CROP PRODUCTION

Level-II

Based on March 2022, Version 4 Occupational standard

Module Title: - Establishing and Maintaining Horticultural, Stimulant and Spices crop

LG Code: - AGR CRP2 M03 LO (1-5) LG (13-17)

TTLM Code: - AGR CRP2 TTLM 0922v1

September, 2022

Addis Ababa, Ethiopia

Table of Contents

Introduction to the Module

This module covers the Knowledge, Skills and attitude required for Stimulants and Spice crop establishment operations. Includes site selection, prepare the site for planting, carry out planting operations, care for young plants, complete crop establishment and management operations.

Horticultural production is one of agricultural sector which need special concern from the field of agriculture due to having a great importance regard to social, economic and environmental aspects for keeping this value the production practice play the main role to achieve this goals. Production of horticultural crops like fruits, vegetables, spice, stimulants, medicinal plants, ornamental plants, flowers, etc... need special concern than that of field crop like wheat, barley, corn etc… because they have a different characteristic which make them differ from field crops.

The production start from site selection, depending on different criteria site is selected then the other operation next to this is preparation of the site for planting and after making the area good for plantation the plantation process is done by seed or using the plant part itself ,this is the main step to establish horticultural crops in our site next to this the module pass to care for the seedling maintenance, improvement and crop protection activity is done to have a good crop at the end and to make our establishment process is as best as possible .

To do the establishment activity it is mandatory to keep our health and safety because there are different hazard that have effect on human being and the environment to protect our self-there are material that used to keep our self from hazards which we call it personal protective equipment, with all of the production and establishment activity it is must to wear PPE and follow all of the instruction regard to removing the PPE and checking all the material are safe to protect our self.

LG #13	LO #1- Preparing Horticultural crops establishment operation

Instruction sheet

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

- Collection of horticultural, stimulants and Spice crops Inputs
- Selection and preparation of machinery, equipment and tools
- Identification, assessing, and reporting OHS hazards and risk
- Identifying environmental implications
- Selection, using and maintain PPE pre-planting soil treatments and their importance

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Inputs are collected for horticultural, Stimulants and Spice crops establishment.
- Machinery, equipment and tools are selected and prepared for the task being undertaken.
- OHS hazards are identified, risks assessed and reported.
- The environmental implications of the horticultural, Stimulants and spice crop establishment program are identified
- Suitable personal protective equipment (PPE) is selected, used and maintained.

Learning Instructions:
1. Read the specific objectives of this Learning Guide. 2. Follow the instructions described below. 3. Read the information written in the information Sheets 4. Accomplish the Self-checks 5. Perform Operation Sheets 6. Do the “LAP test”

Information Sheet 1

1.1 Collection of horticultural, stimulants and Spice crops Inputs

- **Definition of terms:-**

✓ **Horticulture**:-is **a science** and an **art** which deals about production, mechanization, management, and marketing of spice, stimulants, vegetable, fruit, and ornamental plant in one framed worked way.

✓ **Branch of Horticulture include the following:**

- **Pomology**: - production and management of **Fruit** culture, including pome fruits (apple, pear, quince), stone fruits (peach, cherry, plum, nectarine, apricot), small fruits (blueberry, raspberry, grape, strawberry), and nutrient fruits.
- **Vegetable production (Olericulture)**:- Culture of food crop from **vegetable** plants including roots, leaves, fruits and seeds.
- **Floriculture**:-Growing of cut **flowers,** potted plants, bedding plants, and bulbs and floral design.
- **Environmental horticulture or Landscape Horticulture**: - Nursery production of herbaceous and woody plants for landscape design and management.
- **Postharvest physiology**:- Harvest, handling, and storage of horticultural crops including flowers, fruits, and vegetables
- ***Spice***:-A spice is a seed, fruit, root, bark, or other plant substance primarily used for flavouring or colouring food

  e.g:- coriander, fennel, fenugreek, cumin, dill, celery
- ***Herbs***: - a plant or plant part valued for its medicinal, savory, or aromatic qualities.

  e.g:- sage, rosemary and lavender

- ***Stimulant***:-a plant part in which they have chemical or ingredient that have some improvements in physical or mental functioning, thus elevating mood and increasing feelings of wellbeing, energy and alertness

e.g:- coffee, tea, cacao, kchat

Fig 1.1 Spices

Fig 1.2:- herbs as a (medicinal plant)

Fig 1.3:- coffee plant

1.1.2 Input for establishment of Horticultural Stimulant and Spice

- Horticultural production is one of the economic sectors of agriculture from those of different agricultural production sectors; the sector mainly aimed for improvement in economy, utilization, and social works
- The crop differ from other crop groups due to their perishability, seasonality, disease resistance, capacity, and overall production system and establishment; production more of needs establishment and input preparation
- For this reason input must be selected by different amount, quality and their efficiency (machinery). Availability of agricultural inputs to the farmer on the basis for crop production **seeds,fertilizer,pesticide,herbicide,irrigationmaterial,machineries,etc**

- For the production of horticultural crop not only spice and stimulant but also other crops the input must fulfil such measurements:-
  - ✓ Available on time
  - ✓ Enough in quantity
  - ✓ Suitability for environment and worker
  - ✓ Improved quality

- **Some of important input which are used for horticultural crop production**

✓ **Seed(cutting)**:-seed is the basic input and the most important catalyst for the production of spice and stimulant to be cost effective for ensuring sustainability the seed supporting high productivity ,enhancing profitability create biodiversity at a reasonable level .Thus the seed play a vital role in agricultural production specially in horticulture. In horticultural production vegetables, flowers, spices etc. are planted by sowing using their seeds.

Fig:-1.4 seed

✓ **Fertilizer:** - fertilizer, natural or artificial substance containing the chemical elements that improve growth and productiveness of plants. Fertilizers enhance the natural fertility of the soil or replace chemical elements taken from the soil by previous crops. Both **organic and inorganic** fertilizers provide plants with the nutrients needed to grow healthy and strong. Organic fertilizers work over time to create a healthy growing environment, while inorganic fertilizers provide rapid nutrition.

- **Inorganic fertilizer**, also referred to as synthetic fertilizer, is manufactured artificially and contains minerals or synthetic chemicals. So, while inorganic fertilizer is cheaper in the short term, it adds less to the soil in the long term.
- **Organic fertilizer** may also build up concentrations of some nutrients, but buildup of toxicity is unlikely as long as the organic material is able to fully decompose.

Organic fertilizers an organic fertilizer is a fertilizer that is derived from organic sources, including organic compost, cattle manures, poultry droppings and domestic sewage.

Fig:-1.5 fertilizer application

- **Crop protection chemicals**:-**Pesticide** defind as any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest. **Herbicides** also commonly known as **weed killers**, are substances used to control undesired plants, also known as weeds.

- **Plant growth hormone:** - any substance or mixture of substances intended for use as a plant regulator, defoliant, or desiccan.Phytohormones are chemical compounds present in very low concentrations in plants. They regulate plant development, growth, longevity and reproductive processes. Here, let's look at the structure and functions of different phytohormones like auxins, gibberellins, cytokinins, ethylene and abscisic acid. Generally there are two kind of plant growth hormon which are plant growth promoter and plant growth inhibitor

1.2 Selection and Preparation of Machinery, Equipment and Tools

Selecting proper tools and equipment are essential for the effective operation of any agricultural operations. Equipping the agricultural site with the correct tools and equipment plays an essential role in achieving timely and good quality results. For every agricultural activity, there is an optimal combination of tools, equipment and labor.

Depending on the nature and content of the works, the technical staffs needs to know which tools to use and how to effectively combine them with manual labor. In order to utilize the equipment and labor in the most effective way, the use of equipment needs to be carefully coordinated with the output of the work ranges. It is also important that staff know the full potential, as well as the limitation, of the use of manual and equipment-based works methods. Finally, tools and equipment need regular maintenance, requiring good workshop facilities, a reliable supply of spare parts and qualified mechanical staff.

- ✓ **Farm machinery selection depends on:-**
- ✓ Machine performance
- ✓ Machinery cost
- ✓ Operating cost
- ✓ Labor cost
- ✓ Number of crop per acres
- ✓ Weather condition
- ✓ Risk management

Fig 1.6:- primary and secondary tillage

There are many simple tools which are used for horticultural operation mainly on land preparation and planting process this material are solving a lot of problem regard to the establishment of horticultural crops ..

Flip Chart 1-1 Horticultural tools and equipment and their use

No.	Horticultural tools	Description and their use
1	Hoe 	• Long handled with flat and perpendicular blade at the end. • Used to remove weeds by agitating and grooming the soil surface, • Used to dig, move and hill soil during preparation for planting
2	Mattock 	• For digging hard soils
3	Axe 	• Axe is multipurpose cutting tool used for felling and delimbing of trees, splitting of logs for firewood and dressing of logs for timber conversion.
4	Spade 	• A long handled tool traditionally used for • Digging, shoveling soil and compost, • Moving shrubs of plants
5	Meter (Measuring tape) 	• Made from steel or wooden and used for lay out of seedbed, plots and plant spacing
6	Watering can Watering can 	• A portable water container used for watering smaller areas and containers

7	Peg 	• Used for securing net, line or fleece to the ground
8	String (Garden Twine) 	• Used for lay outing activities and tying plants to stakes • Available in natural jute and coated
9	Shovel 	• A highly versatile and widely used garden tool. • Used to dig large holes and transport heavier materials such as wet soil and rocks • Its sharp edges can cut the roots and sods as well as break up compacted soil.
10	Aerator 	• Effective to reduce soil compaction by removing small plugs in soil • Used to aerate soi
11	Forks 	• Used for digging of soils in situations where the use of spade may be difficult for turning of soils, • Used to till large areas of soil and break up compacted clods, • o rake out weeds and stones
12	Gloves 	• Used to protect hands and fingers from cuts, blisters, calluses, sun damages, abrasions and dirt

- Other equipment and tools and machinery need for the establishment operation are :-
  - ✓ Tractors
  - ✓ Tools land preparation and planting equipment's
  - ✓ Rotary hoes
  - ✓ Tap meters
  - ✓ Cultivators
  - ✓ Drip irrigation
  - ✓ Sprinkler
  - ✓ Compass ,theodolite
  - ✓ Seeder or planter Field tool boxes and planting trailers

1.3 Identification, Assessing, and Reporting OHS Hazards and Risk

- **Occupational health and safety**: - is a discipline with a broad scope involving many specialized fields. In its broadest sense, it should aim at:-
  - ✓ The promotion and maintenance of the highest degree of physical, mental and social well-being of workers in all occupations

- ✓ The prevention among workers of adverse effects on health caused by their working conditions
- ✓ The protection of workers in their employment from risks resulting from factors adverse to health
- ✓ The placing and maintenance of workers in an occupational environment adapted to physical and mental needs
- ✓ The adaptation of work to human

In other words, occupational health and safety encompasses the social, mental and physical well-being of workers that is the "whole person".

- **Importance of occupational health and safety: -** Work plays a central role in people's lives, since most workers spend at least eight hours a day in the workplace, whether it is on a plantation, in an office, factory, etc. Therefore, work environments should be safe and healthy. Yet this is not the case for many workers. Every day workers all over the world are faced with a multitude of health hazards, such as:

  - ✓ ***Dusts***
  - ✓ ***gases***
  - ✓ ***noise***
  - ✓ ***vibration***
  - ✓ ***Falling trees and plant debris***
  - ✓ ***Chemicals***
  - ✓ ***Solar radiation***
  - ✓ ***sharp tools and equipment***
  - ✓ ***Uneven surfaces,***
  - ✓ ***Flying and falling object***

Fig:-1.7 work safety rules

1.3.1 Agriculture and occupational health and safety

Production agriculture is associated with a variety of occupational illnesses and injuries. Agricultural workers are at higher risk of death or disabling injury than most other workers. Shocking injury commonly occurs from working with machinery or animals.

Respiratory illness and health problems from exposures to ***farm chemicals*** are major concerns, and dermatomes, hearing loss, certain cancers, and ***zootoxic infections*** are important problems.

Horticulture industry use a lot of chemical for production so, **OHS** is the most important thing that we should not forget.

Innovative means of encouraging safe work practices are being developed. Efforts are being made to reach all groups of farm workers, including migrant and seasonal workers, farm youth, and older farmers. Agriculture is one of the most hazardous of all economic sectors and many agricultural workers suffer occupational accidents and ill health each year. It is also the largest sector for female employment in many countries, especially in Africa and Asia. Agriculture employs some one billion workers worldwide, or more than a third of the world's labor force, and accounts for approximately 70 per cent of child labor worldwide.

- **Some of the injury and illness**

  - ✓ **Respiratory disorders** develop from the inhalation of grain dust, other types of organic dusts, and work in animal confinement facilities.
  - ✓ **Hearing loss** is an important problem in settings where machinery is in use.
  - ✓ **Skin cancers** caused by sun exposure are a serious problem.
  - ✓ Irritant and **allergic dermatomes** occur from exposures to plants and farm chemicals. Zootoxic infections can cause life-threatening illness.
  - ✓ Also **pesticide exposure** can cause serious illness and death. Illness from pesticide exposure is likely frequently not recognized or reported as being linked to this exposure.
  - ✓ Mechanical injury like body part loss it can be foot, leg this is due to sharp material cutting in in land preparation and falling of trees in land clearance etc…

Fig1.8:- Hazards on agricultural operation

- **OHS Hazards** may include ;-Disturbance or interruption of services ,Solar radiation ,Dust ,Noise ,Chemicals and hazardous substances ,Manual handling, moving vehicle ,Machinery and machinery part ,Sharp tools and equipment ,Uneven surfaces and flying and falling objects, falling of tree.

Reporting:-means the process of presentation of some information in organized format for specific audience or to do further improvement in the activity**.** All employees should know how to report an injury or incident to you. When an injury occurs that may result in a workers' compensation claim you should advise your insurer within 48 hours.

The details of any injuries you need to keep are:

- ✓ The name, age, address and occupation of the injured worker
- ✓ The place in which the person was working
- ✓ The operation in which the person was engaged at the time of injury
- ✓ The date and time that the injury occurred
- ✓ A brief description of the type, cause and location of the injury and the treatment given
- ✓ The name of the first aid person in attendance
- ✓ Most insurers provide these registers free.

1.4 Identifying environmental implications

There are different environmental implications related to crop production on our field there are different weeds, pest, and other unwanted material which can minimize the production of our crop due to causing different disease and cause some negative effect on the production.

The production are must be free from any waste material and debris because this waste material are the habitat for different microorganism and it can transmit different disease to the plant so proper cleaning practice must be implemented in the production site. During establishment and maintenance of field crops, some activities can be potentially toxic or hazardous to human beings and pollutant environmental conditions.

- **Occupational and environmental hazards may be occurred through**
  - ✓ Use of machinery

- ✓ Moving machinery and machinery parts from one place to another
- ✓ Plant debris
- ✓ Chemicals and hazardous substance
- ✓ Manual handling
- ✓ Solar radiation
- ✓ Dust, and noise
- ✓ The contamination of off-site ground water or soils from solids, debris, nutrients or chemicals
- ✓ Land disturbance

- **Environmental effect**

The environmental effect of inputs which are using in horticultural crop production process is very high so, it need a great concern from the government also stalk holder to minimize the effect .some of effect are explained below.

- ✓ **Soil**

Arable soils are vulnerable to erosion by wind and water, compaction resulting from the use of heavy machinery, and declining organic matter resulting from frequent cultivations and use of synthetic fertilizers. These factors are highly integrated, and linked also with soil nutrient levels, themselves influenced by soil faunal activity. Inputs in the form of pesticides and organic and inorganic fertilizers also influence soil structure directly, and through their impact on the soil fauna.

- ✓ **Water**

Arable inputs such as pesticides and nutrients can enter ground and surface waters, seriously affecting the quality of drinking water, and the cost of its treatment. Their presence in surface water also can have serious consequences for aquatic life. Erosion of arable soils results in sedimentation of watercourses and deterioration in the quality of water and aquatic ecosystems.

- ✓ **Biodiversity**

Simplification of cropping systems (increased fertilizer and pesticide use, and the introduction of irrigation & drainage) results in reduced crop diversity and loss of non-crop habitats such as

grassland, field boundaries, water-courses and trees, all of which can form an integral component of arable systems.

Modern crop varieties grow vigorously under high rates of fertilizer application, out competing other arable plants, and increases in the use of fertilizers have contributed to a change in the arable flora. The dense crop structure associated with high levels of fertilizer application is unsuitable for some birds as a habitat for nesting and foraging.

- ✓ **Air**

Deposition of atmospheric nitrogen can lead to acidification of semi natural environments, resulting in reduction in botanical species diversity and changes to soil processes.

1.5 Selection, using and maintain PPE pre-planting soil treatments and their importance

During crop establishment soil treatment is important step and for this activity you should have to follow safety required to avoid hazards. When we are doing activity regard to treating our soil we are using different chemical which is synthesis in factory and which have a great effect in our body so ,it is must to cover our body buy using different personal protective equipment if not ,the effect will reach to losing our life .

- **Personal protective equipment**

Personal protective equipment is include material or safety tools that used for protecting our self's from different hazard and which are prescribed under legislation, regulations and enterprise policies and practices.

- ✓ **Select PPE based on the PPE Hazard Assessment**

Consider these factors when selecting PPE:

- Type of hazardous materials, processes, and equipment involved
- Routes of potential exposure (ingestion, inhalation, injection, or dermal contact)
- Correct size for maximum protection
- Minimal interference with movement

1.5.1 Some important PPE which are used in pre planting soil treatment

- ***Foot protection***

Fig1.9:- Boots

✓ Workers must wear closed-toe shoes at all times to protect feet from chemical spills and sharp objects. Steel-toed foot wear and puncture-resistant soles. Slip-resistant shoes for anyone who works in wet environments.

- ***Eye protection***

Fig1.10:- Eye glass

✓ Use safety glasses for minor splash hazards, goggles for moderate hazards, and goggles combined with a face shield for severe hazards.

- ***Hand protection:***

Fig1.11:- Glove

✓ Hand protection is indicated for the possibility of severe cuts, lacerations, or abrasions, punctures, temperature extremes, and chemical hazards. (Nit rile loves are usually a good choice for general use.) Use heavy-duty gloves for non-incidental contact and gross contamination.

- ***Body protection:***

 Fig1.12:- Over all

- ✓ Protective clothing includes lab coats, smocks, scrub suits, gowns, rubber or coated aprons, coveralls, uniforms, and pierce-resistant jackets and vests.

Other Personal protective clothing and equipment may include:-

- Hat/hard hat, Overalls, Protective eyewear ,Hearing, Respirator mask Sun protection, e.g., sun hat, sunscreen

Self-check 1	**Written test**

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Test I: Choose the best answer (2 point each)

1. Which one of the following is an input for production of horticultural crop?

   A, seed B, fertilizer C, machinery D, a and b

Test II: Short Answer Questions (3 point each)

1. What is occupation health and safety?
2. List personal protective equipment used in horticultural production?
3. What are tools and machinery used in horticultural production?
4. What are the environmental of input which are used in horticultural crop production?

Operation sheet -1

1.1 Carry out preparation for Horticultural crop establishment operation

A. Materials and equipment preparation

I. Hoe
II. Peg
III. shovel
IV. Spade
V. Meter
VI. Mulching material (thatching grass)
VII. Temporary shade
VIII. Water can
IX. Compost & sandy soil and PPE

B. Procedure

- ✓ Evaluate site selected for crop establishment
- ✓ Consider environmental implication
- ✓ Improve certain environmental problem that affect crop
- ✓ Adjust material important for activity
- ✓ Adjust PPE
- ✓ Ready physiologically to, starting the activity

Lap Test-1	**Performance Test**

Name……. ID……..

Date…….

Time started: _____ Time finished: _____

Instructions: Given necessary templates you are required to perform the tasks within **1** hour. The project is expected from each student to do it.

Task-1: prepare material and tools for horticultural crop establishment operation

LG #14	LO #2- Prepare the site for crop establishment

Instruction Sheet

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

- Removing and disposing old crops and other waste materials
- Clearing and watering site prior transplanting or sowing
- Preparation of growing media
- Working site for horticultural, stimulants and Spice crops
- Understanding principles of horticultural crop establishment and maintenance (CA)
- Principles and operations of irrigation systems (CA)
- Implementing horticultural, stimulants and Spice crops protection.
- Operation of machinery equipment and tools

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Old crops and other waste materials are removed and disposition in full consideration of environmental implications.
- Site is cleared and watered prior to transplanting/sowing
- Growing media is prepared according to the establishment plan.
- Site is worked according to the Horticultural, Stimulants and Spice crop production plan
- Horticultural, Stimulants and Spice crops protection is implemented according to organization guidelines.
- Machinery, equipment and tools are operated according to organization guidelines.

Learning Instructions:
1. Read the specific objectives of this Learning Guide. 2. Follow the instructions described below. 3. Read the information written in the information Sheets 4. Accomplish the Self-checks 5. Perform Operation Sheets 6. Do the “LAP test”

Information Sheet 2

2.1. Removing and disposing old crops and other waste materials

Before doing any operation of agriculture removing waste material and other plant which is unwanted on the field or plant which have a negative effect on our main crop must be taken out .Waste material is a habitat for different harmful microorganism and this harmful waste can affect the quality and quantity of the produce Spice and stimulant have high absorption capacity of liquid chemical, gas and also affect their aroma and flavor Before every operation sit clearance is the most important operation and have a great influence on the best quality of the produce.

There are many wastes like plant residue, chemical for pesticide, herbicide and fertilizer which are used before the time of actual production, for this operation there is mandatory to implement agricultural waste management system.

Fig2.1:-Removing waste material from the field

2.1.1 Removing and disposing old crops

Dropped leaves that are collected seasonally, other vegetation such as grass clippings, woody debris and dead plants and shrubs that are collected at different times should be removed and

disposed. Also, Deicing sands and gravels found at farm site, snow and ice should be removed and disposed from farm site before establishing the crops. In cultivated farm areas, we have to remove old crop residues of previous season before starting the next season farming activities. After the vegetation has been cut down, the traditional farmer resorts to burning in order to remove the plant debris. Usually the vegetation is allowed to dry for few days before it is set on fire. After the land has been cleared of plant debris, it is often necessary to go through it to remove tree stumps and woody roots. This procedure is called **stumping.** To remove previous year plant debris and old crop one of the mechanism is burning ,this process have it own drawback but most of the time is implemented with that off negative things .

- ✓ **Care during burning**:-it should be in such a way that there is no problem of erosion either by wind or water. The land should not be fully naked or exposed &animals/birds/ beneficial insects should not be killed in order to balance the ecology.
- ✓ **Benefits burning:-**
  - It may kill harmful pests& weed seeds.
  - It leaves an alkaline ash that serve as soil amendment
  - Nutrient source such as K & Ca.
- ✓ **Effect burning:-**
  - Loss of N & S as oxides.
  - Loss of beneficial microorganisms & insects;
  - Adverse effect on soil structure

Fig2.2:- Burning of the field

2.2 Clearing and watering site prior transplanting or sowing

2.2.1 Site clearance

This is an optional step necessary only in opening new areas for vegetable growing and in preparing the field after a prolonged mismanaged fallow (rest) period. Under these conditions, the farm may be too weedy to be plowed. Before plowing, then, it may be necessary to clear the field of obstructions and tall weeds. Land clearing is the development of land with the intention of creating a potential use for agricultural purposes. Land clearing requires the removal of native cover – including trees, bushes and boulders – from the land surface this operation not only consider old crops but also all waste which are found in our plantation are must be removed like plastics ,bottle of herbicide and pesticide packaging and all non-biodegradable waste must be removed care fully

The land is subsequently broken to create a workable bed into which a crop can be seeded. Land breaking includes the removal of roots, stumps and rocks. Depending on field conditions, rocks may have to be removed to allow soil cultivation to take place. Several passes with a heavy disk or cultivator are required throughout the summer to work the new land prior to seedbed preparation. Remaining roots may be raked again into windrows and burned. Land Clearing Methods used to clear land will vary depending on the type and density of native cover

Fig 2.3:- land clearing

- **Purposes of site Clearance**

✓ Avoiding competition of nutrients, water, light and air

- ✓ Reduction of shading and making the land convenient for cultivation
- ✓ Eliminating shelter of pests and diseases
- ✓ Enhancing good tea plants development

Clearing of the land can be done by remove existing vegetation, either completely or partially. The amount of vegetation removed during land clearing is depends on:-

- The production region:- grass land, shrubs or forest land
- Production system:- mechanized or non-mechanized
- Crops to be grown: - fruits, vegetable, spice etc…

.

- Once the site for the farm has been selected and acquired, the farmer proceeds with clearing. It involves
  - Cutting down the vegetation
  - Removal of dead plant materials(collecting and burning)
  - Stumping:- removal of stumps is used to facilitates cultivation of the land and to control infestation of diseases and insect pests

2.2.2 Watering the site before sowing or planting

Stick your finger in the soil to test how well the moisture saturated. ***Is, it wet just on top?*** Or has it gotten wet down deep ***where the roots will go?*** You may need to water the soil again and again, if your soil is really dry and deeply dry, you may need to repeat watering multiple times. That way you will build a deeply moist layer in the soil .Depending on the health and composition of your soil, how much water is needed will vary. This is a crucial step to take to ensure your planting goes well. Skipping this step may cause your plants to not root well in the soil or cause them to dry up and die shortly after placing them in the ground Watering have a great important to loosen the soil, to create a good environment for breaking out of the seedling With proper care, use good quality soil, proper preparation before planting, and careful attention after planting, you are on the road to success.

It is vital that the soil is sufficiently moist and ready well in advance of your planting date. Otherwise, digging the hole for planting will be quite laborious, and when the soil is completely dry, you will find that the plant won't absorb water as expected. The water will run off, and you may lose your new plants quickly.

If you are in a hurry, it's best to wait. You don't want the negative effect of your new plants drying up quickly. You first have to find the right soil for gardens. You've got to start with a plan to get the soil ready for planting. Dry soil just won't do the job. Start early and get the soil ready for the day of planting well in advance of the day of planting. Watering too much and too little is not allowed, optimum watering of the field is good for the germination and growth of the planting material whether it is seed or plant part.

2.3 Preparation of growing media

Definition

A **growing medium** can be defined as substance through which plant root grow and extract water and nutrient .selecting a good growing medium is fundamental to good nursery management and is the foundation of healthy root system

2.3.1 Type of Growing media

Growing media is use in container nurseries is available in two basic forms soil based and organic based ,compare with soil based media organic based media (base organic material that may be compost ,peat ,coconut, coir, and other organic material mixed with inorganic ingredient promo good growth of the plant .generally growing media are classified :-

I. **Organic growing media**
II. **Inorganic growing media**

- **Organic growing media :-** Common organic ingredient include compost, coconut coir, peat moss, bark,ricehull,sawdust,and any other appropriate locally available material .This

material are lightweight, have high water holding capacity and CEC some contain minor amount of mineral content .Some of this ingredient require screening or composting local material before using .the nursery may choose to do the processing, or local supplier may specialized in composting or processing local material to sell to the nursery at reasonable price .Example: - peat moss, compost, coconut, sawdust, rice hulls etc…

- ✓ **Compost: -** is a natural organic fertilizer produced as a result of the oxidization of organic materials, which is facilitated by aerobic microbial activity. Compost should be used on all tea farms given its wide array of benefits, especially on organic tea farms (as petroleum-based fertilizers are prohibited when applying organic standards).

- **Compost has many benefits including:**
  - **Improving soil structure: -** Compost improves the physical properties of soil. It can help improve the soil structure of muddy soil and make compact soil more aerated, 21 which will make it easier to plough when soil is hardened by dry weather. It can also improve the water holding capacity of soil.
  - **Slowly releasing all necessary plant nutrients**: - Compost contains all the necessary nutrients to improve tea plant growth. Furthermore, the nutrients it contains are released slowly into the soil, which reduces the need to frequently add inputs in the soil
  - . **Favoring beneficial soil organisms**: - It is beneficial to organisms such as soil microbes and worms living in the soil, which naturally improve the soil, notably by improving soil structure and reducing the prevalence of soil-borne diseases
  - **Cheap**: - Compost uses agriculture waste and turns it into plant nutrients. It is therefore a cheap method of producing fertilizer.
  - **Preserving the environment and the health of farmers**: - Using compost reduces the need to apply agrochemicals and it therefore helps protect the environment and the health of farmers.

- **Inorganic growing media:-**Inorganic material are added to growing media to produce and maintain a structure system of macropores that improves aeration and drainage Many inorganic ingredient have a very low CEC and provide a chemical inert base for the growing media Several material are routinely used as inorganic ingredient in growing media native in plant nursery and field .For example: - gravel, sand, vermiculate, perlite, pumice and polystyrene beads

- **The various important rooting media are given below:**

  - ✓ **Soil:** Light and sandy soils are well suited as rooting or germinating media while loamy silty or clay soils are unsuitable on account of poor aeration and stickiness. These soils in combination with sand, some organic matter, moss, shredded bark and peat are useful as media.
  - ✓ **Sand:** Sand consists of small rock grains of 0.05 to 2.0 mm in diameter. Quart sand is the most useful as it is suitable for sterilization of fumigation. It has no mineral nutrients.
  - ✓ **Sphagnum Moss:** Commercial sphagnum moss is the dehydrated remains of acid bag plants which is acidic, sterile, light in weight and has high water holding capacity being able to absorb water up to 10 - 20 times of its weight. It contains small amount of minerals. It has ability to inhibit damping of seedlings.
  - ✓ **Vermiculite:** This is a micaceous mineral which expends markedly when treated chemically. It is a hydrated magnesium di-aluminum iron silicate. It is light in weight with good mineral supply and able to absorb large amount of water. Generally particles of 2 - 3 mm are more useful.
  - ✓ **Leaf Mould:** Leaf Mould compost is prepared by putting alternate layers of dried leaves with soil and small quantity of sulphate of ammonia is added to accelerate decomposition rate and to increase mineral content. These layers are watered to maintain decomposition action. For decomposition, a period of 12 - 18 months are required.

- ✓ **Saw dust / Shredded bark / Wood Sharing's:** These materials are the by - products of saw mills. For proper utilization as growing media and decomposition, nitrogen is added in sufficient quantity.
- ✓ **Perlite:** Perlite, a gray-white siliceous material, is of volcanic origin, mined from lava flows. The crude ore is crushed and screened, then heated in furnaces to about 760°C (1400°F), at which temperature the small amount of moisture in the particles changes to steam, expanding the particles to small, sponge like kernels that are very light, weighing only 80 to 100 kg per cubic meter. The high processing temperature provides a sterile product. Usually, a particle size of 1.6 to 3.0 mm in diameter is used in horticultural applications. Perlite holds three to four times its weight of water. It is essentially neutral with a pH of 6.0 to 8.0 but with no buffering capacity. Unlike vermiculite, it has no cation exchange capacity and contains no mineral nutrients.
- ✓ **Coco peat-** It is also called as coco dust that is by-product of cuttings & shifting of husk of coconuts for fiber production. It is becoming very popular propagating & growing medium now-a-days, because it has an excellent pore space (25-30%) & fine structure required for proper growth & development of the roots of seedlings, It is rich source of nutrients & can easily be mixed with other growing media, Homogeneous material composed of millions of capillary micro-sponges, Absorb and hold water up to 8 times its dry weight, High CEC, Has high lignin content that encourages favorable MOS around the root zone
- ✓ **Compost**: compost (composting) as the product of biological decomposition of bulk organic wastes under controlled conditions, which takes place in piles or bins and used as media for propagation and plant growth.

2.3.2 Preparation of growing media

Soil is usually a mixture of: -

- ✓ Mineral components from weathered parent rock
- ✓ Organic components from decomposed litter.

Whereas the topsoil (the top 10-20 cm) can be very rich in nutrients, subsoil from deeper layers is often very poor and depleted. When using soil as a potting substrate it is advisable to use only forest topsoil. Topsoil usually has a good CEC. Its pH is largely determined by the parent rock and the plant composition. However, nurseries requiring large volumes of substrate need to consider the damage soil mining does to the forest floor. As a rule of thumb when soil is to be part of the growing medium, use the following mixtures **(topsoil: fine gravel: well-decomposed organic matter such as manure or compost):**

- ✓ For heavy (clayey) soils 1:2:2
- ✓ For medium (loamy) soils 1: 1:1
- ✓ For light (sandy) soils 1: 0:1
- ✓ As a recommendation 1:2:3(advisable)

- **Filling the pot with prepared growing media**

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 about 2 cm below the top. Heavy compaction should be avoided at the top of pots because it will inhibit root penetration. Horticultural crop need more media composition a container filling compare to other crop because most of Horticultural crops are seasonally and annual so they need a good source of nutrient for the establishment of the crop.

Tea and coffee at the beginning of their seedling grows or cutting growth the nutrient and the water supply must be good for better root and leave development for this reason the pot (media) must be prepared carefully. The coffee tree requires deep permeable soil, of good structure, that contains enough organic matter and it is also requires a favorable water balance. In very sandy or clayey soils, the clay content of the soil should be between 15 and 35%. The optimum pH is between 5.0 and 6.0, but the coffee plant can still grow around neutrality. Coffee grows well where natural forests occur.

Fig:-2.4 Soil media preparation

2.4 Working site for horticultural, stimulants and Spice crops

2.4.1 Field adjustment and maintenance

A. Land preparation

Land preparation is dons to create favorable conditions for seed germination, seedling establishment, and subsequent management of the crop. Properly done, it eliminates most of the weeds and soil-borne pathogenic microorganisms. It also improves the water holding capacity, drainage, and aeration of the soil. Likewise, it facilitates field operations, such as furrow irrigation and mechanized weed control**.** Land preparation is important in that it helps in killing of weeds, improves soil aeration, destroys different stages of crop pest such as egg, larval, pupae or adults by burying them or exposing them to predators, encourages penetration of plant roots and water infiltration into the soil, makes subsequent operations possible and in some cases manure and other organic matter can be incorporated into the soil during this process**.**

- The following are some of land preparation practices' are as follows:-

I. Clearing/mowing.

II. Tillage(cultivation)

III. Manuring, liming, and fertilizer application.

The first steps prior to planting is ensuring fields have a fine tilth achieved by primary, secondary tillage and minimum tillage operations.

- **Primary Tillage:-** is achieved through; Mechanical cultivation that break hardpan for preparation of a deep and large seedbed and disc ploughing suitable for rocky and hardy areas and in which the depth of ploughing is determined by the type of crop to be grown, the type of soil and Implements available for such operation.

- **Secondary Tillage:** - it helps break large clods to reasonable tilth for ease in planting, levels the fields in order to achieve a uniform depth at planting, kills weeds and as well help in mixing up of organic matter in the soil to improve soil aeration. Sometimes repeat secondary cultivation is done depending on the condition of the soil, size of planting material, slope of the land and the moisture content of the soil. The aim is to achieve a fine tilth.

- **Minimum Tillage**: - is the operation that combines all farming practices aimed at least disturbance of the soil. The operations include, establishing cover crop on the field, restricting cultivation to the areas where seeds are to be planted, Uprooting or slashing weeds and application of herbicides to kill weeds.

- **Plowing: -** is initially done to open the compact or hard soil. During this operation the soil is inverted, weed uprooted and stubbles incorporated into the soil. The depth of digging varies from 10 to 30 cm. It has different purpose**s** like
  - ✓ Cutting and turning the soil
  - ✓ Loosening the soil and good root penetration
  - ✓ Aerating the soil and making it permeable
  - ✓ Reducing weeds and insect infestation

- ✓ Incorporating organic matter and soil amendments to improve the structure of the soil
- ✓ Shaping soil: - tillage is done to create raised beds for planting or to create furrows for irrigation.
- ✓ Erosion control:- like in conservation tillage

- **Harrowing:-** if the lumps (clods) of soil left after digging are too large, they must be broken up before planting/sowing if broadcasting and before furrow preparation if row methods of sowing. Purpose of harrowing is
  - ✓ Cutting the clods and sods to a considerable depth
  - ✓ Producing fine seedbed and leveled soil
  - ✓ Obtaining weed free soil
- **Leveling**: - is done to improve surface drainage, for installation of irrigation equipment, or to facilitate the use of farm machineries and equipment

To improve the fertility status of the soil we are Applying different organic and inorganic fertilizer to the land, by taking a soil sample and getting the result of soil sample analysis it is advisable to add different soil nutrient improving components for example **farm yard manure, compost, and other inorganic fertilize** like UREA and DAP. Lime should be applied to the field according to soil test recommendations. Proper liming should adjust the soil pH to the correct range (6.0 to 6.5 for most vegetables). The proper soil pH promotes root development, optimizes nutrient availability, reduces the incidence of certain physiological disorders (blossom end rot) and reduces incidences of certain diseases (Fusarium wilt). Do not over-apply lime, as high soil pH reduces nutrient availability and causes nutrient imbalances.

The other thing you must remember is **soil analysis and amendment** ;this is the crucial thing before you proceed to planting and any other operation, horticultural spice and stimulant prefer different type of soil and nutrient content so, for different and individual crop there is a need of specific soil type .For example :-ginger prefer a soil PH that acid to neutral(between 5.0-7.0)

,ideal soil PH for coffee is(6-6.5),cardamom grows luxuriantly in forest loam soil ,which generally acidic to neutral with a PH range of 5.5-6.5

When we are working in the site the other thing we prepare is **fencing**; the site must be fenced as much as possible to prevent the entrance of wild life and animals which have effect on our cropping area and also **shade house** is the other important thing which must be appear in the site for propagation work, for seedling treatment and with this there is a need of **store house** for material storage and placement

Fig 2.5:- land preparation by machine

B. crop site protection

Crop site protection required for crop establishment may include:-

- ✓ Wind protection such as artificial structures
- ✓ Permanent shelter belts or temporary plantings of shades
- ✓ Stakes; and mulch, including straw, plastic, cover crop or any vegetative material.

- **Fencing** will be needed if crops are need to be protected from roving livestock; fences may be established by growing **thorny hedge** plants or may be constructed from locally available materials such as **tree trucks** as upright inter woven with branches of tree which are sufficiently flexible. More elaborate permanent fences of **concrete posts & wire** are preferable, but these are very expensive.

- **Windbreaks** are the best way to protect soil from wind erosion. They can be in the form of rows of shrubs or trees.

The characteristics of a tree suitable as wind break are:

- ✓ It should be fast growing

- ✓ It should be easily establish able
- ✓ It should be able to acclimatize to the environment
- ✓ Should have dense canopy
- ✓ It should not harbor pests and diseases
- ✓ It should be frost resistant
- ✓ It should be drought resistant
- ✓ It can be propagated by various methods
- ✓ Planting material should be easily available and cheap

- **Roads and drains**: These are laid out according to the plan prepared in advance taking the convenience and levels into consideration. Main irrigation channels also have to be plotted. Open drains should be straight, running parallel to the gradient. Silt catching devices should be employed in the drains. Covered drains should be filled with big stones at the base and smaller ones over them and the top 12 inches should be covered with the orchard soil so as not to impede ploughing and other operations

2.5 Understanding principles of horticultural crop establishment and maintenance

Horticultural crop establishment and maintenance have the following principle:-

- Land clearance
- Land preparation
- Planting /sowing
- Watering
- Mulching
- Fertilization (manuring)
- Weeding
- pest protection
- pruning

2.6 Principles and operations of irrigation systems

Irrigation: - is the artificial application of water to the soil or artificial watering of plants/ provides the root zone of the crop with usable amounts of water during periods of need

- **Irrigation system divided in to 2**
  - **I. Surface irrigation**
  - **II. Sub surface irrigation**

Surface irrigation is the oldest form of irrigation and has been in use for thousands of year .in surface (**flood, furrow, basin**,) irrigation system, water moves across the surface of an agriculture lands, in order to wet it and infiltrate in to the soil Micro irrigation, sometime called localized, low volume irrigation or tickle irrigation is a system where water is distributed under low pressure through a piped network, and applied as a small discharge to each plant or adjacent to it.

Irrigation is the controlled application of water to respond to crop needs. Water used for irrigation maybe taken from nearby lakes, reservoir, rivers, or wells (ground water), but also from non-conventional source such as treated waste water, desalined or drainage water .irrigation water is brought to cultivated land by pipe, hoses or ditches

Fig 2.6:- drip irrigation

Fig 2.7:- Ring irrigation

- Producer who irrigate are less dependent on irregular rainfall for their production ; Producer can supplement rainfall with irrigation to respond to the amount of water the crop need

- By irrigation, the soil storage in the plant root zone is replenished. Instigated by the sun and photosynthesis, plant abstract soil moisture with their root.

- This triggers a nutrient flow through the stem to the leaves, from where the water is transpire back to the atmosphere thus, only the water that is taken up through the root system contributes to the plant and fruit growth.

❖ Water requirement

- The amount of water needed by the plant is expressed as crop water requirement (CWR).it depends on the climate and the crop, as well as on management and environmental condition.
- In sunny, hot, dry and windy place the CWR is highest; the crop species, variety and growing phase determine how much water the root need to take up to enable the plant to grow optimally.
- Producers can reduce the crop water requirement e.g
  - ✓ Through mulching,
  - ✓ Changing the plant density and
  - ✓ Applying different irrigation technology

❖ Irrigation efficiency

- When irrigating it is important to apply the right amount of water at the right time. Too little water will lead to wilting and yield reduction .too much water can lead to water, run off and erosion as well as leaching of nutrient in the soil and salinization, ultimarly leading to yield reduction.
- Plant close to the water source tend to get more water than the plant at the far end of the field as a result ,yield of the farm are compromised because some plant get too much water and some don't get enough
- Surface irrigation methods do not achieve more than 60% field application efficiency as only a limited amount of water actual reaches the root zone

- Sprinkler irrigation system archives an average field application efficiency of 75%,while drip irrigation system can go up to 95% uniformity
- Drip irrigation allows a slow release of water at plant root zone ,as a result soil moisture condition are good ,and no water is lost between plant ,or on the plant
- Crop yield can be double and significant saving can be made in water, energy and labor

2.7 Implementing horticultural, stimulants and Spice crops protection

Horticultural spice crop are easily attacked by different microorganism and other plant which have a negative effect on the yield and quality of the produce this simply solved by applying good agricultural crop protection activity .Crop protection helps to keep plants healthy and maintain sustainable yields. The choice of plant protection principle depends on the type of cultures grown and the threat. It can be diseases, insects, or weeds. At the same time, measures must be timely and, wherever possible, preventive.

Modern crop protection compounds make extensive use of digital solutions. They enable the precise analysis of soil and plant conditions and provide accurate information about external factors such as weather conditions. At the same time, they allow optimizing the use of resources. As a result, farmers can protect crops, increase profits, and minimize environmental damage.

Crop protection combines strategies, tools, and products that protect against various pests. These include diseases, viruses, weeds, and insects. All of them can significantly lower or even kill plants. The best decision is to **control the situation by reducing the risks rather than deal with the problem's consequences**. Culture protection allows farmers to monitor climate change and notice the appearance of dangerous weeds, pests, or diseases timely.

There are many organisms in the agricultural ecosystem that can cause harm to plants. They slow down the development of plants, reduce their thickness, and generally harm yields. Timely preventive steps minimize the dangers. Moreover, the importance of crop protection in agriculture lies in conserving biodiversity and nutrients in the earth, optimizing the resources

used, such as water, land, and labor, and consequently increasing the quality and lowering the food cost.

The main advantages of crop protection for horticultural crop producer

- ✓ increased production of smaller areas;
- ✓ higher yields and consequently more food;
- ✓ protection of the environment;

2.7.1 Crop protection mechanism:-

2.7.2 Chemical crop protection: - is one of the most use full ways of protecting plants. It also makes harvesting yields easier and provides stable growth during each season. Here are some popular chemicals

- **Herbicides**. Farmers often use them to control weeds. Herbicides are suitable for killing actively growing weeds. They cannot eliminate weeds at the same time, but farmers use them before sowing or preventing new pests.
- **Insecticides** are aimed at controlling insects. Several types of crop protection chemicals are applied in the soil (e.g., against worms), and others are used to treat foliage (e.g., against moths and aphids). Farmers scout a field to determine the best time to apply them; otherwise, insecticides are ineffective.
- **Fungicides** in crop protection are used to control disease-causing fungal organisms. They allow increasing yield during the growing season and preserve stored products.

For optimal use of pesticides for crop protection, it is best to divide the field into zones according to the plant damage degree. It allows using resources rationally by applying only the necessary amount of chemicals.

- **Biological Crop Protection:-**Biological control methods for crop protection include various products derived from living organisms. They are an excellent complement to chemicals and provide better protection against pests, diseases, and weeds. Biological plant protection products can be chemically synthesized but resemble natural products in their formulation.

- **Mechanical And Cultural Crop Protection:-**Cultural control can effectively reduce pest activity. One of the most common methods is replacing susceptible plants and new irrigation methods (e.g., reducing irrigation can deprive weeds of sufficient moisture and promote root health).Mechanical crops protection controls help farmers to eliminate pests physically. They include barriers preventing insects and animals from entering the field, traps, mulching, and steam sterilization practices.

2.7.3 Crop Protection Management

There exist various crop protection strategies, tools, and products. Moreover, the industry is constantly evolving, providing farmers with more and more effective methods of pest control. The choice depends on the area being farmed. Here are the most popular culture protection techniques.

- **Weed Management**

Weeds are one of the major enemies of plants. They compete with them for nutrients, water, and space. As weeds are often aggressively growing and spreading plants, they can suppress and even destroy young plants. Proper protection of crops from weeds requires not only timely detection of the threat but also an understanding of the biological characteristics involved. You can use Crop Monitoring to detect an affected zone and send scouts to analyze the situation.

Crop protection from weeds involves preventive and control measures. The former include quarantine as well as special seed treatment and storage conditions. The latter include culture rotation, the use of herbicides, tillage, the production of competitive forage cultures, etc.

- **Disease Management**

It is one of the most complex crop protection practices because various factors can influence diseases: plant age, genetics, environmental conditions, weather, etc. Consequently, it can be challenging to diagnose a disease, especially in the early stages of infection. It is, therefore, crucial to monitor the health of the plants regularly and analyze symptoms that occur sooner rather than later. You can protect your yield against diseases by using one of the following methods:

- ✓ the application of chemicals;

- ✓ culture rotation;
- ✓ deep plowing;
- ✓ organizing quarantine
- ✓ cultivation of disease-resistant species;
- ✓ heat treatment;

- **Pest Management**

Protection of crops against pests means reducing pests and creating the most adverse conditions for their adaptation. Although some insects do not pose an economic threat to production, they can be disease vectors. Farmers should therefore protect crops from pests even if there is no immediate threat of culture damage

2.7.4 Crop Protection and the Environment

Chemical products for culture protection can be harmful for the environment, so governments regulate their use at a legal level.. The incorrect use of pesticides can cause severe damage to the environment. Sustainable crop protection is, therefore, the best solution to ensure nature conservation, resource-saving, and high yields. Modern technologies allow achieving these goals most effectively.

Thus, crop protection is an essential element of agriculture, without which it is impossible to obtain stable yields yearly. No matter what threat you are fighting, plant protection management must be carefully planned and include a variety of practices to ensure the best outcome. Modern technologies such as remote monitoring will allow you to protect your yields and use resources as efficiently as possible

2.8 Operation of machinery equipment and tools

- **Agricultural machinery** relates to the mechanical structures and devices used in farming or other agriculture. There are many types of such equipment, from hand tools and power tools to tractors and the countless kinds of farm implements that they tow or operate.

- Diverse arrays of equipment are used in both organic and nonorganic farming. Especially since the advent of mechanized agriculture, agricultural machinery is an indispensable part of how the world is feeding enhanced.

Self-Check 2	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Test I: Short Answer Questions

1. What is land preparation?

2. What does horticultural crop protection mean?

3. List some of insect or disease which have effect on the horticultural plant?

4. What is the importance of irrigation for horticultural plants?

Operation Sheet -2

2.1Techniques of preparation of the site for planting

A. Tools and equipment's

I. Hoe
II. Spade
III. Meter
IV. Mulching material (thatching grass)
V. Temporary shade
VI. Water can
VII. Compost & sandy soil

B. Procedures/Steps/Techniques

Once the site was selected, the land will be prepared for the nursery as follows

1) Site clearing (clear the land of all the plant woody materials stumps and roots).
2) Ploughing & digging
3) Build up the soil as a ridge on the down slope of the ditch to prevent the nursery from flooding.
4) Plant deriver grass on the ridge to minimize erosion and provide a suitable fine grass for mulching the seedling bed.
5) Build fence around the perimeter of the area strong enough to stop livestock entering and have a single entrance wide enough for vehicle access.
6) Construct a simple store for tools, rolls of poly tube material and fertilizers/chemicals.
7) Finally, plant cuttings according to recommended spacing and planting procedures

Precautions

- Take care while selecting nursery site
- Check tools and equipment before and after undertaking tasks

LG #15	LO #3- Preparing horticulture crop planting material

Lap Test-2	Performance Test

Name……. ID……..

Date…….

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within **1** hour. The project is expected from each student to do it.

Task-1:- perform preparation of the site for planting

Instruction sheet

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

- Obtaining and confirming transplanting plans or instructions
- Selection of planting material
- Storing, handling and transporting planting materials
- Applying instructions of sowing and seedling preparation
- Pre-planting soil treatments
- Importance of correct planting timing
- Preparation and using of tools and equipment
- Calibration of spray equipment and determining quantities and application rates
- Collecting and organizing information

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Transplanting plans/instructions are obtained and confirmed with the supervisor
- Planting material is selected according to the type of crop and organization quality standards.
- Planting materials are stored, handled and transported to the site.
- Instructions about sowing and seedling preparation for transplanting of the crop are applied
- Tools and equipment appropriate to the task being undertaken are prepared and

used according to supervisors' instructions and manufacturers' guidelines
Learning Instructions:
7. Read the specific objectives of this Learning Guide. 8. Follow the instructions described below. 9. Read the information written in the information Sheets 10. Accomplish the Self-checks 11. Perform Operation Sheets 12. Do the "LAP test"

Information Sheet 3

3.1 Obtaining and confirming transplanting plans or instructions

- Transplanting plan and instruction is a guideline which used to perform our planting activity in careful and good manner the document have different important to get successful production practices:-

3.2 Selection of planting material

Horticultural crop can be planted in different form the main planting form area seed and by taking the plant part.

- **Seed: -** Seeds are the product of the ripened ovule,
- **Purpose and Importance of seed selection**

The use of good quality seed has a great importance in crop production. Even though, all conditions require for growth is controlled, the yield will not be good if poor variety is used.

- **Seed selection is irreversible role in:-**
  - ✓ **Adaptability**- they have the capacity to overcome environmental and natural hazards.
  - ✓ **Yielding ability**- increased yield performance
  - ✓ **Improve quality** of the produce or nutritional value
  - ✓ **Increase pest resistance trait** (insect, disease, weed, etc.)
  - ✓ To obtain a **pure variety**- no varietal mixture of the same crop

- **<u>Seed selection criteria</u>**

Good seeds must not only belong to a good variety, but they must also have the following characteristics:-

- ✓ They should have strong germination ability
- ✓ They should have uniform crop stand in the growing fields
- ✓ They should have high and stable yielding ability
- ✓ They should have resistance to pests

- ✓ Uniformity- uniform head or fruit producing ability
- ✓ They should have 100 –seed weight

- **The viability of materials can be maintained by**
  - ✓ Appropriate storage
  - ✓ Shade regulation
  - ✓ Showering
  - ✓ Wrapping

- **<u>Characteristics of good quality seed/planting material</u>**

I. They are pure variety (true to type)
II. They are viable, and have germination capacity up to the standard
III. They have uniform size, shape, color, texture, structure and appearance
IV. They are healthy free from inert matter
V. . They are whole (no break) and contain the desired moisture level.

Fig 3.2:- seed selection

- The seedling quality is determined by the seedling's ability to survive and to grow up right from the first year after establishment. A poor-quality seedling will have few leaves, a high die-back or crown die back and should be replaced. The quality of seedlings can be broken down into two aspects (a) the morphological quality which is related to the seedling

dimensions at plantation date (i.e. height, stump diameter, volume of the roots) and (b) its physiological quality which is the capacity to extract water and nutritive elements in the soil and to create new roots aftter plantation. The physiological quality is determined by what happens to the plant between the delivery dates to the plantation date.

.

- **Advantage of using good quality seed**

The following are the advantages of using good quality seeds.

- Reduced cost of cleaning, standardization and disinfections.
- Uniform germination thus avoiding replanting, gap filling.
- Vigorous seedling growth, which reduces weed and disease, damages.

• Uniform growth stages, maturity and products.

• Maintain good quality under storage conditions.

• Reduced cost

If the seed lacks in any of the characteristics, it may become **UNFIT** for sowing**. So, Seed testing** activity must be done properly, Purity test, moisture content and germination test.

A. Seed purity/Purity test:-Seed purity is expressed as on the basis of percentage by weight of pure seed, other crop seeds, weed seeds, and inert materials.These fractions are weighed, which forms basis for calculating thier percentage in a given sample.

Pure seed:- it includes under sized and shriveled seeds as well as broken seeds of more than half of thier original size. The seeds smaller than half of its size is classified as inert material. The contaminants are:

- ✓ Other crop seeds:- Includes seeds of other plants grown as crops.
- ✓ Weed seeds:- :- seeds of weeds that are found in a seeds.
- ✓ Inert matter :- Includes seed like structures from crop and weed plant that are half or less than half of original size, dirt, stones, pieces of wood, and other plant materials.

The percentage by weight of each component is determined by dividing the weight of individual part by its total weight.

$$\text{Purity \%} = \frac{\text{weight of pure seed}}{\text{total weight of sample seed}} \text{x}100$$

Example: Suppose the weight of pure seed is 1kg, and its original sample weight is 2 kgs, then calculate percentage of purity.

solution

Given:

Weight of original sample=2kg

Weight of pure seed=1kg

Required:

Purity %= ?

$$\text{Purity \%} = \frac{weight\ of\ pure\ seed}{total\ weight\ of\ sample\ seed} \text{x}100 \qquad \text{Purity \%} = \frac{1\ kg}{2\ kg} \text{x}100 = 0.5 \text{ x } 100 = 50\%$$

B . Moisture Content (MC) (%)

The standard moisture content is 14% for seeds that are not oily and 12% for seeds that are oily. High moisture content decreases the viability of seeds.

$$\text{Moisture content (\%)} = \frac{Pre{-}dried\ weight{-}oven\ dried\ weight}{pre{-}dried\ weight} \text{x}100$$

Example: Suppose the weight of pre-dried seeds is 20gram, and its weight after oven dried is 15gram. Then, calculate the moisture content the seed ?

$$\text{MC (\%)} = \frac{Pre{-}dried\ weigh{-}oven\ dried\ weight}{pre{-}dried\ weight} \text{x}100 \rightarrow \text{MC (\%)} = \frac{20\ g{-}15\ g}{15\ g} \text{x}100 = \underline{\mathbf{33.3\ \%}}$$

C. Measures of germination

Germination of seeds can be measured by three parameters

- Germination percentage
- Germination rate
- Germination uniformity

✓ **Germination percentage:**

Germination is the emergence and dev`t of a seedling from the seed embryo under favorite conditions. Germination tests are always carried out with seeds counted randomly from a pure seed lot. **Germination test** is an indicator of the ability of a seed to produce **normal plants** under normal condition. It helps to determine **seed rate.**

The seedlings germinated may be **Normal** or **abnormal** seedlings.

i. Normal seedlings:

Conform one of the following definitions

- Seedling with the capacity for continued development in to plants which grow in good quality soil, favorable water supply, temperature and light.
- Seedlings which possess all the **essential structures** when tested.

ii. **Abnormal seedlings**

- Seedlings which have no the capacity for continued development in to healthy plants or
- Seedlings which poses serious defect when grow on artificial substrate.

Example

- ✓ Seedlings with no cotyledon
- ✓ Constrictions to conducting tissues
- ✓ Splits, cracks, lesions
- ✓ No roots

There are two Methods of germination test:-

I. Direct Germination Test: It is appropriate for seeds that can germinate easily.

Petridish Method (common method)

Place 2 or 3 filter paper or soft paper at the bottom of a petridish and are soaked with water. A conveneint number of seeds 10 to 20 seeds depending on thier size, are placed on the surface of the water-soaked filter paper in the petridish and count the number of germinated seeds until germination of seeds ceased.

$$\text{Germination \%} = \frac{\text{number of normal germinated seeds}}{\text{total seed planted}} \text{x}100$$

II. Indirect Germinatrion test / Seed Viability/:

Indirect Germination test is used for seeds that are difficult to germinate or for those seeds that require long periods to germinate . It doesn't measure % of germination, but it measures the % of the seed that are live (viable). Of the various Methods of seed viability test, Tetra zolium Chloride test is commonly used . In this method seeds are soaked in 0.5 -2% solution of Tetrazolium Chloride. The **red color** indicates the **prescence of active respiratory** process in seed i.e, it is viable. Where as, **dead** seeds retain the **original colour (colourless**).

- **Germination rate**

It measure the speed of germination (time required for a seed lot to reach a pre-determined germination %age).

Methods

i. T_{50} value: number of days required to achieve 50% germination in a seed lot

ii. Mean days: average number of days required for radicle or plumle emergency.

$$\text{Mean day} = \frac{N1T1 + N2T2 + \cdots\ldots\ldots + NxTx}{\text{total No.of seeds germinating}}$$

Where N=number of seeds germinated

T= number of days

2. **Germination uniformity:** Measures how close in time of seedling emergency

- **Part of the plant part as a planting material**

Cutting is the method of propagating plants in which the part of a plant having at least few buds, when detached from parent plant & placed under favorable conditions develop into a complete plant resembling in all characteristics to the parent from which it was taken.

Kinds of cuttings

I. Stem cuttings
II. Leaf-bud cutting (single-eye)
III. Root cuttings
IV. Leaf cuttings

Cutting is commonly used in plants, which root easily and readily, thus, multiplication of plants is very quick & cheap. Grapes, lemon, sweet potato, long pepper, black pepper etc. are commercially propagated by stem cuttings. Stem cuttings to be used may be hard wood, semi hard wood, soft wood & herbaceous cuttings.

A. Herbaceous cuttings: this used the succulent body of the plant used and they are very sensitive - example, sweet potato, chrysanthemum, carnation.

B. Semi hardwood cuttings:

These are cuttings prepared from tender shoots and branches of the current year's growth that are not too hard but show brown blotches on the green stem. They usually measure about 20 cm with a pair of leaves retained at the tip. Example, Jojoba, rose, red-heart, *Piper spp* etc.

C. Softwood stem cuttings:

Those cuttings prepared from the soft tender shoots that are still green are considered softwood cuttings. They are actively growing shoots. These cuttings usually measure 8-10 cm with a growing tip and the leaves are usually retained at the tip. E.g., poinsettia, Peach, Hydrangea etc.

D. Hardwood cuttings:

The **hardwood** cuttings are the common method of propagation, which are prepared from fully matured tissues. It has enough reserve food. The shoots of about one year old or more can easily be used for preparing hardwood cuttings. . Cuttings of pencil thickness with uniform internodal growth are preferred. Generally the cuttings of 15-20 cm length & having 3-5 buds are made. The lower cut is given in a slanting manner just below the bud to increase the absorption of nutrients. The upper cut is given at a right angle to reduce the size of the wound and as far as possible away from the upper bud to avoid its drying. These cuttings are usually tied in small bundles (20-25 cuttings) and buried in moist soil/sand for a certain period for healing of wounds**,** which is known as callusing. Examples are:- Grapes, lemon, rose, *Hibiscus Rosa-sinensis*, Pomegranate,

Plate 1: Cuttings from evergreen (a. Round cuttings & b. Angular cuttings) & deciduous plants.

Polarity

Polarity is the condition that the plant parts maintain their spatial orientation when separated from the mother plant. Care should be taken to maintain the polarity while planting the cuttings, since cuttings planted upside down do not grow. In organized tissues, auxins are involved in the

establishment and maintenance of polarity and in whole plants their most marked effect is the maintenance of apical dominance and mediation of tropisms.

Proximal: is the end of either the root or the shoot that is nearest the stem-root junction of the plant.

Distal: is the end of either the root or the shoot that is furthest from the stem-root of the plant and nearest to the tip of the shoot or the root

.

- **By division** (dividing rooted crowns)

Propagation by division can be considered a modification of layering, as the new plants form before they are detached from their parent plants.

✓ **Runners:** A runner is a specialized stem that develops from the axil of a leaf at the crown of a plant. It grows horizontally (fig.) along the ground and forms a new plant at one of the nodes e.g. strawberry, buffalo grass. The runner production is favored by long day and high temperature. The daughter plants are separated and used as new planting material.

Fig 3.1:- Strawberry

Fig3.2:- Buffalo grass

Asexual propagation by division occurs with the use of rhizomes, tubers (potato, yam, etc.), tuberous roots (sweet potato, turnips, Dahlia, etc.). Rhizomes are specialized stems that grow horizontally at or just below ground level. Rhizomatous plants (e.g. Ginger, turmeric, bamboo)

are propagated by dividing the many attached rhizomes into singular pieces containing a stem axis and associated roots.

Tubers (e.g. potato, dahlia, and caladium) are swollen, underground stems that function as storage organs. Tubers are underground stems similar to rhizomes, except that the ‘eye’ or node produces new shoots instead of roots. The "eyes" of a tuber are nodes or small buds subtended by leaf scars. Tuberous roots are similar to tubers except that tuberous roots are below-ground, swollen root tissue as opposed to stem tissue. Plants with tuberous roots are propagated by dividing these structures into smaller sections each containing a shoot bud.

Fig.3.3:- Ginger rhizome, tuberous root, potato tuber, respectively.

✓ **Micro-propagation/Tissue culture**

Plant tissue culture refers to growing and multiplication of cells, tissues and organs of plants on defined solid or liquid media under aseptic condition. Tissue can be regenerated from explants such as cotyledons, hypocotyls, leaf, ovary, protoplast, petiole, root, anthers, etc.

- **by separation (**dividing bulbs or corms**)**

I. **Bulbs:** - are specialized, globular in shape, underground organs consisting of a short, fleshy stem axis enclosed in thick, fleshy scale leaves. Shallots, onions and garlic are examples of bulbs. These underground organs are useful in propagation by separation.

Fig:-3.4 onion, garlic, and shallot

II. ***Corms***

Corms are globe-shaped, fleshy underground stems. Corms increase in size during a growing season and may be cut into two or more pieces which are each capable of growing into a new plant. Small corms (cormels) often form around the corm. These small corms may be separated and planted to produce plants. Taro, gladiolus and crocus are examples of plants that produce cormels.

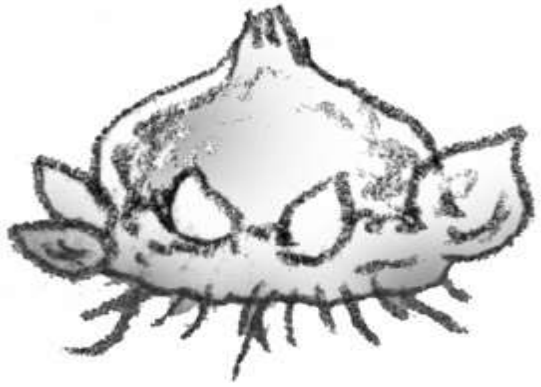

Fig 3.5:-corm

VI. Suckers

A shoot arising on an old stem or underground part of the stem is known as suckers. In other words, a sucker is a shoot, which arises on a plant below the ground. These shoots, when separated from the mother plant and transplanted produce adventitious roots. The capacity of a plant to form suckers varies from plant to plant, variety to variety and is even climate dependent. The sucker formation is common in fruit plants like pear and banana. In banana, sword suckers are commonly used for propagation of plants.

Fig 3.6:- . Formation of suckers at the base of banana plant

- ✓ **Slips (offshoots):** Slips are shoots just arising below the crown but above the ground. They are produced on main stems which can be separated and grown as independent plants. Examples: Pineapple is commercially propagated through this method of propagation

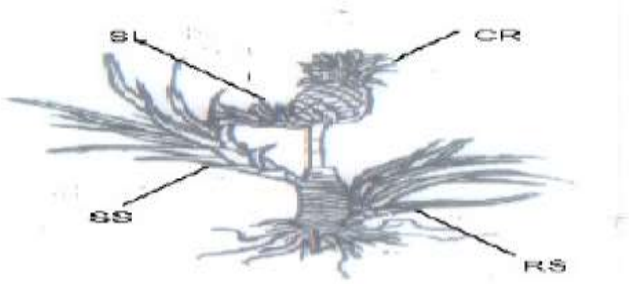

Fig. 1
Plant shoots used for planting material
CR = crown; SL = slip; SS = side shoots or suckers; RS = ratoon suckers Fig:-3.7 Pineapple off set

3.3 Storing, handling and transporting planting materials

- Planting material include both seed and plant parts so, for further viability of this material and to have a good and healthy plant after production it is advisable to use appropriate storage, handling and transportation practices .
- The seed of many vegetable can be stored for a year without appreciable decrease in germination rate or seedling vigor
- Temperature and humidity condition during storage can impact the shelf life of vegetable seeds; in the time between delivery to the farm and planting ,seed intended for use during the upcoming season should be handled and stored with care to preserve quality and viability of the seed

- Whenever possible, store seeds in the unopen package in which they arrive from the seed company or seed supplier. If package have been opened, consider placing them in a container with sealable led such as canning jar or sealable plastic bin
- High temperature and humidity can reduce seed vigor and germination rate .Therefore seed should be stored in cool, dry location and not exposed to direct sunlight. House hold refrigerator can be used for storing small quantity of seeds
- Vegetable seeds are living organism, and they should always be handled carefully to prevent damage to the seed ;the outer layer of seed, called the seed coat, protect the plant embryo inside the seed however, the seed coat can be fragile and easily be damaged if the seed is mishandled
- When transporting seed, avoid high temperature condition and substantial fluctuation in temperature. When possible, transport seed in temperature controlled container.
- Do not place near a heat source and do not allow seed to sit in direct sunlight while being transport

3.4Applying instructions of sowing and seedling preparation

- **Definition**

Sowing

- Sowing is the placing of a specific quantity of seeds in the soil for germination and growth while planting is the placing of plant propagules (may be seedlings, cuttings, rhizomes, clones, tubers etc.) in the soil to grow as plants

3.4.1 Methods of sowing

Seeds are sown directly in the field (seed bed) or in the nursery (nursery bed) where seedlings are raised and transplanted later. Direct seeding may be done by:-

- **Broadcasting**
- **Dibbling**
- **Drilling**

- ✓ ***Broad casting*** **-** Broad casting is the scattering or spreading of the seeds on the soil, which may or may not be incorporated into the soil. Broadcasting of seeds may be done by hand, mechanical spreader or aero plane. Broadcasting is the easy, quick and cheap method of seeding. The difficulties observed in broadcasting are uneven distribution, improper placement of seeds and less soil cover and compaction. As all the seeds are not placed in uniform density and depth, there is no uniformity of germination, seedling vigor and establishment. It is mostly suited for closely spaced and small seeded crops.

- ✓ ***Dibbling*** **-** It is the placing of seeds in a hole or pit made at a predetermined spacing and depth with a dibbler or planter or very often by hand. Dibbling is laborious, time consuming and expensive compared to broadcasting, but it requires less seeds and, gives rapid and uniform germination with good seedling vigor.

- ✓ ***Drilling*** **-** It is a practice of dropping seeds in a definite depth, covered with soil and compacted. Sowing implements like seed drill or seed cum fertilizer drill are used. Manures, fertilizers, soil amendments, pesticides, etc. may be applied along with seeds are drilled continuously or at regular intervals in rows. It requires more time, energy and cost, but maintains uniform population per unit area. Rows are set according to the requirement

3.4.2 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 equipment: At the time of sowing, we have to get enough number of workers and equipment to accomplish sowing at desired time

3.4.3 Factors involved in Sowing Management

This can be classified into two broad groups.

1. Mechanical factors - Factors such as depth of sowing, emergence habit, seed size and weight, seed bed texture, seed–soil contact, seedbed fertility, soil moisture etc.

A. **Seed size and weight:** Heavy and bold seeds produce vigorous seedlings. Application of fertilizer to bold seed tends to encourage the seedlings than the seedlings from small seeds.

B. **Depth of sowing:** Optimum depth of sowing ranges from 2.5–3 cm. Depth of sowing depends on seed size and availability of soil moisture. Deeper sowing delays field emergence and thus delays crop duration. Deeper sowing sometimes ensures crop survival under adverse weather and soil conditions mostly in dry lands.

C. **Emergence habit:** Hypogeal seedlings may emerge from a relatively deeper layer than epigeal seedlings of similar seed size.

D. **Seed bed texture:** Soil texture should minimize crust formation and maximize aeration, which in turn influence the gases, temperature and water content of the soil. Very fine soil may not maintain adequate temperature and water holding capacity

E. **Seeds–Soil contact:** Seeds require close contact with soil particles to ensure that water can be absorbed readily. A tilled soil makes the contact easier. Forming the soil around the seed (broadcasted seeds) after sowing improves the soil–seed contact.

F. Tillering crops like rice should be sown thinly on fertile soils and more densely on poor soils. Similarly high seed rate is used on poor soil for non-Tillering crops. Although higher

G. **Soil moisture:** Excess moisture in soil retards germination and induce rotting and damping off disease except in swamp (deep water) rice. Adjustment in depth is made according to moisture conditions, i.e., deeper sowing on dry soils and shallow sowing on wet soils. Sowing on ridges is usually recommended on poorly drained soils

2. Biological factors - Factors like companion crops, competition for light, soil microorganisms

I. **Companion crop:** Companion crop is usually sown early to suppress weed growth and control soil erosion. In cassava + maize/yam cropping, cassava is planted later in yam or maize to minimize the effect of competition for light. In mixed cropping, all the crops are sown at the same time.

II. **Competition of light:** In mixed stands, optimum spacing for each crop minimizes the competition of light.

III. **Soil microorganisms:** The microorganisms present in the soil should favor seed germination and should not possess any harmful effect on seeds/emerging seedlings.

3.5 Pre-planting soil treatments

3.5.1 Taking soil samples for testing

While soil maps can give you a sense of the variability of soils on your site, the only way to truly understand soil characteristics is to take soil samples. When sampling before planting a vineyard, both **the surface soil (0-8” depth)** and the **subsoil (8-16” depth) should be sampled**. Conditions in the subsoil can be quite different from those on the surface, and it is here where most of the vine’s roots will be found. It is therefore a good idea to try to correct any deficiencies

at the subsoil level as well as those in the topsoil. This is only realistically possible before the vines are planted as it requires deep plowing that would disturb the vines and trellis if they were already in place.

- **Taking a Soil Sample:-**If the site is **uniform and flat, a single soil sample can be taken** that will represent the entire site. As the amount of variation in the soils and topography increases, so should the number of samples that are taken.
- **Soil sampling** should be done no later than the year before planting and preferably earlier if possible. This will allow enough time for any recommended nutrient additions or pH adjustments to be made before final field preparations such as planting a winter cover crop.
- **Soil testing** is used to determine if any nutrients need to be added to the soil, or if the acidity needs to be adjusted, before any vines go into the ground. **A soil test** is a test which is used to gather information about the composition of the soil in a particular area. In a classic soil test, multiple samples are taken from the region of interest and tested before being averaged, ensuring that a random area of contaminated soil does not skew the sample.
- Soil sampling and testing provides **an estimate of the capacity of the soil to supply adequate nutrients t**o meet the needs of growing crops. The test results are compared to standard response data to estimate the need to supply additional nutrients for optimum crop production. Traditionally, the goal of soil sampling was **to develop a representative estimate of the average nutrient** needs for a field so that the best single rate of application could be determined

3.5.2 Soil amendment/reclamation

Soil amendment: - is a material added to soil to improve plant growth and health. A combination of conditioners corrects the soil's deficiencies in structure and-or nutrients. **Soil amendment depends on:**

- ✓ **The current soil composition**
- ✓ **Climate and**

- ✓ **The type of plant**.

Some soils lack nutrients necessary for proper plant growth. Some hold too much or too little water, with water conservation aided in the latter. They can be incorporated into the soil or applied to the surface.

There are three types of adjustments that you may need to make to your site based on the results of your soil tests:

- ✓ **Soil acidity (pH)**
- ✓ **Plant nutrients (e.g., potassium, phosphorus, magnesium, etc.)**
- ✓ **Organic matter**

I. Adjusting Soil pH

If the tests recommend the addition of large amounts of lime, and time allows it, it might be preferable to split the lime application over two years instead of making one very large application the year before planting.

There are **two types of lime** that you can use to adjust soil pH:-

- ✓ **Calcite ('calcium') lime -** Lime that is almost purely calcium carbonate, with very little other materials.
- ✓ **Dolomite ('mag') lime** – Limestone that contains carbonates of both calcium and magnesium.

Both are able to raise soil pH, but dolomite lime can be used to adjust magnesium levels in soils as well. If magnesium levels in the soil are adequate, calcium lime can be used instead.

II. Adjusting Plant Nutrients

While nutrient deficiencies identified in soil tests can be addressed after planting, it is much easier to make adjustments. **The nutrients that most often require adjustment prior to planting** are:-Potassium (K) Magnesium (Mg) and Phosphorous

III. Organic Matter

Organic matter in the soil comes from the **breakdown of organic materials** such as plant and animal matter. As the microbes and other organisms in the soil break down organic matter, they

release nutrients into the soil that plants can take up for their own use, primarily nitrogen, sulfur and phosphorous. Having adequate levels of organic matter in soils has multiple benefits including:-

- ✓ Supplying nutrients
- ✓ Improving both water holding capacity and internal drainage and
- ✓ Helping soils to resist compaction

3.6. Preparation tools and equipment's

- Before we are passing in to planting activity it is mandatory to prepare material and tools need for sowing and planting .the amount, quality, efficiency have a great factor for the production capacity of the worker.

3.7 Check all materials tools and equipment's

Checking and reporting of faulty and insufficient materials of all type is the first step

Check all the tools and equipment's before use, are all the materials functional and sufficient in number? Are all clean of any contaminants? Then check and report to your supervisor how much of the materials he provided in the list are functional and how much of them are faulty. Then are the functional tools and equipment's sufficient enough to the agricultural crop work with the available labor power. Then after reporting the faulty and functional materials your supervisor will guide you what to do if there is insufficiency of material for that particular agricultural crop work.

To identify all materials used in agricultural crop works and separate faulty once follow the following steps

1st **-** use a list of materials provided by your supervisor and then classify the materials according to their purpose as materials used during land preparation, cultivation or harvesting, etc.

Your supervisor will provide you with list of materials used in agricultural crop

2nd – know the name of the materials listed in your supervisors list

3rd – Go to agricultural crop work store or plant science department material store and identify all the materials physically one by one

4th – describe the use or purpose of each material

5th – check wear and tears of each material

6th – separate a materials which doesn't have best match with handle, broken, have hole on containers, not sharp/can be easily broken, or can't function relative to the purpose of the work, or any other unspecified reasons.

7th – count the number of faulty, functional or material that can be maintained very easily.

8th – finally report to your supervisor the categories of material based on their purpose, the total number of each category, the number of faulty materials and also; and also if the functional materials are sufficient in number for the intended agricultural crop work

3.8 Calibration of spray equipment and determining quantities and application rates

- ✓ **calibration**

It is a test measurement of the output of a chemical /pesticide application equipment under typical operating condition to ensure the application of correct amount of pesticides.

Checking and adjusting the different parts of the sprayer before using it for spraying purpose. Example start checking of the sprayer from the nozzle up to the internal part,

a. Checking for clogs: During calibration checking for any coarse particles that blocks the flow of liquid through the pipe to the nozzle.

b. Checking for leak .During calibration checking for whether there is the flow of liquid outside the nozzle or not

c. Checking for nozzle uniformity

If calibration is not done properly mean that either too much chemical per unit area or too low pesticide per unit area

- ✓ If dosage is too much per unit area, the negative effect will be
  - I. The crop may be damaged(phytotoxicity)
  - II. Leads to high residue in the target(crop)
  - III. Wastage and pollutes the environment(water, soil)
- ✓ If dosage is too low per unit area, the negative effect will be
  - I. Failure of controlling the target
  - II. Pest may develop resistance /adaptation
  - III. It will be wastage of time and money

3.9 Collecting and organizing information

Methods of Recordkeeping

Records may need to be provided to government agencies, lenders, insurance companies, safe handling practices, organic production, etc. One of the most important decisions is deciding how to track your production and financial records.

- **Paper** – "shoebox" method, pen and paper or notebook, ledger book specific to production and/or financial records. This method requires more time with potential errors, but is favorable to farmers not familiar with computers. Minor costs associated with this method.
- **Electronic** – spreadsheet (Microsoft Excel®, Google Sheets, etc.), software package (AAIMS, CenterPoint, Farm Biz, QuickBooks®, Quicken®, , Ultra Farm Accounting, etc.). The program may complete the calculations, however, the farmer must have a basic knowledge of computers, time to learn the software, design the form, and enter the receipts correctly. There may be varying costs associated with an electronic method.
- **Outsourcing** – hiring a professional for record keeping. Expect higher costs associated with this method.

Self-Check 3	

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Test I: Short Answer Questions (12 pts)

1. What are seed selection criteria?
2. List some of the characteristics of good seed?
3. How can we handle transport and store seedlings?
4. What the tree method of sowing seed?
5. How can we treat soil for reclamation?
6. How can we identify if the soil is acidic, basic, or saline?

Operation Sheet -3

1.1 Techniques to Carrying out planting operations by cutting

A. Tools and equipment's

I. **Planting materials**

II. **Cutting knives**

III. **Water**

IV. **Basket**

V. **Treating chemicals (disinfectant chemicals such as fungicide)**

B. Procedures/Steps/Techniques

1. If mother bush have aphid infestation, they should be thoroughly sprayed with an insecticide before the cuttings are taken to the nursery site.
2. Shoots taken from aged and flowering bushes are less suitable than those in their youthful vigor- about five-seven years old, before growth difficult.
3. Younger tender leaves should avoid, and only leaves that are hard should be used .thus the top three to four (3 to 4) leaves should be discarded.
4. The remaining good portion of the stem will consists of a series of leaves each with a bud in the axils. The stem is then cut in to individual cuttings with an angle of approximately 45 ^{0}and a length of about 3-4 cm using sharp knife. The cutting consists of a leaf, about and 3 to 4 long internodes.
5. The cuttings are placed in buckets of water or way be sacked for 30 minutes in insecticidal and fungicidal solution. And then they are transported to the planting farm.
6. Plant/sow the planting sources of those crops according to their planting method and depth.
7. Apply fertilizer according to their need.
8. Give other management activities.

Precautions

- Avoid careless handling of planting materials while transporting.
- Use proper materials to handle prepared planting materials.
- Improper selection of mother plant results in preparing poor quality planting materials
- Avoid too deep and too shallow sowing or planting
- Water the planted crop continuously until they are established; unless they will face transplant or planting shock.

1.2 Procedure of Calibration of Spray:

A. Tools and equipment's

- ✓ Knapsack Spry
- ✓ Water
- ✓ Chemical

B. Procedure:-

- ✓ Measure and lay out a known area usually 10m*10m=100m^2

- ❖ fill the sprayers with water to known marker(1/2-3/4)or insert known amount of water
- ❖ spray known area using normal spraying techniques, height above the target /40-60cm)for manual sprayer
- ❖ find out the amount of water used to spray the known area by:
  - ❖ Refilling to its previous level /mark
  - ❖ Measuring the remained water in the tank.
- ❖ Calculate the volume of application rate /this is the amount of liquid required to spray a given area. (a ha of crop land)

$$VAR=\frac{\text{Volume of liquid used to spray known area}*10000m^2/ha}{\text{Area sprayed } m^2}$$

- ❖ Determine the number of spray loads per ha

$$\text{Load per ha=tank per ha}=\frac{\text{VAR Litter/ha}}{\text{Tank capacity (litter /tank)}}$$

- Determine the dilution rate for each sprayer

  Calculate the amount of chemical l to add per tank at each time of spraying

  Amount of chemical (litter per tank) == recommended production rate/ha*tank capacity

  Volume of application rate

Lap Test-3	

LG #16	LO #4 -Cary out planting operations

Name……. ID……..

Date…….

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within **1** hour. The project is expected from each student to do it.

Task-1 perform planting operation of cutting

Task-2 perform Calibration of Spray

Instruction sheet

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

- Treating planting material based on crop nature and identified problem
- Confirming transplanting depth and caring out Planting
- Watering plant before any planting treatment
- Incorporation of appropriate drainage
- Installation of plant supporting devices

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Planting material is treated according to the horticultural crop nature and identified problems.
- Planting is carried out according to the planting plan.
- Transplanting depth is confirmed according to the needs of the crop type
- Plants are watered in and any post planting treatments applied.
- Appropriate drainage is incorporated to ensure root system survival according to the needs of the crop and conditions of the planting site.
- Plant support devices are installed according to the supervisor's instructions plan.

Learning Instructions:

13. Read the specific objectives of this Learning Guide.
14. Follow the instructions described below.
15. Read the information written in the information Sheets
16. Accomplish the Self-checks
17. Perform Operation Sheets
18. Do the "LAP test"

Information Sheet 4

4.1 Treating planting material based on crop nature and identified problem

4.1.1 Seed treatment

Seed treatment is a process of application either by mixing or by coating or by soaking in solutions of chemicals or protectants (with fungicidal, insecticidal, bactericidal, nematicidal or biopesticidal properties), nutrients, hormones or growth regulators or subjected to a process of wetting and drying or subjected to reduce, control or repel disease organisms, insects or other pests which attack seeds or seedlings growing there from. Seed treatment also includes control of pests when the seed is in storage and after it has been sown/planted.

Objectives of seed treatment

- ✓ To prevent seeds from pests infestation.
- ✓ To break dormancy and induce higher germination percentage.
- ✓ To inoculate the seeds with rhizobium (bio-fertilizer).
- ✓ To induce resistance to salinity, drought, frost, etc.

- ✓ **Types of seed treatment**

- ✓ ***Physical seed treatment, soak in water.***
- ✓ ***Biological seed treatments – rhizobium.***
- ✓ ***Chemical seed treatment – fungicides***

- ✓ **<u>The seed treatment is done for the following reasons;</u>**

• To protect from seed borne pests and diseases.
• To protect from or repel birds and rodents.
• To supply plant nutrients.
• To inoculate microorganisms.
• To supply growth regulators.
• To supply selective herbicides.

• To break seed dormancy.

• To induce drought tolerance.

• To induce higher germination percentage, early emergence.

• To obtain polyploidy (genetic variation) by treating with x-rays, gamma rays and colchicine's.

- **Method of seed treatment**

I. **Dry treatment**: Mixing of seed with powder form of pesticides/nutrients.

II. **Wet treatment:** Soaking of seed in pesticide/nutrient solutions

III. **Slurry treatment**: Dipping of seeds/seedlings in slurry. Example–rice seedlings are dipped in Phosphate slurry.

IV. **Pelleting:** It is the coating of solid materials in sufficient quantities to make the seeds larger, heavier and to appear uniform in size for sowing with seed drills. Pelleting with pesticides as a protectant against soil organisms, soil pests and as a repellant against birds and rodents.

✓ **Seed Treatment Application**

✓ **Seed dressing;** –is mixing of the seed with powder or liquid chemical shaking with rotary seed dressing container.

✓ **Seed soaking;** –is immersing seeds in a chemical solution for certain period of time i.e., 10' to 48 hr.

✓ **Seed suffocating** (fumigation)

✓ **Insecticide and Fungicide seed treatment**

Seed treatment is a term that describes both products and processes. The usages of specific products and specific techniques can improve the growth environment for the seed, seedlings and young plants. Seed treatment complexity ranges from a basic dressing to coating and pelleting.

✓ **Seed dressing:** This is the most common method of seed treatment. The seed is dressed with either a dry formulation or wet treated with a slurry or liquid formulation. Dressings can be applied at both farm and industries. Low cost earthen pots can be used for mixing

pesticides with seed or seed can be spread on a polythene sheet and required quantity of chemical can be sprinkled on seed lot and mixed mechanically by the farmers.

- ✓ **Seed coating**: A special binder is used with a formulation to enhance adherence to the seed. Coating requires advanced treatment technology, by the industry.

- ✓ **Seed pelleting**: The most sophisticated Seed Treatment Technology, resulting in changing physical shape of a seed to enhance palatability and handling. Pelleting requires specialized application machinery and techniques and is the most expensive application.

  - ✓ **Types of chemicals used for seed treatment**
  - ✓ Insecticides, e.g. endosulfan
  - ✓ Fungicide, e.g. Thiram
  - ✓ Fumigant

  - ✓ ***Seed disinfectant***: - is treatment that eliminates pathogen from within the seed.

There are *three types* of disinfectant

- ✓ Fungicides, e.g. Bowistin, topsin, etc.
- ✓ Insecticides, e.g. Endosulfan, Thiram
- ✓ Fumigant

4.1.2 Treatment of cutting

Post-harvest treatment for cuttings is a necessity in the nursery industry. Not only does fungicide help to prevent diseased plants, it also accelerates growth by creating an environment that cuttings can thrive in. The right fungicide can save you a lot of time and money, which is why we've curated a list of our top ten fungicides for cuttings, so you can easily learn where to buy them and which ones to use.

Fungicide For Cuttings –Fungicide is a chemical that prevents the fungus infection in fruits, vegetables, and plants. They provide protection against damping-off syndrome. Fungicides are

required in the propagation of cuttings to improve growth rate, reduce leaf spot and root rot, and increase the number of successful plantlets produced per cutting. This overview will give an overview of how to treat your plantlets with a variety of fungicides

There are various types of seed treatment and the important ones are physical arid chemical methods.

- ✓ **Physical methods**:
- ✓ **Mechanical separation**: Healthy seed contaminated with ergot of rye, ergot of bajra, false smut of rice, ear cockle of wheat can be separated mechanically because the pathogen causes alteration in size and weight of the seed.

- ✓ **Steeping the seed in Brine Solution**: The diseased grains are removed by steeping the seed in the brine solution and the diseased grains float due to their lightweight.

- ✓ **Hot water treatment:**. Hot water treatment aims at destroying the infection in the seed without harming the embryo

- ✓ **Chemical Methods**: - The treatment of seed with fungicides is commonly called seed dressing and the fungicide used is known as Seed Dressing Agent (or) Seed Dresser. Fungicidal seed treatment not only kills the pathogen present on / in the seed but also protects the germinating seeds from other soil-borne pathogens till they become established into young plants.

- ✓ **Seed dip method:** Dipping the seed or seed materials in fungicidal solution for 5-20 minutes and drying them in shade before sowing. This method is particularly useful to check externally seed borne diseases.
- ✓ **Slurry treatment:** The seed is mixed with a dust fungicide in a special treater (Slurry treater) in which small calibrated amounts of concentrated liquid (about 5-20 ml/kg seed) are added, thus forming a soap-like slurry to ensure coating without undue wetting. This treatment is common in almost all seed processing plants owned by Government as well as private producers

- ✓ **Sprinkle treatment:** The seed is sprinkled with a fungicidal liquid, solution or suspension, left damp with this for a definite period of tune and then dried. This method is widely used in countries like USA, Europe and UK

4.2 Confirming transplanting depth and caring out Planting

4.2.1 Transplanting depth

Up rooted seedlings are replanted on permanent site with recommended planting depth. This will allow the seedlings to procure water and nutrient according to their rooting habit (shallow Vs deep rooted) and ensure maximum yield.

Factors determining depth

- Seedling size
- The way the young plant develops
- Time of the year, season
- Soil type
- Moisture supply
- Species or variety to be grown
- Establishing capacity of the seedling
- The required amount of population density

Your plant will also not have firm support when it grows bigger stems, shoots, and leaves. It may fall to one side if not planted in the right depth. On the other hand, you should also not bury your plant too deep (that is, you have buried the whole stem and now the bottom leaves are almost touching the ground). If your leaves are too close to the soil, the fungus can be formed due to soil moisture. Therefore, it is extremely important that you bury your plant stem in the right depth when transplanting to ensure its proper and healthy growth.

Before transplanting a tall, young leggy plant, it is advisable to water the plant lightly until the soil is completely moistened. With this, we prevent the root ball from falling apart a lot when removing it from the pot or ground. If the container that you have chosen does not have a hole

for the evacuation of the water, we must make one at the bottom. For older plants, it is advisable to place a layer of gravel or small pebbles at the base of the new container, as drainage. Cover the base of the new container with a small layer of soil. However, if you are transplanting in the ground, skip the above two steps.

Prune the lower leaves of your leggy plant so that we bury the stem deeper in the container or ground. Dig a trench at least 8 to 10 inches deep for a tall leggy plant. If you are transplanting a leggy seedling, dig a trench 2 to 3 inches deep. Place the plant as centered as possible. However, you can also bury the stem horizontally in the trench. Next, fill the pot with more soil until the stem is 1 or 1.5 inches below the true leaves and completely covered.

4.2.2 Planting operation for some horticultural crops

A. Fruits

- ✓ **Mango**


Fig 4.1:- mango plant

Planting should be done during rainy season in pits of size $1m^3$ .Different systems of planting like square, rectangular and hexagonal are followed but square system is most popular. In in-*situ* grafting, rootstocks are planted in the field and soft wood grafting is done in the following year during August – September.

Normally spacing adopted for grafts is 10 X 10 m and for seedlings and in very fertile soils it is 12 X 12m. For dwarf varieties high density planting is considered. The spacing adopted under high density planting is 5X3 / 5X2.5 / 4x4 / 3x2.5 2.5x2.5m. While planting grafts, the graft joint or the union should be 20 cm above the soil surface to prevent entry of disease carrying organisms in to the graft joint. Immediately after planting plants are watered and staked.

- ✓ **Banana**


Fig4.2: banana plant

Planting: The period of planting should be such that the active growth phase of the plant may continue un-hampered during the flower bud initiation stage or stage at which embryonic bunch is formed inside the pseudostem. This generally occurs between 4 and 5 months after planting. This stage determines the no. of hands / fingers in future bunch after planting. At this stage there should be any extreme cold or hot weather or lack of soil moisture or lack of nutrients in the soil. June-July (On set of monsoon) is the planting season. In general the beginning of monsoon i.e. June is the best time for planting banana in most parts, as the rapid growth during first 4 months of monsoon is particularly helpful. In the heavy rainfall tracts like Malabar planting is done after the cessation of monsoon from September to October. This also makes the plants quite small during the expected periods of high winds, storms and cyclones etc.

- ✓ **Citrus**


Fig 4.3:- orange

Digging of Pits: Pits of ½m x ½ m x ½ m size may be dug at required distances 3-4 weeks prior to planting. But where the soils are shallow or under laid with hard pan, pits of 1mx1mx1m may be dug to facilitate better root penetration. Before planting the pits are filled with 25kg of FYM, 1kg of bone meal, 3kg of wood ash and 50g of Aldrin dust powder for control of termites

Planting Season: Planting is done from July to December. In low or scarce rainfall regions, planting should be done at the beginning of the monsoon season (June/July) so that the humid weather helps the young plants to get established fast. In areas of high rainfall, (1000 mm and

above) planting should be done at the end of the southwest monsoon season (October-December.)

Spacing: Spacing adopted for different citrus species are—

Table 4.1 : spacing for different citrus fruits

Sweet Orange	6-8 m
Mandarin Orange	6-8 m
Acid lime	5-6 m
Lemon	6-8 m
Pumelo	6-8 m
Grape Fruit	6-8 m

- ✓ **Papaya**


Fig 4.4 :-papaya

The land should be ploughed deep, harrowed and leveled. Pits of size 45cm X 45cm are dug and spaced about 2.5 m apart each way. The pits after weathering are filled with top soil mixed with 5 kg. Of FYM, 100 grams of neem cake and 40 grams of super phosphate. Four seedlings should be maintained per pit till the identification of female and male progenies.

Finally one female plant per pit and one male plant for every 10 female plants should be retained in dioecious type. Normally male plants flower earlier than female on pendulous hanging inflorescence with branched stalk. The best time for planting in most parts of India is the beginning of the monsoon in the light rainfall tracts and close of the monsoon in the heavy rainfall tracts.

B. Spices

- ✓ **Turmeric**

 Fig 4.5: Turmeric

Short duration varieties: second fortnight of May

Mid duration varieties: first fortnight of June

Long duration varieties: second fortnight of June to second fortnight of July.

Seed rate: mother rhizomes 2000 – 2500 kg per ha

Primary fingers 1500 to 2000 kg per ha Spacing**:**

Red loamy soils – 30 x 15 cm

Black heavy soils – 46 x 23 cm

Method of sowing: sown behind the plough in ridges and furrow system

In bed system, rhizomes are dibbled at 5-10 cm pits. Treat with Dithane m 45 0.3% for 30 minutes before sowing. Germination starts in 10-20 days and will be over by 60 days.

- ✓ **Cardamom**

 Fig4.6:-cardamom

Seedlings are normally raised in primary and secondary nurseries. The nursery site should be selected on gentle sloppy lands, having an easy access to a water source. Raised beds are prepared after digging the land to a depth of 30-45 cm. The beds of 1 m width and of convenient length raised to a height of about 30 cm are prepared. A fine layer of humus rich forest soil is spread over the beds. Seeds are to be collected from well ripe capsules. Immediately after harvesting, the husk is removed and seeds are washed repeatedly in water for removing the mucilaginous coating. After draining the water the beds are to be mixed with wood ash and dried in shade for a day.

In order to ensure uniform and early germination, seeds should be sown immediately after extraction. If the sowing is delayed, pre sowing treatment of seeds with 25% Nitric acid for 10 min is advisable to get a quick and higher germination. One kg of capsules may produce 5000 seedlings.

Sowing may be taken up during November – January and is done in rows. Deep sowing should be avoided for better and quick germination. Seeds are mulched to a thickness of 2 cm with paddy straw or any locally available material and are watered regularly. The germination commences in about 30 days and may continue to a month or two. After germination the mulch is to be removed. Seed rate: 10 g per m2 of nursery bed area.

- ✓ **Coffee**


Fig 4.7:- coffee plant

Planting distance depends on a combination of factors such as variety, topography, soil fertility and management. Varieties with big plant characteristics grown on good soil and in a favorable climate require wide spacing between plants. The usual distancing of the different varieties are Arabica 2x3 m and Robusta 3x3 m. Straight row planting with an east-west orientation is the recommended layout. Coffee is planted during spring time or the beginning of the rainy season, when the soil is moist and under cool conditions. The spacing width between the rows can be 15 cm to 20 cm. In the rows the seeds are placed 3 cm to 5 cm apart, 0.5 cm to 1 cm deep and with the flat side down. If the flat side faces upwards, the radical will have to emerge around a curve and this leads to poor seedlings.

Transplantation of the seedlings is done about six months after they were grown in nursery beds or plastic bags or when they are about 20 cm tall, and they are planted in the fields. Before planting the coffee seedlings, holes must be dug in order to stir the soil and loosen it. The holes

should be dug two months before planting the coffee trees and they should be about 50 cm long, 50 cm wide and 50 cm deep. For dryland planting, it is recommended that planting be done when the soil profile is moist and during the rainy season

4.3 Watering plant before any planting treatment(time of watering)

- Watering of the seedbed should be done very carefully until the seedlings have emerged, especially when the seeds are small.
- Large water drops tend to erode the thin soil covering of the small seeds and may cause it to dry up.
- Watering with a mist sprayer is recommended for highly delicate seeds, such as lettuce and celery. As a rule, the seedbed should be kept moist but not wet until germination is achieved
- Water have a great important on the plant body and it used for different biochemical operation so, it is must to water the plant in different way for a good establishments of the seedling and before applying a chemical it is must to treat the plant by water

Methods of Watering

• Watering can- suitable for small garden or containers

• Garden Hose (fan nozzle or spray attachment) for larger gardens

• Drip or Trickle irrigation- large/small areas has certain benefits

– Reduces water needed

– Water is placed where needed

– Reduces weed growth (limited water for weeds on surface)

– Keeps leaves dry reducing fungal growth

– Reduces soil splash on to leaves

4.4 Incorporation of appropriate drainage

- Drainage is the removal of excess water from the plant field; the amount of water which found on the surface of the root zone have a great effect on the absorption capacity of the root system.

- Plant absorb water from the soil by their root system for different metabolic activity in the plant body ;photo synthesis is the most important metabolic activity in the plant body in which the plant make their own food by using light ,water and carbon di oxide
- The plant root system must be free to absorb water from the soil to the plant body freely; if not there is no transportation of material in the plant body and also as a photosynthesis ingredient there is a problem in formation of food processing in the plant body
- **Drainage system is classified as :-**

✓ **Surface drainage**

✓ **Sub surface drainage**

- **Surface drainage** is a type of drainage system in which it is a mechanism of removing excess water from the surface of the soil by making different structure
- **Sub surface drainage** is a drainage system which is mainly implemented under the surface of the soil

You all knows as we approach planting season, how important it is to prepare the soil properly for your crop. With all the rain we received this winter, it is also important to make sure that your beds drain properly as you water them .why do we need to pay attention to drainage? Plant need water, but they also need air .when water does not drain properly, the plants root cannot access enough oxygen; Plant drainage is critical to plant root health because, by allowing excess water to seep out after watering, you can ensure that water would not pool at the base of your pot .this helps protect the plant roots from bacteria, fungus and rot

Fig 4.8:-drainage application

A soil may need artificial drainage for one or two reasons.

I. When there is a high water table that should be lowered or
II. When excess surface water cannot move downward through the soil or ever the surface of the soil fast enough to prevent the plant roots from suffocating.

Advantages of drainage:

- The field will net get waterlogged and crop can get sufficient water and air
- After the rains are received, the soil comes in tilth earlier and it is possible to carryout agriculture operations properly and in time.
- The structure of soil improves
- There is good aeration and warmth in the root zone which are essential for proper growth.
- Bacteria that change organic matter into plant foods get necessary air and warm temperature in the soil.
- Desirable chemical reactions take place and nutrient become available to the plants easily.
- There is proper root development and absorption of nutrients is accelerated.
- Seeds germinate faster and better stand of crop is obtained.
- Due to healthy growth of plants they can resist the attack of pest and diseases better.
- Weed growth can be checked by timely weeding and inter culturing operations.
- Roots go down deep and can draw up on moisture at greater depth and with stand periods of through better and
- Good drainage permits the removal of many toxic salts and thus, reduces damage to crops.

4.5 Installation of plant supporting devices

There are different plant supporting material; many of horticultural crop need different structure for support; there are numerous common methods for supporting and growing horticultural plants. Each method has pros and cons, requiring different materials and amounts of time to ensure healthy, profitable crops. So how do the different methods compare?

- **Velcro or String**

Velcro or string are two of the most common materials used to support horticultural plants as they grow. As flowers change weight and size, retying and adjustment is typically needed for at least 50 percent of tied branches. Although materials for this method are inexpensive, the task of tying and retying is extremely time-consuming in order to be effective. However, when adequate time is invested, Velcro and string-tying methods will result in a great harvest.


Fig 4.9:-Velcro

e.g:- Velcro, string, bamboo sticks

- **Trellis Netting**

Trellis netting is commonly used over beds or pots and is laid across the entire canopy at week two or three. Plants grow through the netting, which provides support for the stalk and upper branches. Although branches and buds above the net enjoy proper light and airflow, the lower part of the plant can suffer from reduced light and airflow.


Fig 4.10:-Netting on fence

e.g:- Netting, bamboo sticks (plus string or Velcro if plants are accessible)

Wire Tomato Cages

Wire tomato cages are another common method for supporting horticultural plants. In this case the wire stakes of the cage are pushed into the soil around the roots of the plant around week two.

Tomato cages are designed with a narrow diameter at the bottom and larger diameter at the top, like a funnel — or, when viewed from the side, a triangle. Horticultural plants, however are naturally wider at the bottom and narrower at the top. Other considerations with wire tomato cages include interference in ideal lighting conditions and potential contamination near the roots. During the early stages of the flower or veg cycle, lights cannot be lowered close enough to the plant (within 12-18 inches) because the top of the cage is in the way. With metal stakes rusting

e.g:- Wire tomato cages, bamboo sticks, string or Velcro

Fig 4.11:-tomato cage

Self-check 4	**Written test**

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Test I:- Short Answer Questions

1. What is seed treatment?
2. List method of seed treatment?
3. List factor affecting transplanting depth?
4. Write about plantation process of mango?
5. What are material used for plant supporting**?**

Operation Sheet -4

4.1 Techniques of Procedures to carrying out horticultural crop establishment operations

A. Tools and equipment

I. Peg
II. String
III. Hoe
IV. Shovel
V. Rake
VI. Measuring tap
VII. Hammer

B. Procedures/Steps/Techniques

Procedures to carrying out field crop establishment operations are:-

Step1. Select and use tools, materials and equipment's use for field crop establishment

Step2. Identify and asses OHS hazards and risks of site preparation

Step3. Prepare planting materials based on characteristic of good planting materials

Step4. Determine optimum planting time based on types of crops and other factors

Step5. Decide recommended number of seedling planted based on types of crops and other factors

Step6. Select proper sowing/planting methods which are suitable for crops

Step7. Sow/plant planting materials on prepared site based on the site of crops

Step8. Complete field crop establishment operations

LG #17	LO #5 -Completing planting and care for young plants

Lap Test-4	Performance Test

Name……. ID……..

Date…….

Time started: _____ Time finished: _____

Instructions: Given necessary templates you are required to perform the tasks within **1** hour.
The project is expected from each student to do it.

Task-1: perform horticultural crop establishment operations

Instruction sheet

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

- Treating planting material based on crop nature and identified problem
- Confirming transplanting depth and caring out Planting
- Watering plant before any planting treatment
- Incorporation of appropriate drainage
- Installation of plant supporting devices

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Planting material is treated according to the horticultural crop nature and identified problems.
- Planting is carried out according to the planting plan.
- Transplanting depth is confirmed according to the needs of the crop type
- Plants are watered in and any post planting treatments applied.
- Appropriate drainage is incorporated to ensure root system survival according to the needs of the crop and conditions of the planting site.
- Plant support devices are installed according to the supervisor's instructions plan.

Learning Instructions:
19. Read the specific objectives of this Learning Guide. 20. Follow the instructions described below. 21. Read the information written in the information Sheets 22. Accomplish the Self-checks 23. Perform Operation Sheets 24. Do the “LAP test”

Information Sheet 5

5.1 Regular maintenance of transplanted plant

5.1.1 Weeding

Weeds are defined as unwanted plants in crop fields which grow along with the main crop. They are strong and dominating competitors for crops. Their copious seed production, quick population establishment, and adaptation characteristics make them tough competitors and help in their survival. Common examples of weeds are grass, algae, *Amaranthus*, and *Chenopodium*.

Weeds compete for essential components required by crops. They compete for light, water, nutrients, and space. They reduce the yield and sometimes they are sources of diseases as well.

- ✓ **There are different types of weeding:-**

- ✓ **Hand Pulling and Cultivation**:-This refers to the process of weed removal by hand. Certain tools such as a shovel can be used for the task
- ✓ **Pre-emergent herbicides:-**Pre-emergent herbicides prevent the growth of weeds. It is applied to the surface of the ground after planting perennial or annual plants. The plant should be in an active growth stage for effective result.

Weeding is the removal of weeds from the field. It is an effective pre-harvesting method of crop protection and **crop production management.** Weeds act as competitors of the crop for various resources required for growth like nutrients, light, water, etc. so they have to be removed as they may cause interference and decrease the yield. Weeds can be controlled in many ways. Weed management includes land preparation, water management, hand weeding, hand hoeing, crop rotation, and herbicides.

Nowadays, weedicides and herbicides are most commonly used and are effective ways of weeding. Chemicals like MCPA and 2, 4-D are some commonly used weedicides. They can be applied at three stages like before and after crop planting and after weed emergence. But these chemicals can cause health hazards and environmental issues.

Weeds are beneficial to nature but it spoils the crop. Thus, weeds need to be controlled to prevent their impact on living beings.

5.1.2 Watering

Water management and schedule is important to determine:-

- ✓ When to water**(time of watering)**
- ✓ How to water**(method of watering)**
- ✓ Which plant to water
- ✓ How much to water**(amount of watering)**

- **Watering schedule depends on soil type suitable, growth stage and environment.**

✓ **Watering VS soil type**

Different soil types and locations can significantly affect seedling watering requirements. There different characteristic have a great effect on water conservation and retention capacity this directly and indirectly affect the growth and development of the plant

✓ **Watering and clay soil**

Clay soil retains much more water than sandy type; once the clay soil does begin to dry out, however it will hold on to its remaining moisture very tightly, so that the roots cannot take it up in the shoots. Cracks start to appear in the clay soil. This has **four serious effects**:-

I. Allow dry air to enter to soil
II. Make a plant vulnerable to drought
III. Accelerate loss of water and inhibit germination
IV. makes watering extremely difficult (percolation of watering)

✓ **Watering and sandy soil**

Sandy soils are free drained and can dry out very quickly. The producer with sandy soil should always be alert for drought. During a dry period, watering little and often has to be rule, perhaps per 30 square cm or 2.51L every few days in hot dry weather. Newly planted or shallow rotted plants can begin to suffer after only four or five days in to a dry period. If you sow seeds on a

sandy soil, incorporate leaf- Mould in the seed drill prior to sowing and cover the seeds with dry soil.

- ✓ **Watering and shallow soil**

Badly drained soils are the first to suffer during a drought. If the soil is well drained to a depth of only 8 inch or 20cm, this greatly restricts the development of root system. Therefore planting anything on such a poor soil, dig out a much deeper and wider hole than normal, break up the sub soil, increase the depth of soil and mix a large amount of compost.

- ✓ **Watering VS growth stage**

Water up take is largely confined to young portion of the root. Plant factors that influence up take of water are:

- ✓ Type of crop
- ✓ Density of crop
- ✓ Depth of rooting
- ✓ Rate of root growth
- ✓ Aerodynamic roughness of the crop and
- ✓ Varietal effect

- ✓ **Watering VS environmental condition**

Watering of seedling is highly influenced by environment such as;

- ✓ Sun shine
- ✓ Temperature
- ✓ Humidity
- ✓ Wind
- ✓ Rain fall

5.2 Application of treatments for young plant

Young seedling are sensitive for different environmental factor this factor have a great effect on the production quality of the crop in quantity

5.2.1 Pruning

Pruning is the process of cutting away dead or overgrown branches or stems to promote healthy plant growth. Most plants, including trees, shrubs and garden plants like roses benefit from different methods of pruning and maintenance. Pruning at the wrong time of the year does not necessarily kill your plants, but regular improper pruning may cause damaged or weakened plants. To help you take the guesswork out of pruning, we'll go over the common tree and plant types found in the southern United States and explain when and how to prune them.

- ✓ **Ways of Pruning**

Leaves are important to trees because they help convert sunlight into energy. For that reason, when pruning you want to make sure you don't remove more than 30% of a tree's live foliage at one time. There are a few different types of pruning, each which you can do to achieve slightly different results.

- ✓ **CROWN LIFTING**

Which is removing the lower branches in the crown. A major benefit is that crown lifting allows more light to pass beneath the crown. This approach is unlikely to alter the tree or harm its top or crown. Lifting means that you are not pruning the more visible higher parts of the crown. When pruning, avoid leaving a clear stem (without branches and leaves) that is more than one-third of the tree's total height, since branches have a significant role to play in controlling the sway of a tree in high winds.

- ✓ **CROWN THINNING**

Crown thinning means removing select branches throughout the crown without significantly changing the shape of the tree's crown. Crown thinning increases both air circulation and light penetration in the crown. The focus of thinning should be removing the branches that are small in diameter; however, removing too many branches from the crown's center can result in a tree with a poor structure and little ability to prune it in future seasons. Be careful to avoid long, thin branches and minimal foliage in the lower parts. A tree with these characteristics may be more prone to swaying and may be more vulnerable when it is very windy.

- ✓ **CROWN REDUCTION**

If you have a tree that has outgrown its space, you might consider crown reduction. Crown reduction shrinks the overall size of the crown by shortening its branches to boost growth. When possible, aim to maintain a flowing branch line matching the natural shape of the tree. Since it often results in large wounds at the branch ends and decay, crown reduction is only done when necessary due to space issues. We rarely recommend crown reduction for trees which take the shape of a pyramid, such as conifers and birches.

- ✓ **POLLARDING**

Pollarding is a maintenance routine that is started when a tree is young and then repeated at frequent intervals throughout the tree's life. This technique is traditionally used on willows. Typically small-diameter tree branches are pruned back to the secondary branches off the main stem. Regrowth since the last pollard is then removed back to the tree's "knuckles." You may find other gardening sources incorrectly refer to pollarding as the removal of all branches of a mature tree. This practice leaves large wounds and a tree with no foliage with which to produce food. Since this method causes considerable stress to the tree, we recommend against this technique

5.2.2 Thinning

Thinning: - mean the removal of some plants, or parts of plants, to make room for the growth of others. Selective removal of parts of a plant such as branches, buds, or roots

If you want to create a more open plant, you may consider thinning out, which is when a branch or twig is cut off at its point of origin from either the parent stem or ground level. Thinning provides room for growth of side branches and will not stimulate excessive new growth in most shrubs. Thinning out also allows plants to be maintained at a specific height and width for many years. We recommend thinning out the oldest and tallest stems first using hand pruning shears.

- ✓ **Gradual Renewal**

With gradual renewal pruning, some of the tallest and oldest branches are removed at ground level (or slightly above) on an annual basis. Some thinning may be necessary to shorten long branches or maintain a symmetrical shape.

- ✓ **Rejuvenation**

To rejuvenate an old, overgrown shrub, we recommend removing approximately one-third of the oldest, tallest branches at ground level (or slightly above) before new growth starts.

- ✓ **Determining the purpose & method of thinning**

The goals of thinning may include

- ✓ To shape, form, correct or control growth,
- ✓ Provide clearance for services, access or cultural practices,
- ✓ Prevent disease or damage,
- ✓ Promote health,
- ✓ Control capacity and vigor,
- ✓ Manage the canopy and fruit and flower production, and
- ✓ To control yield and quality to meet market requirements.
- ✓ To control yield and quality to meet market requirements.

- **The two main thinning method are**:-
  - ✓ **Selective methods:** - Trees to be removed are marked individually based primarily on their position in the crown canopy, although other considerations (e.g., damage from disease, insects, and wind) may take precedence.
  - ✓ **Mechanical methods:-**Trees are removed strictly on the basis of spacing with little or no regard to crown position. Row or corridor thinning are the primary examples of this type of thinning.

Fig 5.1:- Thinning out seedling

5.3 Water application or operation irrigation schedule

A. 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.

B. 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 system too 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.

Fig 5.2: Inappropriate watering on tomato plant

5.4 Training young plants

- ***Topping***
  - ✓ Removing the main crown shoot of your growing tip will ensure that two new shoots will grow back in its place. Pinching out once will create two tops; pinching out twice will create four tops; and so on.
  - ✓ This technique is as simple as cleanly removing the growth tip until a lighter, fleshy-colored part of the plant tissue is exposed.
  - ✓ This will heal over and then form new growth shoots. It is very important to create a clean cut to avoid “fimming” (see below). I personally like to use a clean pair of nail cutters and to really get in and cut as close as possible.
  - ✓ When incorporating a screen into the garden, topping is essential in creating a symmetrical canopy base from which to work.

Fig5.3:-Topping

- ***Fimming***

- ✓ When fimming, 80 percent of the crown shoot is removed, with a very small amount left behind. In response, the plant will cease to produce upper growth, focusing its energy on the rest of itself underneath the highest part where it has been fimmed.
- ✓ Growth at the low part of the plant, from the very base of the pot and each internode upward, will increase, creating a thicker-looking plant.
- ✓ To use this technique, simply take a pair of scissors and snip away three-quarters of the tip of the crown shoot of the main cola or on the top shoots of the supporting side branches. “Fimming” is short for “Fuck, I missed!” because the technique was discovered by accident.

Fig 5.4:-Fimming

- **Super Cropping**

This is my favorite technique for pushing my plants to the limit. It’s a hands-on high-stress method that involves breaking the inner cell walls of a branch by popping it between your fingers. When successfully performing this technique, you’ll be able to hear an audible snap as the plant’s inner walls collapse-or at least feel a change in the pressure inside the plant.

With young softwood plants, popping the center parts of each internode will suffice; however, with plants that are more woody, it’s much easier to twist and a bend, and there’s a quicker healing response.

Fig5.5:-Super copping

Tie and Bend

Otherwise known as low-stress training (LST), this technique involves tying and bending certain parts of the plant at certain times to compel the canopy to grow symmetrically. This technique involves tying the plant down with string or metal cables and lowering the highest point of the crown shoot. The plant will respond with the rest of the growth tips now competing to produce the main cola. Through careful calculation and planning, a grower can simply use leverage to compel the plant to form into a short and stout bush in which the main cola is unidentifiable come flowering time.

Fig5.6:- Tie and bend

- **Pruning**

Getting rid of fan leaves and low-growing tips is something that all growers should consider doing, but only at the proper time. Plants use their energy on whatever growth there is, so knowing when to cut away and strip the parts that are less productive than the upper parts is important. Take a pair of scissors and, as if you were taking clones, cut away the lowest growth of the plant that will take away from the prize buds you desire.

- **Mainlining**

This technique is slightly more complicated than traditional low-stress training, and it focuses solely on symmetrical plant growth. The principle behind mainlining is to remove the top shoot and all of a plant's lower growth to create a bare stem. This allows the two axillary shoots to grow upward to form two primary shoots. If you picture a capital-Y shape and then grow from this starting figure, you can then tie the two shoots do Strip and Flip

Fig 5.7:-Mainlining

5.5 Importance of field hygiene and quality control (definition for hygiene)

- Options for pest and disease control range from basic cultural practices such as good sanitation and hygiene to biological and chemical control.
- Increasingly, options for effective chemical control are becoming limited due to resistance in the pests and pathogens, the discovery of toxic effects of certain chemicals and residue accumulation and breakdown differing amongst field and hydroponic growing conditions.
- Many growers are now taking up integrated pest and disease management (IPM) strategies, of which one component is limiting the use of harsh pesticides
- Some basic sanitation and hygiene practices which can readily be put into use on farms.
- Good agricultural practices within the crop Care should be taken when removing leaves, fruit and flowers from plants as many diseases can be spread by touching plants.
- It is recommended that farm workers start work in the areas of the crop which are the most disease free and work towards the area with disease if a disease is present as this limits moving the disease to non-diseased areas.

- Controlling plant debris although plant debris (old removed leaves, unmarketable fruit, etc.) can serve as a reservoir for some beneficial insects, debris almost always encourages higher disease levels. It is recommended that plant debris be removed from the area where crops are grown.
- Sealing surfaces the use of sealed cement paths and surfaces within greenhouses allows for easy cleaning to reduce pathogen propagules.
- Many plant pathogens such as bacteria and fungi can reside in soil paths for long periods of time; cement or a sealed surface which can be readily cleaned down improves the ability to eradicate pests and pathogens between crops.
- Clean cutting implements many diseases, especially viruses and bacteria, are transmitted on cutting implements (secateurs, knives, etc.). Care should be taken to routinely sterilize cutters using a disinfecting solution such as bleach, alcohol, or other commercial production

5.6 Collecting, disposing and recycling waste

The new Waste Management Strategy highlights the need to increase waste recycling and recovery in a number of ways that include:

- The renewal of recycling targets
- Focused awareness campaigns
- The possible introduction of incentive schemes

Recovery: "- any activity carried on for the purposes of reclaiming, recycling or re-using, **in whole or in part,** the waste and any activities related to such reclamation, recycling or re-use, including any of the activities specified in the Fourth Schedule, and "waste recovery activity" shall be construed accordingly."

Recycling: A process where materials are collected, processed and **remanufactured into new products** or use as a raw material substitute. To recycle is defined as the returning of material to a previous stage in a cyclic process or the conversion of wastes into reusable materials.

Pros	Cons
• May generate revenue by selling the material • Produces a usable product • Saves resources and energy • Saves space in landfills	• May require treatment first to ensure safe usability • May require sampling before recycling • Public perception regarding usability of product

Reuse: Reducing the amount of waste being discarded by using a product/material on more than one occasion, either for the same purpose or for a different purpose, without the need for reprocessing.

Pros	Cons
❖ Preserves original item ❖ Saves resources ❖ Saves space in landfills	❖ May require decontamination first to ensure safe reusability ❖ Sampling required to verify item is clean ❖ Public perception ❖ May increase risk to public

5.7 Cleaning, maintaining and storing tools and equipment

If nothing else, tools should be cleaned after each use. Doing so keeps diseases, fungi, insect eggs, and weed seeds from being unwittingly spread around the garden. Cleaning also extends the life of a tool by removing moisture-laden, rust enhancing soil from steel surfaces. For tools with a keen edge, a good cleaning keeps rust from eating the edge away.

- **Apply oil to prevent rust**

Even after washing and drying, steel tool heads are still susceptible to rust when exposed to oxygen. In fact, as a general rule, the better the grade of steel used, the more vulnerable it is to rusting. So, considering the high cost of quality gardening tools, it just makes sense to keep rusting to a minimum.

Motor oil is inexpensive and effective rust preventer. When applied to steel surfaces, the oil insulates the steel and prevents it from oxidizing.

- **Remove rust with a wire brush**

Extremely rusty tools require special attention. Use a sheet of 80-grit sandpaper to remove light coatings of rust. For a slightly heavier coat, a stiff wire brush can be effective.

- **Sharpen tools for peak efficiency**

Sharpening tools is a slightly more complicated procedure than removing rust. Some tools like shovels, axes, hoes, and trowels are best sharpened with a hand file, while other tools like pruning shears and knives call for a honing stone. Depending on how dull an edge is, some tools may require a session with a high-speed grinding stone.

- **Grind battered tools into shape**

Since the grinding process removes metal quickly, only the most battered tools are candidates for regular grinding. Tools like lawn-mower blades and grub axes usually merit an annual trip to my grinder. An electric bench grinder is the best way to retrieve a keen edge because it has an adjustable tool-rest platform that allows for more exacting edges.

- ✓ Your farm equipment is the backbone of your business, so it is critically important that you keep it properly maintained on a regular basis.
- ✓ Doing so will maximize the lifespan of your machinery and reduce the chances of breakdowns taking place that can result in costly downtime.
- ✓ If you have a larger operation, you'll need to be as organized as possible so that you make sure all of the pieces of your farm equipment get the attention that they need. Try to

arrange maintenance by season, if possible, so that you'll know what you need to do and when you'll need to do it.

- ✓ Don't try to take care of everything at once. Divide your maintenance into different phases so that you are not overwhelmed and your operations aren't delayed. Keep meticulous records of all your maintenance activities so that you can easily find out when you need to perform them again.

- ✓ It sounds obvious, but having the right tools are critical to being able to maintain your machinery properly. Protect your tools from the elements so they'll be ready when you need them. If you're not technically proficient, hire a professional to take care of your maintenance so that you can be sure it the job will be done right the first time.

- ✓ There are several different ways of providing basic farm equipment maintenance. For tractors, example, make sure the brakes and engines are running correctly. Empty out and clean the fuel tanks of any machinery that is idle so you lessen the chances of an explosion. If you have machinery that runs on batteries, disconnect the terminals before working on them so you avoid the risk of electrocution.

5.8 Maintaining records and documentation

5.8.1 Meaning of record keeping

- ✓ Detailed farm record keeping is crucial when making important business or planning decisions for your operation. Not only is it a poor business practice to not keep records of farming activities, but it can be illegal not to keep your records in order.

- ✓ Farm records can include any of the following: expenses, labor, chemical/pesticide tracking, harvest and yield records, planting records, shipping records, compliance records, and more.

- ✓ Traceability plays a huge role in practicing safe farming, as it is always important to be able to look back and see the full history of product, from planting to shipping. Keeping your records in good order will vastly simplify this process, and make auditing season a breeze.

- **Why Keep Records:**

✓ At a minimum, growers must keep records to comply with legal requirements for taxes and restricted chemical use applications, but additional record keeping is a valuable tool. Many growers track their expenses, from equipment runtime, to labor costs, to chemical and fertilizer costs.

✓ Tracking labor, equipment, and chemical costs enable you to make informed decisions when pricing your products to ensure greater profits.

✓ Harvest yield records can be used to compare crop yield from year to year, to help growers make educated decisions regarding crop management in the future. You can't manage what you can't measure, so record keeping around harvest quantity is essential to growers tracking their income against cost of production.

✓ Pesticide and Spray records are absolutely essential for both food and worker safety. Records of spray dates, chemicals used, and safety intervals such as the re-entry interval and the pre-harvest interval protect your customers and employees from exposure to potentially harmful residues

✓ In many countries, chemical use reporting is mandatory to comply with regulations around food and environmental safety. Chemical use tracking is also a key part of tracking overall farm expenses.

✓ Labor Tracking and worker productivity records are an aspect of record keeping that are essential for managing payroll and piecemeal payouts for your farm workers. More efficient payroll record keeping can save valuable time and money by speeding up the payroll process. Effectively tracking piece-rates for harvest can motivate workers, and make assessing overall productivity easier.

- **What to consider regarding documentation**
  - ✓ What records need to be kept?

- ✓ How are they to be stored – e.g. hard copy, electronic?
- ✓ Where are the documents to be stored?
- ✓ How long are the records to be retained for? (what is an appropriate time, think about the shelf-life of the product and possibly how the product may be misused)
- ✓ Who is responsible for the records?

Self-Check – 5	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Test I: Short Answer Questions (6pt)

1. List way of training young plant?
2. List characteristics of waste?
3. What is record keeping?

REFERENCE MATERIALS

Books:

Acharya, Adhikari, Devraj, 2011. Major commercial Vegetable species in Nepal and Major Problems faced and their Solutions

Agricultural Information Centre, 2009: Agricultural Technology Book, Hariharbhawan, Lalitpur.

Ministry of Agricultural and Cooperative, Government of Nepal, 2068: Agricultural Enterprises Promotion and Data Division, Singhdurbar, Kathmandu

National Agriculture Research Centre (NARC), 1960-2007: Improved and Registered Some Crops (Nepal), Khumaltar, Lalitpur, Nepal

Neupane, Fanindra Prasad, 2003, Enemies of Crop plants and their prevention. Sajha Publication, Kathmandu.

Poudyal, Bharat Kumar, 2068: Commercial Vegetable Farming, Amarawati Horticulture Nursery, Commercial Vegetable Farming Project, Lalitpur.

Sharma Lamichhane, Gopal 2063, Cucumber Production Technology, Vegetable Development Directorate, Khumaltar, Lalitpur

Shrestha, Gyan Kumar, 2068: Technology for Vegetable Production, Heritage Publishers and Distributors (P) Ltd. Kathmandu

Web addresses

https://www.researchgate.net/publication/348621593_horticulture_an_overview

https://www.zimagrihub.org.zw/sites/default/files horticulture

https://www.agric.wa.gov.au/sites/gateway/files/production of horticultural crop

www.k8449r.webbly.production and establishment of horticultural crop

AKNOWLEDGEMENT

Ministry of Labor and Skills and Ministry of Health wish to extend thanks and appreciation to the many representatives of TVET instructors and respective industry experts who donated their time and expertise to the development of this Teaching, Training and Learning Materials (TTLM).

The experts who developed the learning guide

No	Name	Qualification	Educational background	Region	Phone number	E-mail
1	Gosa Shura	MSc	Horticulture	Oromia	+251-923041032	gossashura@gmail.com
2	Tilahun Getu	MSc	Biotechnology	AMHARA	+251-918726766	tile21eme@gmail.com
3	Degefa Guluma	MSc	Soil science	Oromia	+251-913440464	deguluma@gmail.com
4	Bayisa Abeshu	MSc	Agronomy	South west Ethiopia	+251-921434086	Bayoabeshu@gmail.com
5	Berhanu Asefa	BSC	Plant science	South west Ethiopia	+251-922182673	berhanuasefa@gmail.com
6	Fikadu Tilahun	BSc	Plant science	Afar	+251-917363367	fikadutilahun80@gmail.com
7	Wendimu Terfa	BSc	Plant science	Oromia	+251-911266570	gurachoterfa@gmail.com
8	Yimam Mohammed	BSc.	Plant science	Oromia	+251913624360	leylasalo@gmail.com
9	Eyaya Tigabie	MSc	Agronomy	Afar	+251-921944452	eyayatigabie@gmail.com
10	Taka Magarsa	MSc	Horticulture	Oromia	+251917210371	takamagarsa430@gmail.com
11	**Elias Mohammed**	**BSC**	**Horticulture**	**Oromia**	**+251946706670**	**reweda1@gmail.com**