle.

Agitator: agitation of spray materials in the tank is essential to use the full range of spray materials including powdery emulsions, fungicides and other spraying materials. The paddle type mechanical agitators or hydraulic agitators are used.

Pressure gauge: it is provided in all sprayers and it is connected at outlet of pump to show the pressure of spray fluid.

Pipes: to distribute the chemical under pressure to various nozzles for spraying, high pressure metallic and rubber pipes are fixed on beams.

Valves: cut of valves are used on delivery line to stop the discharge. Pressure relief valve is used to prevent excessive pressure and to prevent damage of the system. Bypass control valves and main control valves are used to divert excess discharge for controlling the liquid flow to pump.

Nozzles: a nozzle performs the following functions:

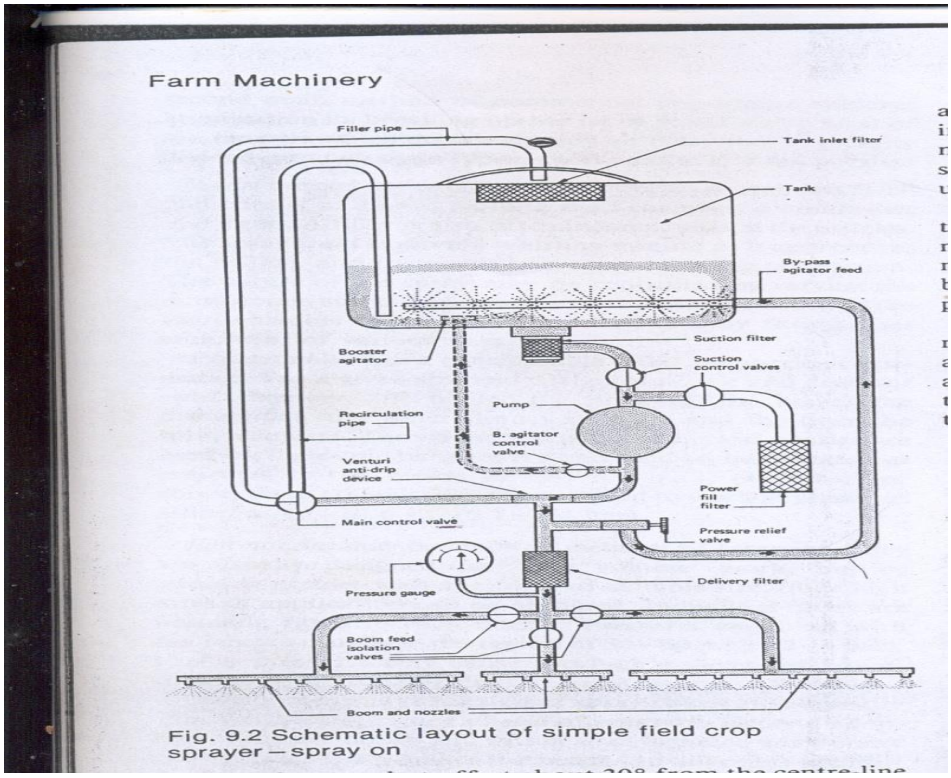


Fig. 9.2 Schematic layout of simple field crop sprayer – spray on

1.Manually operated sprayer

Machines which are carried on the back by means of shoulder straps are called **knapsack sprayers.**

2. Carried manually but power operated sprayer

These are usually called **mist blowers.** The machine iscarried on a shoulder as knapsack sprayer but an engine (mounted with the machine) provides the power, usually to generate a fast flow of air for carrying the dust or liquid chemical to the nozzle trip

3. Tractor operated sprayers.

The pressurized liquid is then to a long boom which has nozzles provided at adjustable distance along it. Such sprayers are also known as **boom sprayers.**

A sprayer of the above type may also be provided with its own source of power for forward travel and such machines are then classified as **self-propelled sprayers.**

4. Aircraft sprayers

Specially designed air craft that are operated by specialized agencies (not individual owned) may be used for spraying pesticides over large areas. While the general principles are the same, much ***greater quantities, distances and areas are involved***, safety considerations make it necessary to restrict such operations to specialists

Duster

Dusters are used to apply chemicals in a dust or granule form instead of in a spray form and it apply pesticide powders over plant or soil surface.

Advantage of duster

- ❖ Dusting is preferred where water is not readily available.
- ❖ Dusting is more useful against chewing insects and pests.
- ❖ The carrying weight is less in case of powder chemicals than liquid spray.
- ❖ The homogeneity of application can be achieved in case of powder chemicals.
- ❖ The equipment coast is cheap when compare to sprayers.
- ❖ Slightly heavy dose in dusting may not cause any serious effect to the crop. If it is spray, the slightly concentrated does may cause burning of foliage.

Disinfecting tool, equipment and work areas

1.1. Actions to prevent nursery contamination

⌘ Plant health status

Healthy, well-fertilized and properly irrigated plants are better suited to withstand pest attacks. However, over fertilizing should be avoided, especially excess nitrogen, which weakens plants and makes them more attractive to many sap-sucking insects, such as aphids and psyllids.

⌘ Plant density

Avoid very dense spacing in germination and nursery beds, because diseases can spread easily. Close spacing can also lead to etiolated and weak plants which are susceptible to disease.

⌘ Hardening

Timely hardening of seedlings will produce strong and healthy plants that are able to withstand a certain amount of pest or disease attack.

⌘ Resistant species or cultivars

If possible, grow resistant types or cultivars, or avoid susceptible species altogether. For example, citrus should not be propagated in areas with high incidence of aphids, since aphids transmit citrus greening disease, and spraying against the aphids usually cannot check the problem to the necessary extent.

⌘ Cleanliness in vegetative propagation

When harvesting scion wood and cuttings, take care that they come from healthy stock plants that are not depleted of nutrients or drought stressed, to enhance their resilience to diseases. Always

sterilize knives and secateurs with alcohol to avoid spreading virus diseases, which are often transmitted on the tools.

⌘ **Staff training**

To keep pest and disease levels low, all employees should be trained to recognize and report pests. Workers, who are in daily close contact with the plants through watering, weeding etc., will probably more often encounter such problems than a nursery manager would.

Self check– 2	**Written test**

*Directions:*Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

1. What is **Sprayers**? (5 pts)
2. What are the part and function of sprayer? (5pts)
3. What is the advantage of duster (5pts)
4. What are the **Actions to prevent nursery contamination?** (5pts)

Note: **Satisfactory rating - 12points and above** **Unsatisfactory - below 12 points**

You can ask your teacher for the copy of the correct answer

Name: _____ Date: _____

Information sheet-3	Clarify plant growth and healthy requirements

Plant growth and health requirements

For health/good growth of nursery plant, it requires

- **Watering**

A good supply of water is indispensable for the growth of seedling but too much water can be harmful. Water should be clean, of pH value ranging from 5.5 to 6.5.

- **Light**

The right amount of light is critical for healthy plant development of seedlings. Too much shade, for example in high plant densities, leads to etiolated and elongated growth of the seedlings and makes them weak and prone to fungal diseases. Too much light leads to sun scorching and drying out of the tender tissue.

- **Fertilizer regime:**

Fertilization of nursery soils is necessary to replace the lost nutrients.

Developing and maintaining high levels of fertility in nurseries are essential for ***producing good quality nursery stocks***. However, soil fertility is only one of a number of factors influencing stock quality. Fertile nursery soil does not compensate for poor practice. It may be possible to ***improve seedling quality*** by altering the timing and level of fertilization in the nursery, or by monitoring the nutritional status of seedlings during an active growth.

Is there danger in over fertilizing seedlings?

Fertilization depends on

- ***Species being grown***
- ***Nursery soils***
- ***Timing of application***
- ***Cultural practices used***.

Changing irrigation regime or seedbed density can also alter seedling response to fertilization. Site condition and other cultural practices made fertilization decisions some of the most difficult in nursery management.

An average of 1-2 kg of compound ***NPK fertilizer***, phosphate fertilizer or ***DAP*** is mixed into 1 cubic meter of soil mixture. Mixing has to be done very carefully to make sure all pots get equal amounts of fertilizer. With slow-releasing phosphate, this may suffice as the only application for the seedlings during their stay in the nursery.

- **Pruning and shaping**

Root Pruning is a standard in most Ethiopian nurseries. Root pruning involves cutting of the taproot, in some cases also of lateral roots.

Advantage

- To encourage the development of fibrous root system. This kind of root system gives the seedlings the best possible start in plantation.
- Controls depth of root penetration and makes lifting of seedlings easier and less harmful.
- Helps the seedlings to have a balanced root-shoot ratio.

- It also helps the seedling to have an adequate root collar diameter (because of the slowdown of the top growth

Disadvantage

If root pruning is not done, tap-rooted species in pots send their roots down deep into the soil. This may result vigorous growth compared with root-pruned neighbors. But problems will arise at the time of lifting and planting, as a large part of the root system is cut off during lifting & the seedlings will suffer from a serious shock during planting.

- **Staking:** Stacking refers to arrange nursery seedlings in an order pile/straight up to avoid growth of root deformity.
- **Repotting**

Growth and Development

- A seedling tree passes through a juvenile period which lasts for seven years.
- Blooming occurs after a dry period of three months in tropics.
- Grafted trees flower in the third year
- They should not be allowed to carry fruit though, as this would inhibit the growth of the tree
- To encourage growth, the blossoms are therefore plucked away until the 4^{th} year.
- Alternate bearing is one of the major problems in Mango
- Several Authors agree that 1 out of 1000 flowers develop into mature fruit
- Rain, high humidity, attacks by fungi and insects, a low C/N ratio, mineral deficiencies, a low percentage of perfect flowers and hormonal imbalance has been blamed for alternate bearing.
- As a result one or more of these causes, not enough vegetative growth takes place in the on-year to support bloom in the off year.

In order to correct this situation, the following measures have been proposed.

1. Avoid cultivars that are known alternate bearers.
2. Plough, manure and irrigate during on-year
3. Double the amount of N during on years
4. Irrigate immediately after fruit setting
5. Deblosom partly in on-years
6. Ring branches, prune and apply salt to roots
7. Light fire and produce smoke during 1 to 4 weeks (smoke has ethylene which would promote flowering. * None are entirely successful

6.3.5. Propagation

- Germination rate and vigor of seedlings are highest when seeds are taken from fully ripe fruits

- Seeds can be stored in soil, sand or sawdust for latter planting.
- Seeds stored in polyethene bags gave the highest rate of germination.
- Remove the flesh completely.
- In polyembryonic seeds, one is zygotic and up to 4 are vegetative growths
- Gametic or sexual seedling will be the most vigorous and generally should be discarded
- Seeds will often germinate within a week and will be ready to transplant from five to six weeks later when the plant has between five and six reddish leaves.

3.3. Waste disposal

Waste materials that is left on the field in which crops are produced must be removed in order to keep the health of plants and to reduce environmental pollution caused by waste disposed. Wastes have their own effect on the growth of plants and environment.

Self check -3	**Written test**

Directions: Answer the following questions accordingly

1. What is the different b/nGrowth and Development?(5point)
2. Write the two types of plant growing media and discuss briefly?(4points)
3. What is Waste disposal?(6 points)
4. what is crop Propagation?(2points)

5. What is the effect of waste on healthy of plants and environmental condition?(2points)

   Note: Satisfactory rating: >10points &above Unsatisfactory rating < 10pts

   Ask your teacher for copy of correct answers

Name_____ Date_____

Information sheet-4	Undertaking nursery operations

Successful nursery operation depends on many factors:

- selection and development of a suitable site
- efficient supervision and administration, adequate planning, forecasting and control procedures, orderly timing of operations;
- use of appropriate production methods and
- Protection from pests, diseases and other damage.

The main operations in a nursery include:

- Site selection
- Site clearing and ground preparation

- planning, controlling and recording all stages from receipt of seed to consignment of plants to the forest
- seed storage and pre-treatment or preparation of cuttings
- soil preparation in the seed bed container or medium for inserting cuttings
- basal fertilizer production and top dressing to control nutrition
- sowing seed and/or rooting cuttings
- operations of pricking out, standing out, undercutting, lifting, transplanting, stumping, or preparing seedlings, etc.
- ensuring mycorrhizal or nodule inoculation if necessary for the chosen species
- weed and pest control (e.g. fungi, bacteria, insects and rodents);
- protection against climatic damage (by means of irrigation, shading and frost protection) and
- Staking.

3.1. Undertaking nursery work

3.1.1 Preliminary considerations:

1. Identify the potential for planting material production and to set realistic production targets based on the resource availability. Availability of sufficient resources, particularly the genuine and certified scion / bud wood and rootstock according to the scientific recommendations in vogue as well as that of skilled manpower for the propagation methods to be followed should be the major considerations for setting realistic targets, from a quality control point of view.

2. Location of targeted planting material production as selection of an ideal location can also serve to improve Production quality considerably. In general, it should be located at a site with access to modern communication and transport facilities, good water source, electricity, skilled and unskilled labor availability throughout the season as well as professionally qualified and competent manpower to oversee the production and quality control. Places with a mild climate, long growing season and even distribution of rainfall is most suitable for planting material production while areas with extremesof temperature or commonly subjected to dry winds, frequent flooding, hail, storms or are known to be frost pockets are better 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.

3. The major considerations 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 / bud wood including its genuineness and seasonality of availability.

4. Identify the inputs necessary for each stage of production and develop specifications and requirements for each input. These generally include containers, growing medium, fertilizer (liquid feed or granular; if granule, regular release or control release), irrigation water, plant growth regulators, pesticides, herbicides, etc. The specifications for each input should be two or three features critical to the production of quality planting material and should be quantitative (that can be measured and verified, Example: container – black poly bags 300 gauge thickness, 24 cm x 18cm size with 4 to 6 holes 5 cm above the bottom; irrigation water –less than 0.5 dsm-1 EC, less than 100 ppm CaCO3 content; etc). The specifications for size and durability of containers should be based on the duration the plantingmaterial has to retained in them without becoming pot-boundand without any bending or twisting of thetaproot. Containers should have provision for drainage of excess water. The widely used growing medium in fruit crop nurseries at present is a mixture of sand, FYM and red earth in equal proportions. This medium needs sterilization by treatment with heat (steam or solarization) or chemicals (such as formaldehyde) to get rid of inherent soil borne pathogens such as Fusarium, Phytophthoraetc and pests such as nematodes. Afterwards, the sterilized medium has to be inoculated with beneficial soil microorganisms such as Vesicular Arbuscular Mycorrhizae (VAM) and Phosphate Solubilizing Bacteria (PSB), supplemented with rock phosphate / super phosphate, filled into the containers and planted with the seed / seedling / cutting. Colonization of the beneficial microbes in the root zone can be verified forty-five days after the inoculation. Use of commercial sterile potting mixes can avoid sterilization of growing medium. Coco-peat, a byproduct of coir industry, has high water holding capacity and good texture, but is low in mineral nutrients. Organic materials such as leaf mold can also be used for preparing growing media, but its composition can vary widely making quality control difficult. The points to be considered for growing medium of nursery plants are proper drainage and water holding capacity, ability to supply requisite plant nutrients, freedom from pests and disease inoculums and proper texture to facilitate root growth. Handling and storing the media inside potting sheds helps to prevent their quality deterioration. The quality of irrigation water with respect to its pH, EC, and dissolved salts has to be defined based on the sensitivity of the plant species under consideration to these and has to be checked at frequent intervals, especially during summer.

5. An appropriate procedure might call for periodic measurement of microbial load, soluble salts and pH of the water and media prior to use in production while container label of fertilizers and pesticides may be checked for content and active ingredient concentration while procuring and the composition of the fertilizer / pesticide solution should be verified prior to use.

6. Proper nursery records may be maintained incorporating all the above information either in the registers and / or in the computer for monitoring. This would be also useful in identifying probable flaws and to rectify them subsequently. At every step, continuous and effective coordination with research organizations on the latest technology development regarding the nursery management aspects would be helpful to upgrade and perfect the quality control measures.

Self check -4	**Written test**

Directions: Answer the following questions accordingly

1. List Preliminary considerations of nursery operation?(4points)
2. discus on Preliminary considerations of nursery operation?(6 points)

Note: Satisfactory rating: >5 points &above Unsatisfactory rating < 5 pts

Ask your teacher for copy of correct answers

Name_____ Date_____

Information sheet-5	Servicing and repairing or replacing faulty parts of irrigation system components

1.1 Servicing irrigation system components

Irrigation system refers to the layout of the irrigation system for flooding should follow the natural slope of the nursery site as this enable to distribute water in all directions easily. Whenever possible, water should be distributed by gravity.

To keep the investment cost of the water -distribution system low, the discharge of all the water Sources (**surface water** which includes spring, river, streams, lake) and **Ground water** which includes (wells and pumping system) Should considerably exceed a daily requirement of about 8mm (PET-rate) otherwise expensive storage tanks and /or ponds have to be provided to store part of or the entire required daily water requirement.

There two main types of irrigation/water distribution system can be distinguished in nursery. This may include:

A. The furrow irrigation:

- Open ditches with watering ponds **E.g.** Ebb and flow
- Open channel system **E.g.** capillary beds

Advantage

- Are relatively simple, cheap to construct but demands needs permanent maintenance to free them from silt and vegetation.

Disadvantage

- Require much land area

B. The pipe irrigation: water is sprayed in very fine droplets in short intervals onto the plants, where it evaporates.

- Sprinklers

- sprayers and drippers

Irrigation system components are serviced and faulty parts are ***repaired or replaced***. It includes:

- Pumps
- Line
- Pipes
- Sprinklers
- Sprinkler heads
- Solenoids
- Filters
- Controllers
- Sprayers and
- Drippers.

1.2 Checking performance parameters of irrigation

Performance parameters of the irrigation system are checked to ensure optimum performance. Checks may include

- Identifying dry spots and blockages
- Water dumping
- Abnormal water flow and leaking heads
- Lines and pipes.

1.3 Monitoring temperature

Temperature controls are monitored to ensure specified temperatures are maintained. The temperature range for optimal plant development is 25-35°C. Depending on the species and the prevailing humidity, it can be slightly higher, but avoid air temperatures above 40°C. When using any type of black container, the substrate can heat up to temperatures above 50°C in direct sun. This is undesirable and can be prevented by shielding the containers, for example with wooden planks. In some locations where temperatures can drop below 20°C, you might need to provide additional heating of propagation beds during the cold months.

Heating cables or mats which provide bottom heat can easily be installed. If these do not have a thermostat, they need to be switched on and off according to a well-monitored schedule. Temperatures need to be most carefully monitored and held inside the recommended range during seed germination, rooting of cuttings and graft union

Self check -5	Written test

Directions: Answer the following questions accordingly

1. list irrigation system components?(4points)
2. what is the advantage of Nursery hygiene practices?(6 points)
3. What aretwo basic approaches to nursery health? 5 (points)

Note: Satisfactory rating: >8 points &above Unsatisfactory rating < 8 pts

Ask your teacher for copy of correct answers

Name_____ Date_____

Information sheet-6	Applying treatments to assist plant growth

6.1. Applying treatments

Treatments are applied to as***sist*** plant growth as directed by the supervisor. Generally, application of treatment for nursery plants includes:

- Pesticides
- Fungicides
- Fertilizer, mulching
- Removing weeds
- Removing dead material
- Tip pruning
- Formative pruning
- Aeration
- Staking
- Tying
- Spacing and
- Thinning

6.1.1 Pesticides

Pesticides are chemicals used to ***kill insects.***Usually the larval stage of an insect life cycle is harmful. At this stage, most feeding on leaves, shoots, roots and boring in stem takes place. An

exception is the weevil group in which adults mostly cause the damage. In general, a particular insect problem is localized to; certain nurseries and tree species.

In Ethiopia, ***termites*** may become a problem especially for Eucalyptus species, but mainly after transplanting of the seedlings to the field. If insecticides are applied one always keep in mind the undesirable ecological effects of some organo-chlorines, notably ***Aldrin, Dieldrin and DDT***. These chemicals are persistent, that is they will not disintegrate under normal atmospheric and biotic conditions.

The final ***choice of insecticides*** depends on

- Local availability
- Use of pest detection survey
- Cultural practice
- Sources of advice and on site expertise
- Cost

Information concerning the ***type of pest, its feeding habits, and its life cycle*** remains essential in determining the appropriate insecticide to use as well as ***the rate and method of application*** that will achieve satisfactory control. Insect feeding habits determine, to some extent, the type of chemical control to be used.

Pesticides can be classified as ***stomach poisons, contact residuals, or fumigants***. Chewing insects, such as ***caterpillars, beetles, and grasshoppers***, are the targets of stomach poison. Stomach poison must be ingested to kill pests. Since piercing-sucking pests (***aphids, mites, leafhoppers,***etc) feed below leaf surfaces, they often avoid contact with stomach poisons. Such chemicals poison insects or mites that crawl on treated surfaces, eat treated leaves, or are sprayed directly.

All pesticides must be used in accordance with the directions for use on the label! When treating a specific plant or pest.

Some pesticides Labeled for use on Insects and Related pests of Shrubs

Pesticide	**Formulation ***	**Classification**	**Mode of action**	**Targets and remarks**

Acaraben (Chlorobenzilate)	25% WP 45.5% EC	Chlorinated Hydrocarbon	Contact Contact	Aphides, bugs, caterpillars, leaf mites, leafhoppers, sawflies.
Di-Syston (disulfoton)	15% G	Organophosphate	Systemic	Lace bugs, leafhoppers, scales, thrips, whiteflies.
Dithione (sulfotepp)	Fumigant	Organophosphates	Contact	Aphides, mites, thrips, whiteflies
Karathane (dinocap)	25% WP, 48% EC	Nitro-phenoxy	Contact	Mites, will alos control powdery mildew
Sevin (carbaryl)	50% WP	Carbamate	Stomach, contact	Chewing pests, thrips
Thidon (endosulfan)	24.2% EC, 50%WP	Chlorinated hydrocarbon	Contact	Aphids borers, mites, weevils, whiteflies

Key: EC=Emulsifiable concentrate; WP = wettable powder; D =dust: G = granular

6.2.2. Fungicides

Fungicides are chemicals used to ***kill fungi***. Damping-off is a disease of young seedlings caused by a number of soil born fungi (such as fusarium, pythium, Rhizoctoniaetc) altogether there are about 30 species of fungi.

Damping off can be divided into two.

- **Post emergence damping off** decay occurs in the root and the stem. Tissue of the root collar turn dark in color causing seedlings to fall over with their leaves still green and die. This is the common type damping-off and regarded as the any type of damping-off by some authorities.

- **Pre-emergence damping off:**Fungi, which live in, the soil attack seeds immediately after germination. They destroy the emerging radical (primary root). This type of damping-off is difficult to identify. Failure of seedlings to emerge can be attributed to other reasons such as quality of seed. Some scientists do not regard this pre-emergence damping-off at all.

Hosts: Damping-off is troublesome with pine seedlings. There are some differences in susceptibility between different pine species. It also attacks other species such as Eucalyptus. With pine seedlings the risk if disease is usually high.

Control: Damping-off is favored **high humidity**, **damp soil surface** and **heavy clay soils**, **cloud weather,too heavy shade**, **dense stands of seedlings** which reduce evaporation, high content of **organic matter**, **high levels of nitrogen**, **alkaline soils** (pH 6 or above). Warm weather encourages its spread. The risk of damping-off is especially high when sowing done during rains. Damping-off can be controlled by paying due attention to proper **cultural practices** and by using **certain chemicals.**

Cultural practices (Aeration)

The most effective preventive measures are avoiding of excessive watering and maintain of good aeration in seedbeds. Correct density of sowing is important as aeration in dense patches of seedlings is much reduced. Too heavy shading must be avoided. During long periods of cloudy weather, it is advisable t remove the shades entirely.

Soil sterilization

- Helps in controlling pre-emergence damping-off. However, it is much less effective in controlling post-emergence damping-off.
    1. ***Cooking the soil with some water*** for some minutes can treat small quantities of seedbed soil.
    2. Bigger amount of soil can be treated with ***formaldehydes (formal***). Commercial (40%) formaldehyde is applied to the bed at the rate of 80 cc per 5-liter of water per one square meter. Formaldehyde should be applied 7 to 10 days before sowing to avoid soil damage to seed.
    3. ***Methyl bromide*** is widely used for soil sterilization.

Standard dosage is 50 to 100 grams per square meter applied as vapor under an absolutely air tight polythene cover several days before sowing. For the time being, no methyl bromide treatments have been applied in Ethiopian nurseries.

The risk is high when sowing is done during rains. Other Measures to be taken to control Damping-off

- Delay seed sowing until soil temperature is high enough to promote rapid germination.
- Sow stratified seeds for quicker germination.
- Cover seed with non-compacting material.
- Maintain soil pH to neutral
- Use area prone to damping-off for transplant or resistant seedling specie

Fungicide application on Nursery Plants

Fungicides		**Anthracnose**	**Botrythis**	**Damping off and root rot**	**Damping off and root rot by**	**Downy Mildew**	**Powdery**	**Leaf blight**	**Action**
Common name	Trade name								
Benomyl	Benlate	X	X		X		X	X	S
Captan	Captan	X	X		X			X	P,E
Mancozeb	Dithane M-45	X						X	P
Maneb	Dithane M-22	X	X	X	X		X	X	P
Metalaxyl	Subdue				X				S
Dodemorphe	Karathane						X		P

Key: S = systemic, P = protectant, E= eradicant

6.3.3. Removing weeds

The chemicals used to kill weeds are referred to as Herbicides.

Weed Elimination techniques (The principal methods of weed control):

Weeds can be eliminated by

- ® **Manually by hand**
- ® **mechanically**
- ® **Chemically.**

Hand weeding

Weeding by hand should be limited to plant containers or germination beds were the weeds cannot be reached by tools without disturbing or damaging the tree seedlings. In all other cases, small ***weeding hoes, cultivators*** etc. may be used for weeding of plants are somewhat widely spaced as in traditional beds.

Mechanical weeding

Mechanical weed control by ***motor cultivators, tillers, & rotary hoes*** attached to a tractor is limited to large level nurseries producing bare rooted plant stocks.

Chemical weed control

Weed killing chemicals are called ***herbicides***. They are widely used in agriculture and land clearing during planting. The use of herbicides should be restricted to large nurseries raising mainly conifer seedlings and to nurseries where labor is expensive or not available.

Chemical can have a harmful effect on broad-leaved tree species. ***Non-selective herbicides*** are toxic to all kinds of plants and they are used for weed control on paths, along fence line & around buildings. ***Selective herbicides*** destroy certain species selectively but cause little or no injury to others.

Herbicides like ***2.4.D and 2.4.5.T*** kill broad-leaved weeds but not grass and conifers.

Fertilizer

Fertilization of nursery soils is necessary to replace the lost nutrients. Developing and maintaining high levels of fertility in nurseries are essential for producing good quality nursery

stocks. However, soil fertility is only one of a number of factors influencing stock quality. Fertile nursery soil does not compensate for poor practice.

It may be possible to ***improve seedling quality*** by altering the timing and level of fertilization in the nursery, or by monitoring the nutritional status of seedlings during an active growth.

Site condition and other cultural practices made fertilization decisions some of the most difficult in nursery management.

Application of solid Fertilizers

Fertilizers can be applied in the following way:

A) Mixing into soil mixture before filling pots:

An average of 1-2 kg of compound ***NPK*** fertilizer, phosphate fertilizer or ***DAP*** is mixed into 1 cubic meter of soil mixture. Mixing has to be done very carefully to make sure all pots get equal amounts of fertilizer. With slow-releasing phosphate, this may suffice as the only application for the seedlings during their stay in the nursery.

B) Top dressing

Dusting of dry fertilizer to soil surface of very soluble nitrogen fertilizers may need be applied frequently. In small nurseries this is usually done by dibbing small quantities of fertilizer in to the soil around each plant. It is important to see that no fertilizer is left on the leaves and that no fertilizer is in direct contact with the stem of the plant, as this would cause scorching. Light watering should be done immediately to wash the fertilizer off the seedlings and to help the fertilizer sink into the soil.

Application of liquid fertilizer

- Fertigation
- Starter solution
- Foliar

Mulching

Mulching is any artificial modification of the soil surface. Mulching means ***covering the bed surface with a 0.5 - 0.2 cm layer of organic materials*** Germinating seeds need warmth,

moisture, light is not necessary in most cases. To be effective a, layer of mulching should be 1-2cm thick.

The primary purpose were to ***conserve soil moisture*** by reducing evaporation from the soil and ***protects it against sun***, hence ***lowers the soil temperature*** and also ***protects the soil against heavy rains t***hat can wash the seeds which are sown.

Mulch also ***minimizes the risk of exposing the seeds to birds and rodents***. In areas where watering is necessary throughout the year; mulching helps to ***reduce both the frequency and amount of watering needed.***

Materials

- Grass
- Rice straw
- Rice husk
- Compost, and
- Partly decomposed forest litters or saw dust is commonly utilized.

Avoid the use of mulch to beds in rainy areas as this can reduce aeration and risk of damping off would be increased

- **Grass mulching of Sowings**

In Ethiopian nurseries sown seeds both in seedbeds and in pots are covered with a layer of grass. The reason is to prevent the soil surface and seeds from being washed aside in watering, as local watering cans have very rough sprinklers and the drop size is large. The grass mulch has got some disadvantages. It may bring into pots or beds weed seeds and insects. Introduce of fine-hose watering cans could bring about considerable improvements in nursery techniques in Ethiopia.

Removing dead material and diseased plants

Plant stock material from other nurseries (seed, cuttings, scion wood and rootstock) can harbor nursery pests. Wherever possible, accept propagation material from nurseries only if it has a plant inspection certificate. If in doubt, surface sterilization should be carried out on all new and unknown material.

Diseased plants in a nursery should be culled rigorously and burnt rather than composted. Composting diseased material can only be recommended if the compost temperatures are high enough to kill pests (above 60°C), and can be maintained at this level for several days.

Pruning

Root Pruning is a standard in most Ethiopian nurseries. Root pruning involves ***cutting of the taproot***, in some cases also of ***lateral roots***, to encourage the ***development of fibrous root system***. This kind of root system gives the seedlings the best possible start in plantation. Root pruning also ***controls depth of root penetration*** and makes lifting of seedlings easier and less harmful.

Root pruning helps the seedlings to have ***a balanced root-shoot ratio***.

It also helps the seedling to have an ***adequate root collar diameter*** (because of the slowdown of the top growth).

Methods of root Pruning

Root pruning can be done in several ways:

A) Pruning with knife or secateurs

This is the most common method with potted seedlings. Each pot is lifted up & the protruding roots are snipped off. Consume time as a single person can only prune 500 seedlings a day. If root pruning is done using this method, it is good to leave some 30cm of the storage bed without pots at one end.

B) Root wrenching /shocking/

Pots are only lifted off the ground to snip or pull roots which has grown in to the ground. It is much faster than knife pruning and the operation can be combined with weeding or cultivation. As this method is not sufficient to use it alone, roots should be cut with knife or secateurs every 4-6 weeks between root wrenching.

C) Pruning with piano wire

This method can be applied to potted seedlings, which are kept in raised beds framed with reverting boards, and to bare rooted seedlings.

Frequency of root pruning

Depends on: -

- The growth rate of seedlings
- Species and
- Environmental condition of the nursery.

Weekly pruning is recommended for fast growing seedlings like eucalyptus. With pines and cypress, the interval between pruning is about 2 weeks.

Care of seedlings during pruning

- It is best to do root pruning on a dull, cloudy or during the cool hours of the day.
- A clean cut with a sharp blade will favor proper healing of the pruned roots.
- Immediately before and after root pruning the container bed should be watered thoroughly to soften.
- Some Eucalyptus or other species show symptoms of wilting after pruning and it may be necessary to put them under shades for a couple of days after prune

Staking

Stacking refers to arrange nursery seedlings in an order pile/straight up to avoid growth of root deformity.

Spacing

Avoid very dense spacing in germination and nursery beds, because diseases can spread easily. Close spacing can also lead to etiolated and weak plants which are susceptible to disease.

Thinning

Thinning in nursery refers to the way of reducing the density of seedlings for different purposes.

- ✪ To strengthen the vigor and health of plants.
- ✪ To reduce completion (water, air and nutrients).
- ✪ To minimize disease transmissions.
- ✪ To avoid deformed plants.
- ✪ To use nursery stock (cuttings and rooting) for duplication

6.1 Applying Water

Water is applied in required quantity and in an appropriate method specified by enterprise work procedures. Work procedures will be based on sound horticultural principles and practices and may include

- Supervisors oral or written instructions
- Plant care program
- Enterprise standard operating procedures (SOPS)
- Specifications
- Production schedules
- Routine maintenance schedules
- Work notes
- Product labels and material safety data sheets (MSDSS)
- Integrated pest management (IPM) programs
- Manufacturers service specifications and operators manuals
- Waste disposal
- Recycling and re-use guidelines
- OHS procedures.

Disinfecting irrigation water

Household bleach usually has a strength of 3.5% or 35 000 ppm ***NaOC***l. It contains 24, 000 ppm chlorine ***(Cl2).*** To make 1 L of a 1 ppm Cl2 dilution, 0.042 ml (or 42ul) of household bleach is needed. Generally, a good supply of water is indispensable for the growth of seedling but too much water can be harmful. Water should be clean, of pH value ranging from 5.5 to 6.5. Newly sown containers seed trays or nursery beds must never dry out, but kept continually moist though not soaking wet.

Frequency of watering

There is no fixed rule about the intervals between watering and quantity of water required, because this ***varies with species, soil conditions, age of plants, weather condition***, etc. Watering should be done frequently, at least ***twice a day*** in small quantities. Seedlings are watered immediately after transplanting. Therefore, light watering is carried out 2- 4 times a day depending on the progress of the seedlings.

Time of watering

The watering should do ***early the morning, before 10.00 a.m. & in the afternoon after 4:00 p.m***. This will enable the seedlings to utilize efficiently with the water sprayed on to them without being lost.

Methods used to apply water

Methods used to apply water may be applied ***manually or by operating the irrigation systemtoo heavy watering*** should be avoided, as this causes ***pudding of soil and poor aeration,*** which creates favorable condition to damping off-fungi. Every nursery manager should find out the best possible watering regime himself/herself.

Fine – hose watering cans must be used in watering of seedbeds without grass mulch. If not available, try to use grass much.

Self check -6	**Written test**

Directions: Answer the following questions accordingly

1. List Factors that influence plant health?(4points)
2. what is the advantage of Nursery hygiene practices?(6 points)
3. What aretwo basic approaches to nursery health? 5 (points)

Note: Satisfactory rating: >8 points &above Unsatisfactory rating < 8 pts

Ask your teacher for copy of correct answers

Name_____ Date_____

Information sheet-7	Undertaking seedling hardening off practice

⌘ **Hardening**

Timely hardening of seedlings will produce strong and healthy plants that are able to withstand a certain amount of pest or disease attack.

⌘ **Resistant species or cultivars**

If possible, grow resistant types or cultivars, or avoid susceptible species altogether. For example, citrus should not be propagated in areas with high incidence of aphids, since aphids transmit citrus greening disease, and spraying against the aphids usually cannot check the problem to the necessary extent.

⌘ **Cleanliness in vegetative propagation**

When harvesting scion wood and cuttings, take care that they come from healthy stock plants that are not depleted of nutrients or drought stressed, to enhance their resilience to diseases. Always sterilize knives and secateurs with alcohol to avoid spreading virus diseases, which are often transmitted on the tools.

⌘ **Staff training**

To keep pest and disease levels low, all employees should be trained to recognize and report pests. Workers, who are in daily close contact with the plants through watering, weeding etc., will probably more often encounter such problems than a nursery manager would.

Self-Check -7	**Written Test**

Name: _____ Date: _____

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

1. What is Hardening? 8 pts
2. what is Resistant species or cultivars?6pts
3. What is the advantage of Staff training**?** 5pts

Note: **Satisfactory rating - 9 points and above** **Unsatisfactory - below 9 points**

You can ask your teacher for the copy of the correct answer

1.

Crops production -II

Learning Guide- 50

Unit of Competence: - Assist to Establish and Maintain Nursery Plants

Module Title: - Assisting to Establish and Maintain Nursery Plants

LG Code: - AGR CRP2 M11 0919

TTLM Code: - AGR CRP 2 0919-TTLM112019

LO5. Complete nursery plant maintenance operations

Information	Learning Guide -50

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics –

- Recording workplace information
- Collecting and disposing or recycling wastes to minimize damage to external environment
- Cleaning and storing tools and equipments
- Following nursery hygiene practices to minimize risk of contamination

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, you will be able to –

- Record workplace information
- Collect and dispos or recycling wastes to minimize damage to external environment
- Clean and store tools and equipments
- Follow nursery hygiene practices to minimize risk of contamination

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 to 6.
3. Read the information written in the information “Sheet 1, Sheet 2, Sheet 3 and Sheet 4”.
4. Accomplish the “Self-check 1,Self-check t 2, Self-check 3 and Self-check 4” **in page -6, 9, 12 and 14** respectively.
5. If you earned a satisfactory evaluation from the “Self-check” proceed to “Operation Sheet 1, Operation Sheet 2 and Operation Sheet 3 ”**in page 15.**
6. Do the “LAP test” **in page – 16** (if you are ready).

Information sheet-1	*Recording workplace information*

1.1. Recording work place information

With the aim to ensure the complete stand history of certain plantation; it is indispensable to note all operation of nursery tending activity. Moreover for good nursery management, recording all work done, the progress made is essential. Records of workplace information may include:

Environmental parameters (light, temperature humidity and wind)

Date of treatments and

Type of treatment and

Rate of treatment.

A careful recording will also help to tend nursery plant the most appropriate production data for each species.

I) Nursery registration form:

The recording is done on individual nursery bed basis.

1. Species ----------
2. Provenance ----------
3. Date of seed collection
4. Reception date of seeds
5. storing condition
6. Method of seed pretreatment
7. Density of sowing
8. Quantity seed per sq. m ---kg
9. Area seed bed ---sq. m

10. Protective measures taken
11. Registration number of seed bed
12. responsible person
13. Expected number of seedlings per sq.m and in total
14. seedling description for planting
15. Destination of seedling
16. Transportation specification (date, seedling transported, seedlings eliminated) and so on

II) Nursery diary: all the operations and observations of the day should be mentioned in this book as detail as possible

Example

Date	Work done	Remark
2/1/2002	2 people prepared beds	

III) Nursery calendar: here we record all the activities to be done and when they are to be done.

Example

Activity	S	O	N	D	J	F	M	A	M	J	J A
weeding											
Pruning											
Treatment application											
Mulching											

IV) Nursery delivery Record: this shows how and where the seedlings were distributed

Example

Date	Species	Number	Bed No	Receiving station
20/10/ 2000	Capsicum Annum	30000	A2	Agarfa town
22/12/2000	Solanum	20000	B3	Robe

V. Attendance book: daily of laborers' is important.

Example

Name/date 1 2 ---------- 30

P S H

A P O

Where: p= present, A = absent, S = sick, H = holiday, O = off duty

VI. Workers and work organization

- It is recommended to employ permanent workers for the following activities: Sowing, Transplanting, Grading, Foremen, watchman
- For pot filling, manufacturing of shading and mats temporary workers can be employed.

Self-Check -1	**Written Test**

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

1. List records of workplace information? 8 pts
2. what are the importance of recording production data?6pts
3. What is Nursery calendar**?** 5pts

Note: **Satisfactory rating - 9 points and above** **Unsatisfactory - below 9 points**

You can ask your teacher for the copy of the correct answer

Name: _____ Date: _____

Information sheet-2	**Collecting and disposing or recycling wastes to minimize damage to**

	external environment

2.1 Collecting Wastes

Waste is collected and disposed of or recycled to minimize damage to the external environment.

Waste may include:

Left over treatments

Unused containers

Plant debris

Faulty irrigation components.

Its implications for the external environment:

Contamination of off-site ground water or soils from solids

Nursery debris

Nutrients or. E.g. composting

Chemicals E.g. pollution

2.2 **Managing waste materials**

Waste management is the collection, transport, processing, recycling or disposal, managing and monitoring of waste materials. The term usually relates to materials produced by human activity, and is generally undertaken to reduce their effect on health, the environment or aesthetics. Waste management is also carried out to recover resources from it. Waste management can involve solid, liquid, gaseous or radioactive substances, with different methods and fields of expertise for each.

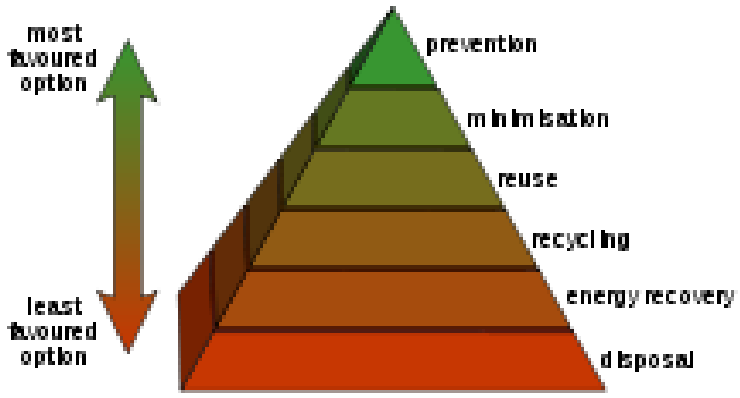
Waste management practices differ for developed and developing nations, for urban and rural areas, and for residential and industrial producers. Management for non-hazardous waste residential and institutional waste in metropolitan areas is usually the responsibility of local government authorities, while management for non-hazardous commercial and industrial waste is usually the responsibility of the generator.

Waste management concepts

There are a number of concepts about waste management which vary in their usage between countries or regions. Some of the most general, widely used concepts include:

2.3 **Diagram of the waste hierarchy**.

Waste hierarchy - The waste hierarchy refers to the "3 Rs" reduce, reuse and recycle, which classify waste management strategies according to their desirability in terms of waste minimization. The waste hierarchy remains the cornerstone of most waste minimization strategies. The aim of the waste hierarchy is to extract the maximum practical benefits from products and to generate the minimum amount of waste.



An active compost heap.

Waste materials that are organic in nature, such as plant material, food scraps, and paper products, can be recycled using biological composting and digestion processes to decompose the organic matter. The resulting organic material is then recycled as mulch or compost for agricultural or landscaping purposes. In addition, waste gas from the process (such as methane) can be captured and used for generating electricity and heat (CHP/cogeneration) maximising efficiencies. The intention of biological processing in waste management is to control and accelerate the natural process of decomposition of organic matter.

Recycling refers to the collection and reuse of waste materials such as empty beverage containers. The materials from which the items are made can be reprocessed into new products. Material for recycling may be collected separately from general waste using dedicated bins and collection vehicles, or sorted directly from mixed waste streams.

The most common consumer products recycled include aluminum such as beverage cans, copper such as wire, steel food and aerosol cans, old steel furnishings or equipment, polyethylene and

PET bottles, glass bottles and jars, paperboard cartons, newspapers, magazines and light paper, and corrugated fiberboard boxes.

Self-Check -2	Written Test

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

1. What is waste? 8 pts
2. What is waste management?6pts
3. What is waste hierarchy? 5pts

Note: Satisfactory rating - 9 points and above Unsatisfactory - below 9 points

You can ask your teacher for the copy of the correct answer

Name: _____ Date: _____

Information sheet-3	Cleaning and storing tools and equipment's

- 3.1 Cleaning and storing Tools and equipment
- Tools and equipment are cleaned and stored according to enterprise work procedures

Cleaning materials, tools and equipment's after work has so many advantages, such as:

- To prevent from rust
- To be durable and long life span to use
- To prevent our health and the environmental pollution etc.

Tools and equipment should be cleaned and sterilized according to the manufacturer's specifications, enterprise procedures and regulations. This is used to increases life span of tools and equipment and avoids scarcity of tools and equipment at critical periods. Always before storing of tools and equipment cleaning is a must.

3.2 Disposing waste

After completion of all field crop maintenance activities all containers, leftover fluids, waste and debris should be disposed safely and appropriately. Waste materials which may be toxic to human beings or pollutants environmental conditions should be properly disposed to minimize hazards.

3.3 Recording and documenting

All required work place records should be completed accurately and promptly in accordance with enterprise requirements. Recording and documenting your work activities in an area serves you for several purposes simultaneously. It helps you in evaluating and learning from past field crop maintenance efforts. It also helps you to organize your own work for the future and allows you more closely monitor your activities.

All chemical usage should be recorded as well as any necessary recording of vehicle and equipment use in logbooks. Additionally, any assessment of pests and weeds, protein levels, quality and yield should be recorded appropriately.

Record keeping systems used may be either paper-based or digital, and information will be recorded into logbooks or other records.

Self-Check- 3	**Written Test**

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers

1. What does mean Recording and documenting?[5pt]

*2.*What does mean disposing waste? [**4pt]**

3. What does meandisposing waste? [6pt]

Note: Satisfactory rating - 9 points and above Unsatisfactory - below 9 points

You can ask your teacher for the copy of the correct answer

Name: _____ Date: _____

Information sheet-4	Following nursery hygiene practices to minimize risk of contamination

4.1. Practicing nursery hygiene

Healthy plants are the goal of every nursery manager. This is not restricted to research nurseries but applies to nurseries of all sizes and levels of sophistication. Nursery hygiene does not necessarily mean using expensive or toxic chemicals — you can achieve a healthy nursery with ecologically sound management.

2.1. Identifying OHS hazards and assessing risks

OHS hazardsassociated with tending nursery plants includes

- ✪ The use of chemicals and hazardous substances
- ✪ Sharp tools
- ✪ Manual handling
- ✪ Solar radiation and
- ✪ Operating spray equipment.

OHS Requirements of tending nursery plants may include:

- ⌘ Identifying hazards
- ⌘ Assessing and reporting risks
- ⌘ Cleaning
- ⌘ Maintaining and storing tools and equipment
- ⌘ Appropriate use of personal protective equipment including sun protection
- ⌘ Safe operation of tools and equipment
- ⌘ Safe handling

- ⌘ Use and storage of chemicals and hazardous substances
- ⌘ Correct manual handling
- ⌘ Basic first aid
- ⌘ Personal hygiene and
- ⌘ Reporting problems to supervisors.

Employers are responsible for providing a healthy and safe work environment for their employees. OHS are to be in accordance with Federal and Regional Legislation and regulations, and organizational safety Policies and procedures.

Self-Check- 4	**Written Test**

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers

1. What does mean nursery hygiene ?[5pt]

*2.*What does ***OHS hazards***associated with tending nursery plants? [**4pt]**

3. What does meanecologically sound management? [6pt]

Note: Satisfactory rating - 9 points and above Unsatisfactory - below 9 points

You can ask your teacher for the copy of the correct answer

Name: _____ Date: _____

Operation sheet 1site selection

Objectives

After completing this practical, the trainee will able to

- ❖ Select proper site for tea crop production
- ❖ Familiarize with criteria's required to select for site selection

Materials

- Meter -Surveying materials -Metrological data
- Bag -Digging materials

Procedures

1. Survey the topography of the land whether undulating, slopping or plain
2. Locate suitable spot for digging pits at 2-3 places in one hectare as areas, the number of pits may be more according to the area and the topography
3. Collect the soil samples layer wise from 0-60,60-120cm,120-2 meter
4. Put samples in bags, label individual bags indicating location of pits and depth
5. Indicate the source of water(such as well or irrigation canals)
6. Take the water sample in plastic bottles from 4-5 places for testing its suitability for irrigation purposes
7. Have the soil and water sample analyze in soil testing laboratory
8. Collect the metrological data from the nearest metrological observatory for the least 5 years.
9. Depending on the metrological data and soil and water test results, select the site for crop planned to be grown.

Precautions

- ✓ Soil sample and water to be tested must be taken by respective person or expert

- ✓ Be careful while interpreting the soil and water testing results, because if you make mistake here, it will lead you to make a mistake in selecting site.

Operation sheet 2. Land preparation

Objective

At the end of this practical, the trainer will able to

- ✓ Prepare land for tea nursery
- ✓ Identify different land preparation procedures

Materials

- ✓ Measuring tape
- ✓ Meter
- ✓ Spade
- ✓ Pickaxe
- ✓ Rope
- ✓ Pegs
- ✓ Rack

Procedures

1. Identify the site which was selected and crop for which land will be prepared
2. Collect the tools and equipments required for land preparation
3. If the site is newly selected site which is not previously ploughed, clear the site manually or mechanically by machine
4. After the site is cleared, remove the materials which interfere ploughing or digging operation
5. Also remove different stubbles, rocks, gravels and larger stones
6. Plough or dig the site to make loose and pulverized the soil
7. Repeat the digging or ploughing operation until the soil reach required tilt

Operation sheet 3. Constructing seed bed

Objectives

- To enable students how to select site
- To familiarize students about land preparation
- To acquaint students how to construct seed bed

Materials required

- Hoe
- Axe
- Meter
- Spade
- Peg
- Saw

Procedures

1. Select site based on pre-set criteria's for seed bed construction
2. Clear land
3. Avoid unwanted vegetations and materials like stones, debris etc.
4. Perform digging of the selected land
5. Perform pulverizing and leveling of the soil
6. Perform proper mixing of soil and nutrient ratio or add organic matter to the soil if needed
7. Perform the lay out using triangular method
8. Measure the land using your meter based on your availability of seed
9. Construct seed bed and make it ready for seed sowing

LAP Test	Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions:

1. You are required to perform any of the following:
   - Prepare seed bed
   - Prepare land
   - Select site
2. Request your teacher for evaluation and feedback