Horticulture crops production Level II

Learning Guide -47

Unit of Competence: Establish Horticultural crops

ModuleTitle: Establishing Horticultural crops

LG Code: AGR HCP2 M12 LO1-LG-47

TTLM Code: AGR HCP2 TTLM 1219v1

LO1: Prepare for crop planting operations

Instruction Sheet	Learning Guide #-47

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

- Obtaining and confirming transplanting plans/instructions
- Applying planting instructions, preparing and using tools and equipment
- Identifying and reporting OHS hazards
- using and maintaining PPEs

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

- Obtain and confirm transplanting plans/instructions
- Apply planting instructions ,preparing and using tools and equipment
- Identify and report OHS hazards
- use and maintain PPEs

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described in number 3 to 28.
3. Read the information written in the “Information Sheets 1”. Try to understand what are being discussed. Ask you teacher for assistance if you have hard time understanding them.
4. Accomplish the “Self-check 1**”** in page 6.
5. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. (You are to get the key answer only after you finished answering the Self-check 1).
6. If you earned a satisfactory evaluation proceed to “Information Sheet 2”. However, if your rating is unsatisfactory, see your teacher for further instructions or go back to Learning Activity #1.
7. Submit your accomplished Self-check. This will form part of your training portfolio.

Information Sheet-1	**Obtaining and confirming transplanting plans/instructions**

1.1. Introduction

Horticulture: is the science and technology that deals with production, handling, management, processing, marketing, and utilization of:

- Fruits – Banana, Avocado, Mango, papaya etc.
- Vegetables – Cabbage, lettuce, carrot, onion etc.
- roots (swollen underground root – Sweet potato, Cassava) and tubers (swollen underground stem – Potato, Taro)
- herbs and spices – Korarima, Cumin
- stimulants/beverages – Coffee, Cocao
- ornamentals
- medicinal plant

Unique characteristics of horticulture

Horticulture is a part of agriculture but it differs from agronomy and forestry for the following reasons:-

- It requires more management
- It is an intensive and expensive culture
- An individual plant is important
- High gross or net return per unit area
- It need strong investment for post-harvest technology
- High moisture content, typically 70% to 95%
- Large unit size, typically 5g to 5kg
- High to very high respiration rate.
- Soft texture, easily bruised

- Perishable, natural shelf life is a few days to several months
- Losses usually caused by rotting (bacteria, fungi), senescence
- Losses in LDCs usually 15% to 50%
- Wide adaptation
- Low Cultivar variability
- Harvested at different stages
- Requires more intensive management and higher labor inputs than other branches.
- Offers a higher gross return per unit area per unit time.

Basics of Horticulture are:-

- **Food self-sufficiency**
  - ✓ Can be narrowly defined as the ability of village, district, nations or a region to meet 100% of its staple food needs from domestic production and/ or storage under all-weather probabilities.
  - ✓ Is the ability of nations to meet its entire staple food needs through local production and/or storage except during periods of extreme drought or natural disaster when commercial food imports and/or food aid is required.
  - ✓ This can be attained by food maximizing, increasing yield &/or value per unit area, maximizing income generation.
- **Food security** is defined as “access by all people at all times to enough food for an active healthy life”.

Two essential elements

- ✓ are the availability of food (i.e. adequate food availability) and
- ✓ The ability to acquire it (i.e. the food must be accessible to all people at all times).

- **Improved nutritional status: -** vitamins, minerals, proteins, carbohydrates, lipids, etc
- **Raw materials for local industries:-** fruits are raw materials for local industries such as jam processing unit

- **Employment opportunity: -** because of intensive culture there will be high employment opportunity both for rural and urban dwellers.
- **Nature conservation and development: -** perennial and tree crops, through agro forestry practices, can modify micro environment.
- **export potential:-** e.g. flowers, coffee and other fruits earn hard currency

1.2. Obtaining and confirming transplanting plans/instructions

1.2.1. Importance of careful planning of the horticultural crop production

- To produce the right quantities of product, at the right time.
- To make efficient use of resources, particularly raw materials and labor
- To reduce risk and make sustainable development.
- To schedule production activities
- To analysis cost and benefit.
- To monitor the plan and prepare the final draft of horticultural crop production plan

1.2.2. Factors to be considered during planning for horticultural crop production

- Market trend information/Customer requirement for crops
- Availability of resources/inputs, materials, tools and equipment
- Amounts of product/produce to be produced
- Suitability of environmental conditions

Self-check 1	Written test

Name_____ Date_____

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

1. Define horticulture ?(1 pts)
2. Write the general characteristics of horticulture (1 points)
3. List the importance of horticultural crops? (2 pts
4. Write the importance of careful planning of the horticultural crop production? (3 pts)
5. Factors to be considered during planning for horticultural crop production? (2 pts)

Note: **Satisfactory rating – 9 points** **Unsatisfactory below- 9 points**

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information sheet 2	Applying planting instructions

2.1. Apply planting instruction for horticultural crops

2.1.1. Establishing horticultural crops

1. Site selection

Each species of horticultural crops has specialized environment requirement which must be meet for good growth and production of the soil, topography, climate, water availability and drainage. Besides Labor availability, transport, and nearness to market must be profitable.

During site selection for horticultural crop production it needs consideration

1.1. soil condition

- ✪ Many horticultural crops may be grown on a wide variety of soil types.
- ✪ Very heavy soils are difficult to handle and sandy soils do not hold moisture well and are likely to be in fertile.
- ✪ A loam or sandy loam soil is good for most horticultural crops and such soils are found in many parts of our country.
- ✪ For good performance of a horticultural crop a deep, well-drained soil free of excess salts, acids and bases with a fair amount of humus is essential.
- ✪ Optimum soil moisture content

1.2. Climatic condition

- ❖ Refers to meteorological conditions (change in the atmosphere) in a given area of land.
- ❖ Is defined as the aggregate of all external conditions and influences affecting the life and development of organisms.
- ❖ Climatic factors such as temperature, humidity, rain fall, wind, sun light, frost, and hail storms which influence the growth and development of horticultural crops must considered.
  - ✹ The following climatic factors should be considered for establishing horticultural crops production site.

1.2.1. Rain fall:-

- Rain fall is the most important climatic factors influencing agriculture in the tropics as it has biggest effect in farming systems.
- The distribution and reliability of rainfall are more crucial factors determining vegetation.
- Horticultural crops are once planted they require sufficient amount of soil moisture throughout the growing.
- In arid and semiarid areas beside to rain fall water the availability of irrigation water is a must.
- In Humid and high rain fall areas a continuous rain fall throughout the growing season also not important:-
    - It interferes with normal pollination activities of bees /insect
    - It interferes with different agronomic and harvesting operations
    - There may be periodic flooding
    - There may be water logging problem

1.2.2. Temperature

- Temperature is the most important climatic factors influencing the performance of horticultural crops (growth development).
- Each Horticultural crop has its own optimum temperature range for good growth and dev't.

1.2.3. **Sun light**

- Sunlight is required for photosynthesis and the growth of all green plants.

1.2.4. Strong winds

- An abnormal wind (high speed of wind) interferes with normal growth of horticultural crops.
- **If there is high speed of wind Cause:-**
    - Increase /facilitates transpiration= Thus, desiccation due to moisture stress occurs.
    - Damage young and tender branches of horticultural crops.
    - Can be break grafted or budded plants
    - It interferes with normal bee activities
    - Reduces photosynthesis. Because strong wind cause the closure of stomata opening.

Controlling high speed of wind

- Wind breaks should be estimated 2-3 years before land preparation planting.

❖ **Use of Wind Break**

- ⌑ Reduce wind velocity /speed by 45-60%
- ⌑ Reduce rate of transpiration by 60%
- ⌑ Reduce damages of twigs, branches and fruits

❖ **What types of trees are suitable for wind break?**

- ¥ Should not be alternative host for pests of a given farm
- ¥ Should be tall enough to cover large area
- ¥ Should be dense enough to block high wind
- ¥ Should be strong enough to resist pressure of winds (must be deep rooted)
- ¥ Must be multipurpose tree.

1.2.5. **Frost**

❖ Living plant cells are killed when water freezes with the inter and intra cellular parts of the plant.

❖ Frost can cause damage to horticultural crops, particularly at higher altitude areas (Ethiopia). This is most common between the months of October and January.

❖ Sensitive crops should not be planted over this period- like tomato, potato.

❖ But the response of horticultural crops to frost is often variety dependent

- ➢ Some crop species are never frost tolerant like E.g. Potato or tomato
- ➢ Some are generally tolerant for short periods of frost E.g. Cabbage
- ➢ But others tolerant to frost (like onion, carrots) better.

Frost Problem can:-

- Give rise to seasonal gluts of produce.
- Affect greatly the marketing crops

1.3. Topography

↗ Slope greater than 15% are not suitable, the optimum slop is 4% the degree of land slope will generally decide its suitability for different type of crops.

↗ Level of gently sloping lands with well-designed drainage facilities are most suitable for annual crops.

↗ The sloppy lands are suitable for long term perennial fruits provided that suitable protections against soil erosion are done prior to plantations.

1.4. Irrigation potentials

❖ In Ethiopia most horticultural crops are produced with supplementary irrigation.

- If irrigation water is to be drawn from rivers, lakes or dams it is essential to determine the availability of water at the time peak demand during the dry season.

2. Site clearing; is removal of unwanted materials from establishment site

- All trees shrubs perennial weeds and big stones should be removed
- Divide the land in to the blacks if commercial
- Grade the land for convenience of irrigation
- Construct irrigation cannels and drainage system in areas of saline soils
- Fence the area
- The extent of the clearing operation necessary prior to planting on orchards depends on whether the land has been previously cropped
- Terracing is important depending on the slope of the area

3. Tillage and land preparation

Tillage is changing a soil's condition or position with a tool, for man's benefit.

- Tillage is a mechanical string of soil for seedbed preparation for planting. It includes cutting and inversion of hard soils and separates it from lower layers after the harvest of previous crop or fallow land.

4. Terracing and irrigation

- terracing and ridging should be done on slope to control erosion
- combination of ridging, terracing and cover crops are necessary in tropical fruit orchards if sever erosion is to be prevented
- installation of pipes and digging of ditches prior to planting
- The irrigation system must be considered in conjunction with layout planning and soil conservation practices.

5. Laying out the planting field

- location and cultivar name of each crops
- Irrigation fixture
- trellises or tree supports
- orchard roads and paths
- permanent features like packing shed

6. Sowing

- Is the simplest (and often the least expensive) way to bring introduce new plants into the garden. Seeds can be sown directly into the garden (*in situ*), or in containers where they are grown to a hardy size for transplanting into the garden.
- In large gardens and farms, seeds are almost always sown *in situ*, to avoid the additional labor involved in transplanting.
- Hand sowing is the process of casting handfuls of seed over prepared ground: broadcasting. Usually, a drag or harrow is employed to incorporate the seed into the soil. Though labor intensive for any but small areas, this method is still used in some situations. Practice is required to sow evenly and at the desired rate. A hand seeder can be used for sowing, though it is less of a help than it is for the smaller seeds of vegetable seeds.
- In agriculture, most seed is now sown using a seed drill, which offers greater precision; seed is sown evenly and at the desired rate. The drill also places the seed at a measured distance below the soil, so that less seed is required. The standard design uses a fluted feed metering system, which is volumetric in nature; individual seeds are not counted.

standard planting: on a land which is level or only a slight slope and medium textured soils

6. **contour planting**: on slopes excess of 3% and not grater than 25-30% and medium texture
7. **planting on terrace**: on slope in excess of 25-30%
8. **planting on beds and ridges**: practiced on poorly drained soils

Planting pattern (system)

Patterns that can be followed on flat or gentle sloping:

- **Square**: each tree is planted equidistant from each other, at the spacing recommended for mature trees.
- **Triangular/Quincunx**: the same as square planting except that an additional plant is placed at the center of each square. Has advantage of producing higher yield during early years of production and cut down the central trees later.
- **Hedgerow**: trees are planted closely together to form solid thick row. For dwarf deciduous trees and required special pruning and training.

Self-check 2	Written test

Name_____

Date_____

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

1. Write the site selection consideration for establishing horticultural crops**?** (2pts)
2. Write the purpose of tillage for horticultural crops (2 pts)
3. Write the types of planting pattern (system) and discuss each of them (2 pts)

Note: **Satisfactory rating – 6** **Unsatisfactory – below 6 points**

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions.

Information sheet 3	preparing and using tools and equipment

3.1. Selecting machinery and equipment's

Horticultural crops different in kind, the machinery and equipment's needed also different, but mostly we use the following for the following purpose:

3.1.1. Tools and equipment's used during land preparation for horticultural crop establishment

1. **Shovel/spade**: used for loosening the soil light digging to prepare irrigation channels, for opening ridges & furrow etc.
2. **Hoes**: used for light digging, collection of soil, irrigation & opening trenches.
3. **Pick axe:** used for deep digging, opening & trenches, digging pits, loosening the soil, etc.
4. **soil auger or sampling probe**: used to collect soil samples
5. **Big kudali:** for light digging & loosening the soil.
6. **Crow bar (locally gesso):** an iron rod usually of 1.5 m length & 2.5 - 4 cm thick with one end flattened .The flattened end is used for digging pits in hard soils.
7. **Digging fork**: for loosening the moist soil& mixing manure in pits.
8. **Garden hand rake**: for removing stubbles, small stones, leveling of nursery beds & for formation of small beds, etc.
9. **Sickles/machetes**: used for clearing the land.
10. **Wheelbarrow**: to transport materials like farm yard manure, compost, seed, seedling for transplant etc. from one area to another area in the farm.
11. **Water can/sprinkler can**e: used for watering seed beds/trasplants
12. **Axe:** clearing the lands and sharpening of the wooden tools for handle and other purpose
13. **Tractors, tractor mounted implements (disc plow, mould board, disc harrow, leveler, rigder), Tractors with accessories** such as :

Primary tillage implements	Secondary tillage implements	Implements for sowing/spray/harvest/transport
❖ Mold board plough ❖ Disk plough	❖ Disk harrow ❖ Cultivators	❖ Fertilizer spreaders ❖ Trailer (gari in Amharic)

❖ Subsoil Plough/ Chisel Plough ❖ Ridger & Broad bed maker (BBM) plough ❖ Rotary Tillers ❖ Wooden plough or Indigenous plough	❖ Spike, Tine and Spring Tooth Harrows ❖ Blade Harrow ❖ **Plank and Rollers** ❖ Culti-packers ❖ Levelers	❖ Planters ❖ sprayers ❖ Harvester

3.1.2. Tools and equipment's used during cultivation

Cultivators: two finger hoe & three finger hoe: - Used for loosening the soil & breaking clods & mixing of manure & fertilizers in the soil. cultivators usually loosening the soil ,breaking of cemented soil surface for proper soil aeration & to allow better water infiltration in to the soil & to reduce weed growth on the established horticultural crops.

Hoes: those are used for light digging, collection of soil, irrigation & opening trenches.

3.1.3. Tools and equipment's used during fertilizer and pesticide application

i. Fertilizer applicator (similar to planter)
ii. Pesticide sprayers; Tractor mounted sprayers , Knapsack sprayers, ULV sprayers

3.1.4. Tools and equipment's used during irrigation

1. Diversion wires
2. Siphons
3. Sprinkler system
4. Drip system

Hose: a plastic tube used for conveyance of water from water source to the required area i.e. farm area or temporary reservoir.

3.1.5. Tools and equipment's used during transplanting horticultural crops

1. **Garden trowel**: for lifting horticultural seedlings from nursery beds, seeds pans or pots.
2. **Transplanting trowel**: for lifting the young seedlings along with a ball of earth.
3. **Dibbler:** for making holes for transplanting of seedlings.

Crow bar (locally gesso): an iron rod usually of 1.5 m length & 2.5 - 4 cm thick with one end flattened. The flattened end is used for digging pits in hard soils.

3.1.6. Tools and equipment's used during grafting/budding/ pruning

1. **Grafting/budding knife**: for grafting and budding purpose.
2. **Grafting –cum--budding knife**: used for grafting & budding purposes .it has two blades, one for budding & the other for grafting.
3. **Pruning saw**: used to cut thicker branches.
4. **Pruning knife**: for pruning of medium thick branches in top workings, etc.
5. **Pruning shears**: to cut young shoots& arrange them at equal distance
6. **Bill hook**: commonly used for cutting branches or to remove the old & dead branches from a tree.

7. **Tree pruner**: used for pruning shoots of a tree, which are beyond reach from ground level.
8. **Grass shears**: for cutting grass in lawns & soft & succulent twigs.

3.1.7. Tools and equipment's used during harvesting and post harvesting

1. Combine harvester
2. Manual harvest
    a. gathering tools (basket: container of products during harvesting, bags(wooden, plastic): for packing and safe transporting of products., sacks, etc)s
    b. Sickles, **Ladder:** used for climbing of tall trees during harvesting
3. Refrigerators/ cold room

3.1.8. Other materials include

Weighing balance ,meter, rope (string),pegs, ranging poles, poly bags or pot, mulching materials; (dried grass, chip wood, sand, plastic),compost or forest soil for media preparation, chemical fertilizers, bags (container), plates, canvas, volumetric measuring tools(measuring cylinder), pesticides & safety clothes (goggle, respiratory device, sun hat, overall, boot(safety shoes), sun screen lotion, helmet), fencing materials (wooden pole, cement, gravel, nail, hammer, corrugated iron sheet barbed wire etc..) and storage facilities.

4.

Self-Check -3	Written Test

Name_____

Date_____

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

1. List the tools and equipment's used during land preparation for horticultural crop establishment? (2 pts).

2. Differentiate and give examples of primary and secondary tillage implements? (2 pts)

3. List tools and equipment's used during transplanting horticultural crops? (2 pts)

Answer Sheet

Name: _____ **Date:** _____

Short Answer Questions

Note: **Satisfactory rating - 6 points** **Unsatisfactory - below 6 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information sheet 4	Identifying and reporting OHS hazards

4.1. **Occupation health and safety hazards.**

Definition of Occupation health and safety:

- ❖ Is the discipline concerned with protecting the health and safety of all stakeholders in the workplace from exposure to hazards and risks resulting from work activities.
- ❖ A hazard is any source of potential damage, harm or adverse health effects on something or someone under certain conditions at work.

4.1.1. Identification and control measures

4.1.2. Occupation health and safety hazards.

Tremendous amount of OHS hazards are happening in horticultural crop production operation throughout the world. Work will not stop but working conditions can be improved with safe operation guide. OHS hazard agents may include: Typical occupational health and safety risks common to the horticultural crop production sectors may be categorized as physical, chemical, ergonomic, and biological risks.

Physical risks; Slips, trips, falls, noise, solar radiation, magnetic fields, pressure extremes (high pressure or vacuum) and vibration during horticultural crop production.
Chemical risks; Fires, explosions, leaks, spills, and exposure to gases, vapors, mists, dust, and fumes are common workplace hazards during horticultural crop production.
ergonomic risks; Muscular-skeletal problems resulting from repetitive activities such as lifting and carrying, or from spending long periods in one single position such as sitting at desks and working with computers, field preparation, cultivation, hoeing for horticultural crop production.
Biological hazards; Bacteria, viruses, insects, plants, birds, animals, and humans, etc.
Psychosocial hazards. Stress, violence, etc.

On the other case, improper application of chemicals in horticultural field has its own impact to the environment i.e. toxicity development that injure and kill beneficial microorganisms in the soil, aquatic organisms in the water body and generally the ecosystem can be disturbed.

Consumers by eating such highly concentrated chemicals from plant and animal products causes different types of diseases like cancer due to its chronic effects.
In the different activities there could happen different hazards to our health and safety this could be identified as

- Poisoning from chemicals
- To be hit (injured)
- Fire hazards

- Sun hitting the support provider
- Dust affecting eyes and breathing system
- River for irrigation taking or killing the worker

Example: - When spraying crops the worker may be exposed to hazardous chemicals contained in the spray. Many pesticides and herbicides that have been banned in some countries because of their toxic effects are still used in many developing countries. If spraying takes place on a windy day, the spray can be breathed into the lungs and blown on to the skin where it can cause damage. It can also be absorbed into the body through the skin.

4.2. Control measure of work place hazards during horticultural crop production

Eliminate/control risks

Once risks have been assessed action must be taken by line managers (in consultation with staff, and in some cases, clients) to eliminate or control risks. Whilst the most effective action is to eliminate risks, this is not always possible, so control measures must be implemented according to the hierarchy of control contained in the Occupational Health and Safety Regulation.

The Hierarchy of Control will assist in determining the most appropriate course of action to control the risk identified in the Hazard report form. The Hierarchy of Control ranks risk control strategies from the most effective to the least effective. Not all strategies will be practicable and a combination of strategies may be needed to achieve the best protection, for example ventilation and gloves.

The following is the Hierarchy of Control in descending order:

- **Eliminate the risk** (most effective)

  Examples of elimination strategies are:

  - **Redesigning the workplace**: by redesigning rooms to allow sufficient space for manual handling tasks (widening doorways, removing furniture).
  - **Changing work practices** so that unnecessary high risk tasks are no longer carried out (using a hoist to move clients rather than lifting them).

- **Minimize the risk**

a. Substitution

This is achieved by replacing hazardous substances or procedures with those that are safer. Examples of substitution strategies are:

- Replacing tiles in the bathroom with non-slip tiles.

- Replacing hazardous cleaning products with non-hazardous environmentally friendly products.

b. Modification

This is achieved by modifying the workplace or work practices. Examples of modification strategies are:

- Improving drainage in bathrooms.
- Rearranging the layout of a bedroom to allow free access with a hoist.

c. Isolation

Examples of isolation strategies are:

Guarding exposed moving parts on machinery. Moving a photocopier away from a desk area.

- Locking medication in a cupboard in a respite house to prevent unauthorized access.

Provide horticultural crop establishment based on work place information

There is different horticultural crop production that you provide and it depends on the different instructions or work place information given to you either orally or in written form by your supervisor or the enterprise standard operation procedures (SOPs). Then you should follow the instructions strictly to satisfy the standard of the enterprise you are working in, otherwise the quality of the end product/result could be worse because of you not following instructions correctly. To safely use tools and equipment's there is an instruction which come with the material from the manufacturing industry and this is called Material Safety Data Sheet (MSDSs); therefore both the working and material safety instructions should be followed to perform the task in the desired standard and quality.

Examples:- in providing irrigation to certain horticultural crops you should follow the work place instructions given to you by the supervisor strictly about the irrigation interval, the depth of application or time of application the stream size, discharge rate, etc. not following this work place instructions/information have a consequence of less or no product of the horticultural crop

Recording and reporting

All the necessary events such as accidents and emergency, malfunctioned tools and equipments, work progress, the required material, tools, equipments, facilities and other resources should be identified, recorded and reported with proper format to the supervisor periodically. This practice is the core activities for the future work improvement and adjustment. It is because that good supervisor can identify which activity is low or high in efficiency, which tools and equipments are normal or faulty, recommendation of technical training for workers, purchasing materials, etc for future healthy and productive horticultural crop production.

Once the hazards are identified it should be recorded. The record should include the type horticultural crop to be produce, how the risk occurs, and the likely solution, etc. The table below can serve as a recording format, or you can make a better recording format.

No	Type of crop work activity	The type risk		Possible solutions	
		Man	Environment	Man	Environment

Self-Check -4	**Written Test**

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

1. Define occupation health and safety? (3 pts)
2. Write and discuss the types of occupation health and safety?(4 pts)
3. Write the ways of minimizing occupation health and safety?(2 pts)

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Question

Information Sheet-5	using and maintaining PPEs

5.1. Use Personal Protective Equipment (PPE)

Personal protective equipment is the least satisfactory solution to OHS risks that should occur during horticultural crop production as it does not address the hazard but merely provides a shield to protect the employee. It should only be used when it is not reasonably practicable to address the risk any other way or to supplement other risk strategies.

Personal protective equipment and clothing must be:

- Carefully selected and appropriate for the task.
- Correctly fitted and comfortable to wear.
- Selected to take into account individual differences within employees.
- Always worn where indicated/instructed.

Examples of personal protective equipment are:

Gloves, safety glasses, protective footwear, ear plugs.

By using personal protective equipment employees are responsible for:

- Carrying out all work activities of horticultural crop production in a safe manner and in accordance with procedures.
- Reporting hazards and bringing them to the attention of the supervisor or manager.
- Providing assistance in rectifying hazards and participating in consultation processes.

Working safely during repairing and maintaining by using personal protective equipment

- ✓ **Repairing**

Materials to be repaired may contain residue of different chemicals if it is a container/sprayer there for careful cleaning and making it free is the first criteria before maintain. Or else if the material to be repaired could have any contaminants, may be used in horticultural crop production it is also desirable to clean the material first. During repairing of materials if hammering is required you should take care of your hands and legs, and also take care of the fire you used to heat the material. to be hammered. Learn some techniques of repairing materials by your own without harming yourself the material being repaired as desired and also no harm to the surrounding.

- ✓ **Maintaining**

Maintaining is a little less than repairing, and it involves cleaning, fastening, making together of the different parts properly, etc of the materials. While doing the maintenance job we should take care of ourselves from cleaning wastes not to be poisoned when maintaining the nozzles of a sprayer, and not to hit yourself while making the different parts together for example when mounting a planter to a tractor, etc.

Jobs of maintenance could be conducted by using personal protective equipment

- Cleaning of sprayers and nozzles
- Adjusting implements to the desired spacing or form
- Holding the different parts together
- Calibration of equipments
- Fastening the main tool and the handle

Self-Check -5	**Written Test**

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

1. what are personal protective equipment's ?(2 pts)
2. Why using personal protective equipment is considered as least effective method of controlling work place hazards? (3 pts)

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

References

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Fortier, Jean-Martin. 2014. The Market Gardener: A Successful Grower's Handbook for Small-Scale Organic Farming. Gabriola Island, BC: New Society Publishers. Includes a section on starting seeds indoors and direct seeding.

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HORTICULTURAL CROPS PRODUCTION LEVEL II

Learning Guide-48

Unit of Competence: Establish Horticultural crops

Module Title: Establishing Horticultural crops

LG Code: AGR HCP2 M12 LO2-LG-48

TTLM Code: AGR HCP2 TTLM 1219v1

LO 2: Prepare the site and plant material for planting

Instruction Sheet	Learning Guide # 48

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

- Operating machinery, equipment and tools
- Clearing site and watering prior to transplanting
- Modifying Soil or growing media
- Confirming transplanting depth

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

- Operate machinery, equipment and tools
- Clear site and watering prior to transplanting
- Modify soil or growing media
- Confirm transplanting depth

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described in number 30 to 45.
3. Read the information written in the “Information Sheets 1”. Try to understand what are being discussed. Ask you teacher for assistance if you have hard time understanding them.
4. Accomplish the “Self-check 1**”** in page 34 .
5. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. (You are to get the key answer only after you finished answering the Self-check 1).
6. If you earned a satisfactory evaluation proceed to “Information Sheet 2”. However, if your rating is unsatisfactory, see your teacher for further instructions or go back to Learning Activity #1.
7. Submit your accomplished Self-check. This will form part of your training portfolio.

Information sheet 1	Operating machinery, equipment and tools

1. 1. Agricultural Machineries and Equipment's for use

- Are devices used to till soil and to plant, cultivate and harvest horticultural crops.
- In ancient time peoples used pointe and sharpened tools to dig and keep soil loosened.
- These days' modern large agricultural implements and prime mover machineries are being introduced for large scale horticultural farming.

1.2. Types and uses of machineries and equipment's.

There are so many machineries types introduced for horticultural crop production purposes. Different manufacturers designed different models of machineries featured with different applications. Similarly different attachments and implements are designed moderately for the intended performance.

1. 2 .1. Machineries

- Are prime movers of the equipment's or implements they have different features and different horse powers according to their performance of desired task.
- These days large scale horticultural farming is widely used in the world. Therefore, greater horse power machineries and large – scale equipment are becoming effective for the productivity.
- As the working equipment is becoming larger, the machine should be of greater horse power to perform the intended duties.
- The capacity of the machinery should property meet to the equipment attached.
- Machineries are used to pull or mount the equipment's, and they are prime movers or source of power to operate equipment
- As they are different types of machineries for different purpose our focus lies on this lesson only on agricultural machinery.
- There are different agricultural operations performed on farming activities.

1.2.2. Equipment's or implements are designed for two farming operation in General.

1. **Non cultivation** :- Operation which takes the procedure from Up-rooting → Ploughing → Harrowing → Planing → Furrow
2. **Cultivation: -** Operation after seeding → moulding → fertilizer application...etc.

- Cultivation implements relatively use lesser horse power machineries than non-cultivation implements.
- Whenever higher horse power machineries perform duties of lesser horse power operation, it is under capacity operation and it is a great loss.

Non – cultivation implements and operation

Operation	**Implement**
○ Up rooting	○ Heavy harrow
○ Sub soiling (soil loosening)	○ Sub soiler → optional
○ Ploughing	○ Plough →disc→mould board
○ Harrowing	○ Light harrow
○ Planning	○ Planer
○ Leveling	○ Leveler (scraper) accordingly

Cultivation implements and operation

Operation	**Implement**
Molding :-(reversion of furrow) for irrigation	Double mould board
R.R.solo- Harvested cane reshaping of furrow	Double mould board without fertilizer
R.R.F. fertilizer application	Disc plough for lesser plant mould board for greater plant with fertilizer applicator
Malang opening length according to the topography	Single row moved board for irrigation facility
Weeding and spraying	Weeder and sprayer

1.3. Inspection of machineries

- Machinery inspection is the best way of handling and using a resource properly. Primarily the operator is responsible for proper inspection of the machine and the attached equipment. If the machine is not inspected always, it is a great loss.
- Machineries have their own inspection intervals according to their specification. But commonly all machines have the following routine inspections.

1.3.1. Pre–Operation inspection: - it is an inspection which is performed before starting an operation.

- As it is discussed in operating basic machineries and equipment's section, pre-operational checks and inspections should be performed correctly. Visual inspections of loosen parts, attachments, connections... etc will be considered properly.

1.3.2. During operation: -

- Agricultural operation needs more attention on inspection during operation comparing with others. As it is a series of different connected sequential operation, observation of machinery and equipment operation saves more cost and time.
- An operator must observe the performance of the machinery and the equipment as wells as the field he is working on it.
- If any unusual situations are occurred on the machine or the equipment, he has to stop the machine and avoid the failures.
- Symptoms and signs of failures, like, sudden drop of oil pressure, increasing coolant temperature, abnormal noise, smoke, vibration, equipment faulty movement, oil leakage or liquid leaks...etc.

1.3.3. Post operation:-

- After finishing the daily operation
- Take the machine out of the field and stop on a level place
- Let the engine on idle and check for any leaks and unusual signs
- Inspect the equipment condition and rest the implement
- Clean all the operating medias after parking the machine and the equipment
- Check the oils, air cleaner, joints, loosen parts...
- Use stopper and apply all safety rules of machineries
- Record the performance and observations of your working time situations happened on the machine or equipment
- Convey the information to the concerned official or others.

1.4. **Machines and equipment's problem**

- Machines and equipment's face problems in different cases. The main problem arises from non-skilled or careless operation.
- Common problems of machineries are:- black smoke, tyre damage or under inflation, power loss, over heating, charging, braking steering, clutch ... etc fuel system, leakages of oil fuel...

- Problems of equipment's:- cylinder or hose leakage, loose connection; they all have their own cause and remedy.
- Some problems of machineries and equipment's can be avoided by the operator himself but further repairs and maintenance will be taken care by skilled mechanics.

Self-Check -1	**Written Test**

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

1. Define agricultural machineries? (2 pts)
2. Differentiate non – cultivation implements and cultivation implements(3 pts)
3. List all machines and equipment's problem? (2 pts)

Note: **Satisfactory rating - 7 points** **Unsatisfactory - below 7 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information sheet- 2	Clearing site and watering prior to transplanting

2. 1.Clearing and preparing land

Clearing means cutting down of vegetation and removing the dead plant materials from cropping area. All un-wanted vegetation must be removed from the area including trees, bushes and weeds; the woody remains should be burned and the remainder placed on the compost heaps. Stones should be also removed and the soil roughly leveled.

Purposes of Clearing

- ✪ 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 horticultural plants development

Land preparation is importance for many things, that is.

- ✹ Breaks up the soil layer and brings in to suitable physical condition
- ✹ It helps to control weeds
- ✹ Also it helps in uniform germination of seed
- ✹ It improves soil aeration and infiltration
- ✹ Improves drainage of the soil
- ✹ It destroys most of pests and diseases in the soil that expose to sun
- ✹ Adds organic matter to the soil

Pulverizing and leveling soil

Preparation of soil for sowing and plantings are essential steps for cultivation of horticultural crop. Digging is the first step followed by pulverizing and leveling. This steps including ploughing helps for;

- ❍ Burying debris and weeds
- ❍ Aerating the soil
- ❍ Incorporating compost
- ❍ Ensuring a frost tilth
- ❍ Ensure better water holding capacity
- ❍ Breaks up the soil compaction

2.3. Watering prior to transplanting

Availability of water

Subsequent irrigation, several times (2 to 3) before planting, will also allow the mixed soil to settle in the hole. In most soils, the early and rapid growth of the plant is better when the holes are prepared one to two months before planting.

The horticultural crop requires a large quantity of water for sustainable growth.

Critical factors regarding water for irrigation purposes are:

(i) The sustainability of the water source,
(ii) The quantity of water available for irrigation,
(iii) The distance to the field, and
(iv) The quality of the water

Self-Check -2	**Written Test**

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

1. Define site clearing before horticultural crop establishment? (2 pts)
2. Write the purpose of site clearing? (2 pts)
3. Write the critical factors regarding water for irrigation (2 pts)

Note: **Satisfactory rating – 6 points** **Unsatisfactory - below 6 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information sheet 3	Modify soil or growing media

3.1. The Growing media

- Is any substrate in which horticultural plants grow their roots and absorb nutrients, water and air.
- In conventional horticultural crop production crops are grown in natural soil in the field which provides the plants with nutrients, water, air and anchorage.
- The production of horticultural crops in fields and other technological production systems such as green houses, vertical farming etc involves a number of cultural inputs.
- To produce horticultural crops in containers especially in green houses, vertical farms and nursery conditions, conventional soil does not suit the condition and requires amendments to improve its suitability for these conditions.
- A growing media must provide sufficient water, air and nutrients through the root system to the plants depending on the physical, chemical and biological properties of the media.
- Each horticultural plant may require different components of growing media, and there may be a variation in those requirements according to the growth cycle of the plant.

A **soil conditioner**, also called a soil amendment, is a material added to soil to improve plant growth and health. A conditioner or a combination of conditioners corrects the soil's deficiencies in structure and-or nutrients.

The type of conditioner added 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.

3.2. Types of Growing media

Generally, there are two types of growing media: soil and soilless growing media

3.2.1.) Soil Media

Components used for soil growing media that involves soil preparation include organic and inorganic materials:

i) Top soil/garden soil, (subsoil), forest soil

Top soil is generally more fertile because it contains higher organic matter and usually have dark color. However, top soil is mostly high in disease causing pathogens.

Sub soil is less fertile because it has low organic matter content. However, it is free from disease causing pathogens and can be used in instead of top soil.

ii) **Organic fertilizer (compost/manure, humus, peat, muck)**

Compost contains all plant nutrients in small proportions. Compost is also considered as a soil conditioner because it improves soil physical properties.

- increases water holding capacity of soil
- increases porosity /aeration
- increases infiltration rate of rain water
- reduces soil bulk density or soil strength

iii) **Sand**: increases porosity/aeration and infiltration rate of rain water

3.2.2.) soilless growing media

Crops can be grown without soil if all the necessary requirements can be provided to them. Such growing media are called soilless growing media. There are different types of soilless growing media.

i) **Container soilless growing media**

Soilless growing media are usually commercially sold products: They include minerals such as perlite, vermiculite, gravel, wood residues/saw dust, bagass, huls of rice or wheat, lime and fertilizers and other industrial byproducts.

ii) **Special soilless growing Medias**

- hydroponics /hydroculture/aquaponics/ (liquid growing media)
  plants are grown in water in which all the necessary plant nutrients are dissolved. Air is continuously bubbled into the water with a compressor to provide the roots with oxygen.

Aeroponics

- All the necessary plant nutrients are continuously sprayed as nutrient solution to the roots as a mist.

- Plant roots are kept in dark conditions by covering them.

3.3. Qualities/Requirements of growing media

- Most horticultural crop use mixtures of topsoil with organic and inorganic materials that provide an anchor for the root system of the plant, and make available nutrients either directly or indirectly to the root zone.

The characteristics of the suitable growing media include:

- high nutrient content (fertilizer)
- good aeration
- ability to retain and supply sufficient moisture to the plants
- good infiltration rate
- good drainage
- good texture/balanced, limited clay.
- high organic matter content (avoid non- decomposed organic matter)
- light weight/low density/compaction
- right pH/neutral
- compatible to plant health
- Free from disease pathogens fungi; bacteria; weeds; viruses…etc. and weeds:
- gave good contact between root and substrate: firm enough to hold the plants in place during germination.
- little mechanical resistance (workability)
- sufficient depth (this is mostly the characteristics of the containers)

Self-Check 3	Written Test

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

1. Define growing media? (2 pts)
2. Mention types of growing media(2 pts)
3. What are requirements of a good growing media?(2 pts)
4. Write the two types of plant growing media and discuss briefly?(3 pts)
5. What are the components of growing media for plants(1 pts)

Note: **Satisfactory rating – 10 points** **Unsatisfactory - below 10 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information sheet 4	Confirm transplanting depth

4.1 Planting operation

- This is probably the most critical phase in the establishment of a new plantation.
- Mistakes at this point may lead to a poor survival rate of offshoots or tissue culture-derived plants, regardless of the efforts put in during the preparation phases.
- The aim is to assist the grower to execute the planting operation in a way that will ensure a high transplanting survival rate in the newly established plantation.

The planting operation is divided into different activities which will be discussed separately.

1. Plant spacing

It is difficult to prescribe definite plant spacing but there are specific factors influencing the spacing such as:

- To allow for sufficient sunlight when plants are tall;
- To allow for sufficient working space within the plantation; and
- To provide sufficient space for root development.

Spacing and Time of planting of some horticultural crops

S/No	Type of fruits	Spacing(m) b/n row and plant	Time of planting
1	MANGO	8*8	Jun-July
2	BANANA	1.8*1.8	-
3	ORANGE	6*6	Jun-July
4	LEMONE	5*5	Jun-July
5	GRAPE	3*3	
6	GUAVA	6*6	Jun-July
7	PAPAYA	1.8*1.8	

8	PINEAPPLE	33.5cm b/n plants 45cm b/n row 90cm b/n trench	Jun-July
9	APPLE	3*4.5	Jun-July

2. Time of planting

The critical factor is to transplant the young tissue to ensure a good survival rate and proper horticultural crop establishment before the beginning of a "hard" season.

3. Transplanting stage

- Research has shown that the best field survival rate, as well as early plant development, is obtained when the tissue culture plantlets are transplanted at the four (4) plus pinnae leaf stage.
- Plants received from a tissue culture laboratory normally only have juvenile leaves or one pinnae leaf at the most.

4. Planting time

- Planting should always be initiated early in the morning to limit stress on the plantlets and also to allow sufficient time for adaptation (from the plastic bag to the soil).
- Bags are to be removed with care and the plant, with most of its surrounding substrate, to be planted carefully.

5. Transplanting depth

- The planting depth is critical because the "heart" of the plant should never be covered with water
- The depth of hole for transplanting seedling varies in type of species.
- Most crops should be planted to the depth of the cotyledons (Seedlings at Transplant Maturity, Planting Depth)
- Horticultural Crops in the Solanaceae family (tomatoes, peppers, eggplants, etc.) and Brassicaceae family (broccoli, cabbage, cauliflower, etc.) are adventitious rooters and may be buried to the bottom of the first set of true leaves
- Sometimes, plants are placed on their side if stems are leggy, e.g., tomatoes, sunflowers; or plant up to cotyledons, e.g., broccoli) avoid planting plug above air pocket
-

Self-Check -4	Written Test

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

1. write the factors affecting transplanting depth?(2 pts)
2. Why transplanting depth differs for different crop species? (2 pts)
3. Write the transplanting depth of selected horticultural crops like Avocado, Mango, coffee, Tomato? (3 pts)

Note: **Satisfactory rating - 7 points** **Unsatisfactory - below 7 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

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HORTICULTURAL CROPS PRODUCTION LEVEL II

Learning Guide-49

Unit of Competence: Establish Horticultural crops

Module Title: Establishing Horticultural crops

LG Code: AGR HCP2 M12 LO3-LG-49

TTLM Code: AGR HCP2 TTLM 1219v1

LO 3: Remove seedlings from original site

Instruction Sheet	Learning Guide # 49

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

- preparing Crown
- Employing Safe manual handling techniques
- Picking/lifting Seedlings
- Applying Pre planting treatments and crop protection measures
- Safe handling and preparing of Seedlings

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

- prepare Crown
- Employee safe manual handling techniques during lifting
- Pick/lift Seedlings from seedbeds or pots without damaging the roots
- Apply Pre planting treatments and crop protection measures
- Safe handle and prepare of seedlings

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described in number 47 to 60.
3. Read the information written in the “Information Sheets 1”. Try to understand what are being discussed. Ask you teacher for assistance if you have hard time understanding them.
4. Accomplish the “Self-check 1**”** in page 50.
5. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. (You are to get the key answer only after you finished answering the Self-check 1).
6. If you earned a satisfactory evaluation proceed to “Information Sheet 2”. However, if your rating is unsatisfactory, see your teacher for further instructions or go back to Learning Activity #1.
7. Submit your accomplished Self-check. This will form part of your training portfolio.

Information sheet 1	**prepare Crown**

1.1. **Crown preparation**

- ❖ Crown is prepared according to requirement of species and time of transplanting.
- ❖ The place/hole that seedling placed should be prepare before the time of transplanting.

1.2. Time of transplanting

- ❖ The correct stage of transplanting varies with the density of sowing or the size of container and with the vigor of the seedling.
- ❖ Seedling of vegetables should be transplanted on they are at least 12 to 15cm tall.
- ❖ Seedling of cabbage, cauliflower, etc can be transplanted when they are 3 or 4 weeks, whereas tomato chilies and eggplant takes 5to6 weeks and onion seedlings are transplanted at age of 6 to8 weeks at the time of transplanting seedlings should be have two or three pairs of true leaves. Seedlings should be produced good root system.

No	Common name of vegetable	Spacing		Time of transplanting plant height
		Between plants	Between rows	
1	Tomato	50cm	100cm	10-12cm
2	Pepper	30	60	10-12 cm
3	Cabbage	30	60	10-15 cm
4	Carrot	6	10	Direct sow
5	Potato	30	70	Direct sow
6	Lettuce	25	30	7 cm
7	Pumpkin			8-10 cm
8	Watermelon			Direct sow
9	Garlic	10	40	Direct sow
10	Swiss chard	10	70	10-15 cm
11	Onion	10	40	12-15 cm
12	Shallot	10	40	Direct sow

2.3 Techniques of Seedling Picking

- Sowing in seedbeds requires transfer of germinated plants in to pots after same time.
- It is very important that the seedlings are picked out when they have reached the right size.
- Picking begins when the seedling have its first true leaves.
- There are the leaves which appear after the germination leaves.
- If transplanted earlier, the seedlings are too delicate.
- If pricking out is done late, their roots get too long to put in the pots.
- Seedling should be watered thorough the day before picking out to avoid damage them.
- Seedlings are lifted with flat pieces of wood. Only healthy well developed seedling is picked out.
- If roots are to long prune them with sharp knife.
- If only a tap root has to be cut use finger nail.
- The root may die after only three minutes in the full sun or exposed to dry wind.
- Therefore work under shade; work in the late afternoon or when sky is cloudy.

Stages of transplanting or planting out

- Prepare permanent beds completely and dig holes at the planting stations.
- If possible transplanting should be takes place in the evening or in a cloudy day the transplants are lifted with a fork or trowel , care being taken to damage them as little as possible .
- Loose soil is removed from the roots and plants are placed in bucket or small container with moist sacking or banana leaves in which they are transported to the planting area.
- Plants are set in the holes at the same level or slightly deeper than they were growing in nursery.
- Water the plant immediately after transplanting.
- If weather is sunny, banana leaves, or leaves of twigs are useful for shading the transplants for first few days.

Self-Check -1	**Written Test**

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

1. Define crown?(2 pts)
2. How can you prepare crown (3 pts)

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Question

Information sheet 2	Employing safe manual handling techniques

2.1. Safe Handling Techniques for seedling

- ❖ Protecting seedlings from temperature and moisture extremes and from physical damage at all times.
- ❖ Keeping out-of-soil seedlings moist, either by restricting water loss with a water vapor barrier or by adding water to the roots at regular intervals.
- ❖ The seedling should be well hardened.
- ❖ Water the seed bed before lifting the seedlings
- ❖ Lift seedlings using fork
- ❖ As soon as lifting keep seedlings in a trench dug in shade
- ❖ Trimming(the removal of excess leaves in over aged seedlings)

2.2. **Safe Handling Techniques for employee**

- ❖ Appropriate gardening clothes protect you when you spend hours outdoors. Long sleeves, pants, a hat and sunscreen cover your skin to reduce exposure to the sun's rays.
- ❖ You also keep dirt, fertilizer, grass and other potential irritants away from your body.
- ❖ Shoes with closed toes prevent injury to your feet from shovels or other implements used while planting.
- ❖ Gardening gloves keep dirt and contaminants away from your skin and out of cuts you may have.
- ❖ Handle planting during the cooler parts of the day, such as early morning or evening.
- ❖ The tools used in planting vary depending on the preparation needed for the area.

2.3. Successful /safe handing for transplanting

Start with strong seedlings. If you start your own seeds, make sure your seedlings have plenty of light, adequate water and drainage. A good growing medium is critical for root establishment.

If you buy seedlings remember biggest doesn't always mean best. Look for healthy and consistent leaf color. The roots should be deep, long, white and fibrous. The stem should be thick and strong. The growing medium should be held together by tight tangled roots.

Do not choose leggy seedlings; too long of stem means the seedling was starved for light.

Hardening off is important. Don't skip this step. Store bought seedlings are typically hardened off in the garden center, but seedlings you start need to be acclimated to the natural environment before transplanting.

Hardening takes 1-2 weeks. You can move seedlings to a cold frame for a week and then set in the garden an additional week. Or set seedlings out during warm daytime temps and bring them in at night.

Timing is everything.

- Frost-free dates and warm and cool weather crop temperature requirements for your growing zone are good guidelines.

- Consider last season's planting dates and the weather forecast. Overcast days are great days to plant because cloud coverage reduces the probability of sun-scorching tender plants.

- During the transplants' last week indoors, withhold fertilizer and water less often to condition them to life outdoors.
- Anything that raises the temperature of the soil will help plants adjust to the shock of the cold ground.

Self-Check -2	**Written Test**

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

1. Write the method of safe handling for seedling? (2 pts)
2. Write the method of safe handling for employee? (2 pts)
3. Write the consideration for successful /safe handing for transplanting? (4 pts)

Note: **Satisfactory rating - 8 points** **Unsatisfactory - below 8 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Question

Information sheet 3	Picking/lifting Seedlings

3.1. Seedlings

- Any plant that is growing in the seedbed is called seedlings.
- A plant, which is raised in a traditional bed where it was grown directly as well as from direct sowing into pot are also called seedlings.

3.2.Seedling Lifting

- Is the process of uprooting seedlings from the beds for transferring them to the main planting area.
- It involves a careful removal of the seedlings from the soil with minimum damage to the root system.
- This will reduce the loss of seedlings due to transplanting shock.

Handling uprooted seedlings: is the care that is needed to reduce the damage that could occur to the seedlings due to inappropriate handling. The process encompasses:

- keep the moisture content of the soil (bound the root and the soil with a wet cloth or sisal sack)
- Hold the seedlings at the base of the stem
- Avoid direct sunlight
- Avoid holding too many seedlings together
- Provide seedlings with mist of water (improve the humidity of the air)

To correctly determine a lifting date, some factors should be considered.

1. **Physiological conditions**
   - Bud dormancy
   - Frost hardiness
   - Root growth capacity (or potential)
   - Natural xylem water potential
2. **Weather and soil conditions for lifting**
   - Cool and humid, and soil moist to avoid desiccation damage to the seedlings.

- If the weather is too cold and soil is frozen, seedlings may be mechanically damaged.
- if soil is too dry or wet, the workability of soil is poor and lifting operation cannot be implemented

Storing Seedlings:

- After uprooting the seedlings; they need to be stored under the shade temporarily
- Helps in reducing the damage until the replanting time.
- Important if the main planting site is far away from the nursery site.

Self-Check -3	**Written Test**

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

1. Define seedlings? (2pts)
2. Define seedling Lifting? (3 pts)
3. How you can handle uprooted seedling? (2 pts)

Note: **Satisfactory rating - 7 points** **Unsatisfactory - below 7 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Question

OPERATION SHEET1	Steps for seedling lifting

Steps for seedling lifting

1. Digging the soil by the side of the seedling (few centimeters' from the base of the stem)
2. Pulling out by holding the base of the stem, and
3. Then move it to a safer storage place with minimum shock.

LAP Test	Practical demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within 2-3 hours.

Task 1: lift seedlings

Information sheet 4	Applying pre planting treatments and crop protection measures

4.1 Selection of horticultural planting materials

Purpose and Importance of seed selection

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

Therefore seed selection and preparation have irreplaceable 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

4.1.1 Seed selection criteria

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

Characteristics of good quality seed

1. They are pure variety (true to type)
2. They are viable, and have germination capacity up to the standard
3. They have uniform size, shape, color, texture, structure and appearance
4. They are healthy free from inert matter
5. They are whole (no break) and contain the desired moisture level.

4.2 Seed treatment and its importance

Seed treatment is the process of applying physical, chemical or biological treatment to the seeds to keep it viable and healthy.

For the purposes of this manual, seed treatments are defined as chemical or biological substances that are applied to seeds or vegetative propagation materials to control disease organisms, insects, or other pests.

Seed treatment pesticides include

- Bactericides
- Fungicides and
- Insecticides.

Most seed treatments are applied to true seeds, such as corn, wheat, or soybean, which have a seed coat surrounding an embryo. However, some seed treatments can be applied to vegetative propagation materials, such as bulbs, corms, or tubers (such as potato seed pieces).

In agriculture, a **seed treatment** or **seed dressing** is a chemical, typically antimicrobial or fungicidal, with which seeds are treated (or "dressed") prior to planting

Before sowing, certain seeds first require a treatment prior to the sowing process. This treatment may be seed scarification, stratification, seed soaking or seed cleaning with cold (or medium hot) water.

.

Fungicidal seed treatments are used for three reasons:

(1) **To control soil-borne fungal disease organisms** (pathogens) that cause seed rots, damping-off, seedling blights and root rot;

(2) **To control fungal pathogens that are surface-borne on the seed**, such as those that cause covered smuts of barley and oats, bunt of wheat, black point of cereal grains, and seed-borne safflower rust; and

(3) **To control internally seed-borne fungal pathogens** such as the loose smut fungi of cereals

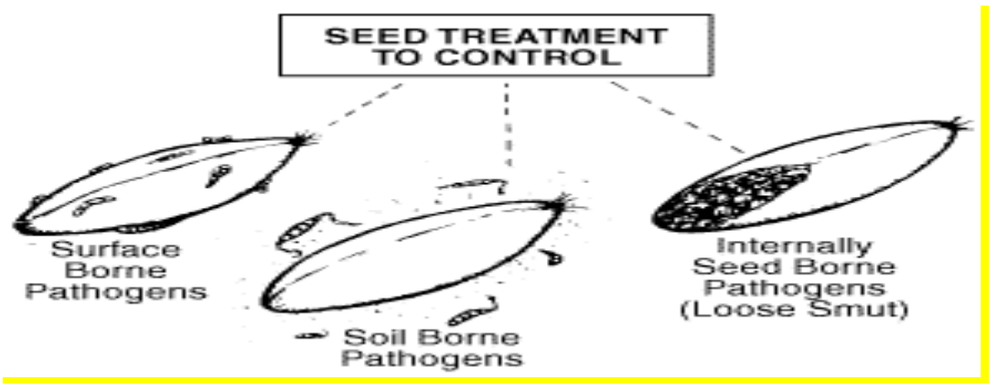


Figure 1. Reasons for seed treatment.

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**.

Types of chemicals used for seed treatment

- Insecticides, e.g. endosulfan
- Fungicide, eg. 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, eg. Endosulfan, Thiram
- Fumigant

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)

Effectiveness of pesticides depends on:-

- Toxic property of chemical
- Stage of application

- Ways of application
- Sequences of application

4. 3. Pre-lift Treatment

- Lateral-root pruning
- Undercutting before lifting can reduce mechanical damage to the root system
- Cultural practices in that promote the adaptation of seedlings to bad conditions tend to increase transplanting and storage success
- Water and nutrient stress often leads to frost hardiness and induce bud dormancy, which could improve the ability for stock to withstand manipulation of lifting, grading, packing, and storage.

Self-Check -4	**Written Test**

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

1. Mention pre-lift Treatment?(2 pts)
2. Write the criteria used for selection of planting materials? (2 pts)
3. Define seed treatment? (2 pts)
4. Write the method of seed treatment?(3 pts)

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Question

References

1. DuPont, T. 2012. Selecting the Right Seeding and Transplanting Strategies. Mid-Atlantic Commercial Vegetable Production Recommendations.

2. Funded by USDA Specialty Crop Block Grant Project ME#44166076 – “Sustainable Production and Pest Management Innovations for Next Generation Young and Hispanic/Latino Specialty Crop Growers”

HORTICULTURAL CROPS PRODUCTION LEVEL II

Learning Guide-50

Unit of Competence: Establish Horticultural crops

Module Title: Establishing Horticultural crops

LG Code: AGR HCP2 M12 LO4-LG-50

TTLM Code: AGR HCP2 TTLM 1219v1

LO4:Carry out planting operations in new environmen t

Instruction Sheet	Learning Guide # 50

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

- Selecting planting material
- Storing, handling and transporting planting materials
- Incorporating appropriate drainage
- Planting seedlings
- Watering plants and applying post planting treatments
- Installing plant support devices

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

- Select planting material
- Store, handle and transport planting materials
- Incorporate appropriate drainage
- Plant seedlings
- Water plants and applying post planting treatments
- Install plant support devices

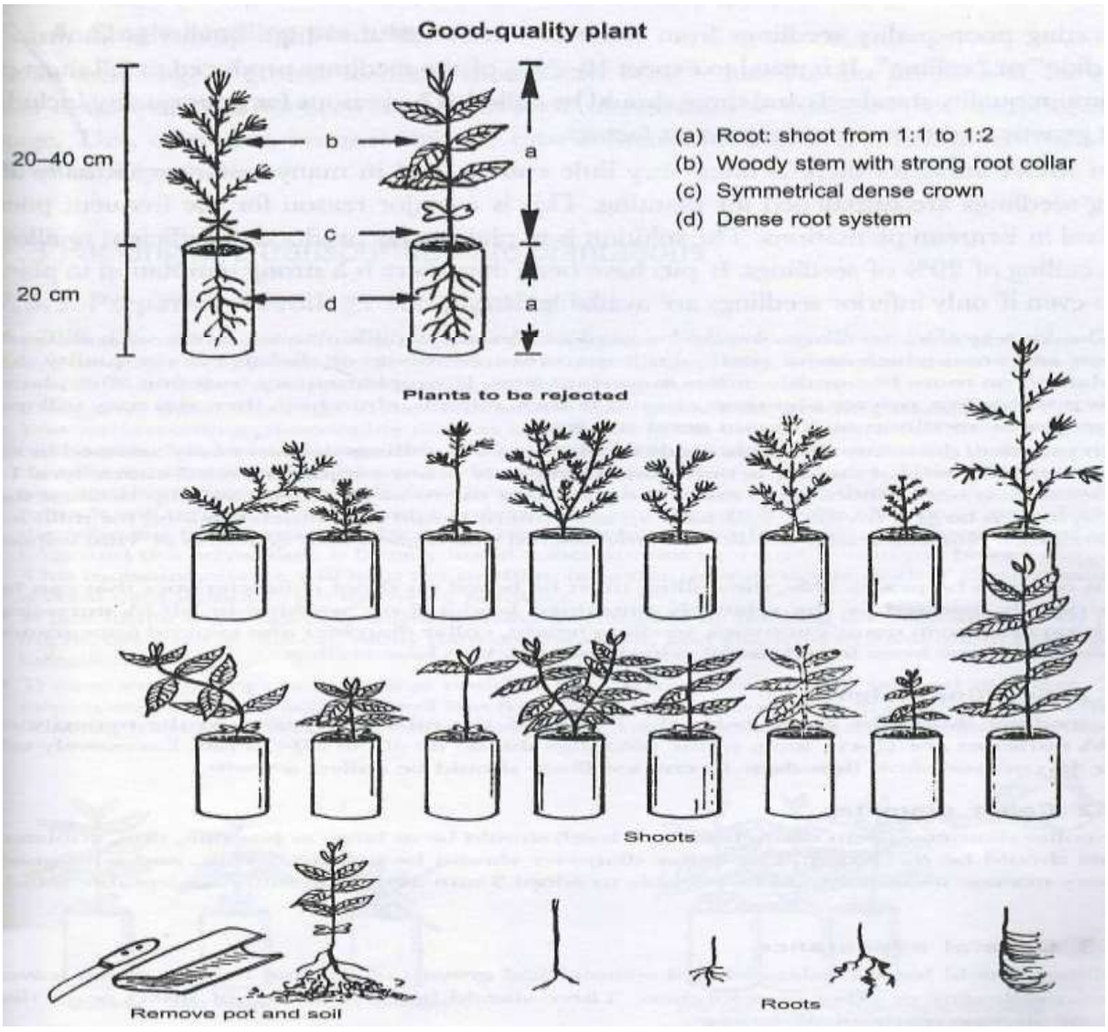
Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described in number 52 to 87.
3. Read the information written in the “Information Sheets 1”. Try to understand what are being discussed. Ask you teacher for assistance if you have hard time understanding them.
4. Accomplish the “Self-check 1**”** in page 65.
5. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. (You are to get the key answer only after you finished answering the Self-check 1).
6. If you earned a satisfactory evaluation proceed to “Information Sheet 2”. However, if your rating is unsatisfactory, see your teacher for further instructions or go back to Learning Activity #1.
7. Submit your accomplished Self-check. This will form part of your training portfolio.

Information sheet 1	Selecting Planting material

1.1 . Grading

- The process of separating poor-quality seedlings from those of reasonable and high quality
- In any nursery there are always some poor-quality seedlings which would have a low chance of survival if planted out.



1.2. Selection of appropriate seedlings

Selection of appropriate seedlings that are to be transplanted is necessary to improve the success of seedling establishment in the main field.

Selection could be made on the

- bases of health status (disease symptoms)
- level of insect damage (presence of live insects, eggs, or larva)
- length (avoid too long or too short)
- Presence of physical damage (avoid root and stem damage during tending operations).

Self-check 1	Written test

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

1. Define grading in horticultural seedlings?(2 pts)
2. How can you select appropriate seedlings for transplanting? (2 pts)

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Question

Information sheet 2	Storing, handling and transporting planting materials

2.1. Temporary storage place

- Temporary storage place should be prepared in order to avoid instant drying of the seedlings
- It must be free from pests and pathogens;
- It must be accompanied by a note,
- carrying the scientific name of the species,
- place of collection, date of collection,
- Number of seeds/unit weight and whether any treatment has been applied.

2.1. Handling seedlings

Lift the seedlings by holding them at the base of the stem (above the root collar) and move them to temporary storage place and cover them with a wet sisal sack.

2.2. Transporting

- Transport the seedlings to a shade place where they should be stored, until they were moved to the main field.
- Packing of container-raised plants for transport presents few problems. They are put in trays and loaded into vehicles.
- The tins which have been used for seedling trays can be used for transporting container plants.
- Sometimes wooden trays are used, but these are heavy.
- Often, plants are damaged during transport to the planting site.
- Adequate care must be taken to avoid mishandling of plants during loading and unloading from vehicles.
- Plants require protection during transportation, as the air-flow can cause drying.
- It also is important that the containers are packed tightly, so that they cannot move.
- Special shelves for stacking pots or trays can be added to the vehicle platform
- When possible, plants should be transported in the planting season on cool, cloudy, or even rainy days to prevent desiccation during transport.
- Shipping schedules should be planned to avoid delays and to allow proper disposition of the plants immediately upon arrival.
- Normally, plants should arrive one day ahead of planting; where shade and watering facilities are available; supplies can be brought several days in advance.

- As soon as the plants arrive at the planting site, they must be watered and, if necessary, heeled-in a cool, moist, shaded place until they are needed for planting.

Self-Check -2	**Written Test**

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

Define temporary storage place?(2 pts)

1. Write the transporting cares of seedling? (2 pts)
2. Write some characteristics of storage place of seedlings? (2 pts)

Note: **Satisfactory rating – 6 points** **Unsatisfactory - below 6 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Question

Information sheet 3	Safe handling and preparing of Seedlings

3.1. Safe handling during lifting operations

- Two important aspects of harvesting bare root nursery stock are date and method.

Whatever method to use and when to lift the seedlings, we should concentrate on:-

- ❖ Retaining the maximum amount of fibrous roots
- ❖ Avoiding damage to roots and tops and
- ❖ Preventing roots and tops from drying out or overheated.

The severity and amount of damage depends on

- ♦ Soil texture
- ♦ Soil moisture and
- ♦ Lifting method.

It is more difficult to lift in seedling from fine-textured soil than from coarse-textured soil. Soil moisture is important because when soil is moist, soil workability is best.

Hand lifting

Hand lifting is the traditional method for stock lifting.

In hand lifting, shovel is used to loosen and remove seedlings from seedbed. Roots are separated from each other and from soil by gentle shaking. Usually, root damage is kept minimum.

Machine lifting

The main parts of the lifting machine are the undercutting blade and pickup belts. The blade undercut seedlings and belts transport them up for people to grade, count, and pack. Machine works fine on sandy or sandy loam soils. Soil compaction may be a problem using machine lifting

3.2. Bounding seedlings

Bounding is the activity of covering seedlings with covering materials.

Advantage

- ✓ To prevent drying
- ✓ To avoid breakage
- ✓ To protect fungal development

- ✓ Translocation of nutrients

Bounding materials

- Banana leave
- Fiber sack
- Bandage
- Plastics for cuttings
- Seedlings are delicate creatures and require gentle hands when it comes to planting out.
- To remove your seedlings from their original pots, place your fingers around the stem of the plant and turn the pot upside down.
- Pinch the bottom of the pot if possible or tap it gently to encourage the plant to fall out into your hand.
- If the plant won't budge it may have been left in the pot too long and become "pot bound".
- If this is the case don't fret, just get a long dull bread and butter knife and run it around the inside of the pot to dislodge any roots that may have become attached to the pot, then repeat the first step.
- Cat litter trays work really well for this but if you don't have one try using a baking tray. Simply lay the seedlings out into a tray of water and use the buoyancy of the water to take the weight off the root ball.
- Then you can gently prise the seedlings roots apart without tearing them. It's important not to lose a lot of the soil that is around the roots as it contains many of the good bacteria that the plants need to make a safe transition to the garden.
- Seedings don't like being out of the ground for more than 10-15 minutes, so keep the root ball wet at all times and get your babies in the ground as quickly as possible

Self-check -3	Written test

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

1. Write the factor affecting safe handling during lifting operations? (2 pts)
2. Write the difference between hand lifting and machine lifting? (2 pts)

Note: Satisfactory rating - 4 points Unsatisfactory - below 4 points

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

Information sheet 4	Incorporating appropriate drainage

4.1. Drainage

- Drainage of excess soil water is essential to sustainable horticultural crop production on many soils.
- Drainage can improve crop yields, reduce year-to-year yield variability, and provide trafficable conditions for field operations at critical times of planting or harvest.
- Drainage system design and management can impact crop production and have environmental consequences.

Improving drainage of horticultural fields can be achieved by three primary means:

- Installing subsurface, artificial “tile” (perforated pipe) drains at some depth below the soil surface;
- Surface ditching;
- Land shaping (usually used with either ditching or subsurface drainage).

❖ Both the subsurface tile drainage and ditch-type systems function to lower the water table in the soil below the crop’s root zone, while land shaping prevents water ponding on soils with very low infiltration capacity by building a crown or convex surface to direct surface flow from the field.

❖ These practices are usually used in combination; tile lines and/or surface-shaped fields need to drain to a ditch.

❖ Selection of a drainage system depends in part on the drainage problem that exists and the particular soil characteristics causing the problem

Problem soil characteristics Potential solution	**Problem soil characteristics Potential solution**	**Problem soil characteristics Potential solution**
Soil frequently saturated Poorly drained Ditch or tile	Soil frequently saturated Poorly drained Ditch or tile	Soil frequently saturated Poorly drained Ditch or tile
Low infiltration rate Clay or compacted soils Land shaping with ditches	Low infiltration rate Clay or compacted soils Land shaping with ditches	Low infiltration rate Clay or compacted soils Land shaping

		with ditches
Shallow impeding soil layers	Layer of low permeability	Ditches or tile with surface inlets

Table 1. Common drainage problems, the soil characteristics associated with the problem, and the potential drainage solution.

Lowering the water table has several horticultural crop production benefits:

- Drainage removes excess soil water in the root zone, allowing for improved soil aeration. Prolonged exposure to saturated conditions and poor soil aeration can stress the crop, reducing yield.
- Drainage can improve field trafficability, allowing more reliable field access while reducing compaction.
- Drier soils are less susceptible to compaction than wetter soils.
- Drainage enables crops to establish deeper root systems in fields without impeding or compacted layers allowing them greater access to nutrients and soil water.

Self-Check -4	**Written Test**

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

1. What is drainage? (2 pts)
2. Why improving drainage of agricultural fields is important? (2 pts)

Note: **Satisfactory rating - 4 points** **Unsatisfactory - below 4 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Question

Information sheet 5	Planting seedlings

5.1. True Leaves on a plant seedling

- The general rule of thumb is that when a seedling has three to four true leaves, it's large enough to plant out in the garden (after it has been hardened off).
- When you plant a seed, the first leaves to emerge are the cotyledons.
- These leaves will look different from leaves that will grow later.
- The purpose of these leaves is to provide stored food to the seedling for a short period of time. True leaves grow shortly after the cotyledons.
- The true leave emerge and start generating energy through photosynthesis that will help feed the plant for the rest of its life.
- Making sure that the plant has enough of these leaves to keep it sustained when planted out in your garden is important to its proper growth.

5.2. Characteristics of seedlings

- No single characteristic determines seedling quality.
- Seedling quality is a combination of height, diameter, plant nutrition, health, root size and shape.
- Together, these characteristics determine how well the plant will establish itself in the field, and they affect the rate of survival.
- Height alone is often not a good predictor of how a plant will grow in the field.
- A good nursery practice is to judge seedling quality by several traits.
- Many of these traits act together and influence one another.
- The goal of producing the best seedling is to optimize these traits while producing specifically what is needed for a particular site.
- You will need to talk to foresters and farmers to find out the most important desired traits.
- For example, plants for dry, rocky soils may need to be short and be produced in small containers, whereas plants for flooded sites or active pastures may need to be quite large.

5.3. Quality of transplant

- ✓ Transplant quality and size influence plant establishment, initial growth and eventually yield.

Healthy roots

- ✓ Roots of healthy transplants should be white and actively growing.
- ✓ If the plants have been over-watered, injured by excessive soluble salts, infected with disease or stressed in other ways, the color may be tan or brown.
- ✓ Root breakage results in severe transplant shock and plants sit in the field for several weeks before they start to actively grow.
- ✓ This period of sitting extends the time to harvest and defeats the earliness purpose of using transplants.

Healthy green color

- ✓ Look at the leaves and stems of the transplants.
- ✓ The leaves should be green, not chlorotic. Yellowed or chlorotic leaves could indicate the transplants have not been fertilized properly and are suffering nutritionally, likely from nitrogen deficiency.
- ✓ Purple leaves would indicate phosphorous deficiency.
- ✓ Transplants that are nutritionally stressed, especially with limited nitrogen, have long-term reductions in earliness and total yields.
- ✓ Avoid the other extreme of very lush and soft over fertilized plants.
- ✓ They will be subjected to more breakage by the wind and other problems.

Lack of insects and diseases

- ✓ Inspect the foliage for signs and symptoms of insects and diseases.
- ✓ Planting transplants in the field already infested with aphids is planting problem.
- ✓ The leaves should also be free of lesions and spots because they could indicate the presence of disease and you may be planting plants that are already suffering from disease.
- ✓ Also note how many leaves are present.
- ✓ Transplants with few leaves will be slower to establish or develop normally when planted.
- ✓ In tomato, it has been noted that in plants that lost their cotyledons, flowering was delayed by 4 days with one lost and 10 days if both were lost.
- ✓ Once again a 10 day delay could offset the benefits of using transplants for earliness.

Thick stems are an additional desirable characteristic

- ✓ Note the thickness of the plant stems.
- ✓ Plants that are tall and spindly will suffer more from wind breakage.

- ✓ Thick stems on transplants are an indication that they have not been grown too rapidly and that there is a good root to shoot balance of nutrients.
- ✓ Other problems with the stems such as lesions or girdling near the roots can delay field establishment.
- ✓ If purchasing transplants try to determine the age of the plants.
- ✓ If they are so old that they are flowering or have set fruit already then they will probably take longer to establish and will be slower to yield a crop.
- ✓ Be sure to remove fruit from any transplants that are being set in the field to help alleviate delays.
- ✓ Transplants that have been in containers for long enough to become root bound will suffer greater root breakage during planting.
- ✓ As noted earlier, root breakage has been associated with transplant shock.
- ✓ For tomato transplants 6 to 8 weeks is an ideal age.
- ✓ Plants that are 10 weeks or older will still produce fruit but typically produce less than their full potential.

Steps of transplanting process

1. The day before transplanting, water the beds
2. Hold the leaves of the seedlings and insert a dibble underneath the root system to loosen soil.
3. Pull out seedlings gently; immediately put those into water can (make vessels full of water)
4. Water the pots. (To moist the soil ;)
5. Make a hole with a dibble. (Tools made of wood for making holes)
6. Hold the seedlings leaves, and insert root system in.
7. Hold the dibble in a slanting position; insert it in the soil about 1/2 inches away from seedling to the same depth as the whole.
8. Replace the soil, slightly compact it.

Self-Check -5	Written Test

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

1. What are true leaves? (3 pts)
2. Characteristics of seedlings? (2 pts)

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Question

Operation sheet 2	Transplanting of the seedling

Steps for transplanting seedling:

1. Irrigate the seed bed with watering can.
2. Lift the young seedling with the help of transplanting trowel.
3. Remove lower leaves.
4. Keep the seedling under shade and sprinkle water over them.
5. Take the seedling to the planting site for transplanting.
6. Transplant during evening time or on cloudy day.
7. . Plant in a prepared pit after treatment with Bordeaux pest or in a furrow in nursery at proper spacing for raising root stocks.
8. Irrigate after transplanting

A. transplanting of bare rooted seedlings:-

1. Keep the bare rooted plant moist by soaking in mud-solution prepared in bucket.
2. Wrap the plants in banana leaves, plastics, or sisal sacs to keep the roots moist and protect from the sun.
3. Remove some of the soil from previously prepared planting hole.
4. Insert a pole post stake to support the seedling
5. prepared a cane of soil at the bottom o0f the hole.
6. Trim the root system to remove damage or deformed roots.
7. Place the plant spread out the roots in several directions. The root should not be bent or kinked off.
8. Add soil gradually firming as added and water deeply.
9. Put additional soil to firm it and to fill the 2/3 of the hole.
10. Apply commercial fertilizer and water
11. Construct a watering basin around each plant.

B. transplanting ball out seedling:-

1. Remove the ground plant with ball of earth and container grown plant by slitting the sides.
2. Losing the soil below and the sides of ball of earth.
3. Cutting any circling roots
4. Setting the plant in the same depth as they were growing in the nursery or container.
5. Refilling the soil and watering.
6. Constructing basins

LAP Test	Practical demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within 2-3 hours.

Task 2: Transplant the seedling

Information sheet 6	Watering plants and applying post planting treatments

6.1. Post -planting treatments

6.1.1. Basin preparation

- Immediately after transplanting, a basin is prepared around the plants to prevent run-off and to ensure a sufficient supply of water to the plant.
- When using a micro irrigation system, it is recommended to have a basin of approximately 3 m in diameter and 20 to 30 cm deep.
- The basin should have a slight downward slope towards the plant to allow the water to reach the root system of the young plant.

6.1.2. Mulching

- The mulching is done by putting a layer of organic material around the base of the plant. **Mulching of the basin has the following advantages:**
  - Limits water loss from the soil through evaporation;
  - Prevents crust formation;
  - Allows better water penetration into the soil:
  - Limits weed growth around the plant; and
  - Improves the humus content of the soil.

6.1.3. Irrigation

- Immediately after transplanting, the horticultural plants should be irrigated to limit transplant stress.
- Once the plantation is established, a frequent irrigation schedule is to be followed to allow sufficient water supply to the young seedlings.
- The irrigation frequency is soil type dependent, but on very sandy soils it requires daily irrigation.
- During the first six weeks, the plant growers should inspect their plants to verify that the surface soil does not dry and shrink away from the plant.

6.1.4 .Pest control

Pests:

- are any organisms which interfere with human activities.
- They are reducing quality and quantity of crops.

- Includes insects, disease, weeds and vertebrates

Diagnosis of the pest problem

- Correct identification of the pest specifies present in the agro ecosystem is the most important aspect of pest management.
- If identification is incorrect, then the choice of tactic is often wrong.
- Incorrect pest identification may occur when one known species is confused with another known species.
- These types of error can usually be corrected by consultation with expert.

The major steps are as follows

1. The pest species must be correctly identified
2. Determining the pest and crop biological parameters, including pest population size, pest distribution, stage pest development and etc
3. Evaluate the potential damage sustained by the crop relative to the pest density.
4. Review all the tactic that are available to manage the target pest.
5. Consider the possible interactions among the target pest and other pests and beneficial those are present in the agro ecosystem.
6. Finally make decision.

Methods of weed control

Weed can be controlled/eradicated by: -

1. prevention methods

- using clean seeds,
- well decomposed organic matter,
- clear farm land,
- cleaning irrigation channels,
- burning the unwanted materials in the field
- Plant quarantine law.

2. weed control methods

A. Physical (mechanical) methods of weed control

- Hand weeding
- Weeding with hand held implements
- Mechanical tillage
- Mowing or chapping
- Mulching
- Burning
- Shading

B. Biological weed control

- It is host parasite relationship exists between organisms, that limits weed infestation several bio-agents such as insects, herbivores, fish other animals, diseases organisms and even competitive plants.

C. Cultural methods

- Tillage
- Use of crop rotation
- Time of sowing

D. **Chemicals weed control**

- Some weed problems can best be controlled with the use of herbicides.
- Where chemical weed control is used, however, the farmer and extension worker should have a good idea of which specific weeds are present since herbicides do not give broad-spectrum control.

E. Integrated weed management/System approach/

- It is where more than one method of weed control in a coordinate program is considered to most practical approach to weed control.
- Time of sowing + fertilizer (N-fertilizer) higher dose for striga control + pre-emergence herbicide hand weeding at 30-35 days.
- Pre-emergence herbicide + hand weeding at 25-30 days

Control methods of insect and diseases

1. Cultural methods

- Cultural controls such as crop rotation, intercropping, burying crop residues, timing the crop calendar to avoid certain insects and diseases, controlling weeds and natural vegetation that harbor insects and diseases are all effective control methods for some insects and diseases.
- In most cases, however, cultural controls need to be supplemented by other methods.
- Crop varieties vary considerably in their resistance to certain insects and diseases.

2. Organic materials

- "Organic" control refers to non-chemical methods in general, including the application of homemade "natural" sprays made from garlic, pepper, onions, soap, salt, etc. and the use of materials like beer to kill slugs and wood ashes to deter cutworms and other insects.
- Some of these "alternative" insecticides are slightly too fairly effective on small areas like home gardens and where insect populations are relatively low.

3. Mechanical control

- In greenhouse, soil sterilized by heat helps control some plant diseases.
- Use of hot water is also effective in producing clean seed and planting materials.

- Seed and vegetative propagation materials (such as roots, bulbs, corms, and tubers) may be treated before planting to control some fungal, bacterial, and viral diseases.

- In greenhouses and other enclosed growing areas, as well as in areas where food and feed are stored, you may be able to control temperature and humidity to keep pathogens from building up rapidly enough to cause damage.

4. Sanitation

- Sanitation practices help to prevent and suppress some plant diseases by removing the pathogens themselves or their sources of food and shelter.

- Disinfecting equipment and tools

5. Integrated pest management

- Each control measure is not always effective when used alone.

- Ay two or more control measure that is compatible to the farming system and each other are advisable.

6.1.5. Light

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

6.1.6. Fertilizer management

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

Fertilization application depends on

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

6.1.7. Pruning and shaping

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

Advantage of pruning and shaping

- To encourage the development of fibrous root system.
- This kind of root system gives the seedlings the best possible start in plantation.
- Controls depth of root penetration and makes lifting of seedlings easier and less harmful.
- Helps the seedlings to have a balanced root-shoot ratio.
- It also helps the seedling to have an adequate root collar diameter (because of the slowdown of the top growth)

Disadvantage pruning and shaping

- If root pruning is not done, tap-rooted species in pots send their roots down deep into the soil.
- Large part of the root system is cut off during lifting & the seedlings will suffer from a serious shock during planting.

6.1.8. **Staking**

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

Self-Check -6	**Written Test**

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. list the advantage of mulching?(2 pts)

2. Define pests? (2pts)
3. Write and discuss method of pest control on the horticultural crops? (3 pts)

Note: **Satisfactory rating - 7 points** **Unsatisfactory - below 7 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Question

Information sheet 7	**Install Plant support devices**

7.1. Installing plant support devices

- It is important to install plant support device once transplanted from the nursery site.
- Some horticultural crops need supporting device (e.g. tomato).

7.1.1. Shade

Is an over ground construction used to protect seedlings from direct sun light. Where shade is required, they should be planted before the seedlings, preferably during the previous year, so that they are well established before soil is disturbed by planting seedlings. Shade trees can be raised from seed on the plantation or it may be possible to purchase seedlings from a forest nursery.

Advantage of shade

- Protect seedlings from direct sun light
- Adds organic matter to the soil
- Conserves soil moisture

- ❖ Increase leaf area to dry weight ratio
- ❖ Regulates light and temperature
- ❖ Protects erosion
- ❖ Increases yield(more total biomass)\
- ❖ As the wind break

Effect of shade

Shade trees have an effect on light by absorbing a considerable amount of radiation of solar spectrum.

- ✪ Shade trees may **be useful for insects and diseases.**
  - ✹ Mites
  - ✹ Blister blight
  - ✹ Black root
  - ✹ Red spider

  thrive best under shade
- ✪ May **compete for nutrients and sun light**
- ✪ May **cause mechanical damage** when they fall down

Identifying shade construction materials

Shade can be constructed either by planting natural plants or by using mechanical shadings.

Plants used as a shade for seedlings are;

1. Leguminous plants
2. Albizzia species
3. Gravellia Robusta
4. Erithina species
5. Acacia species

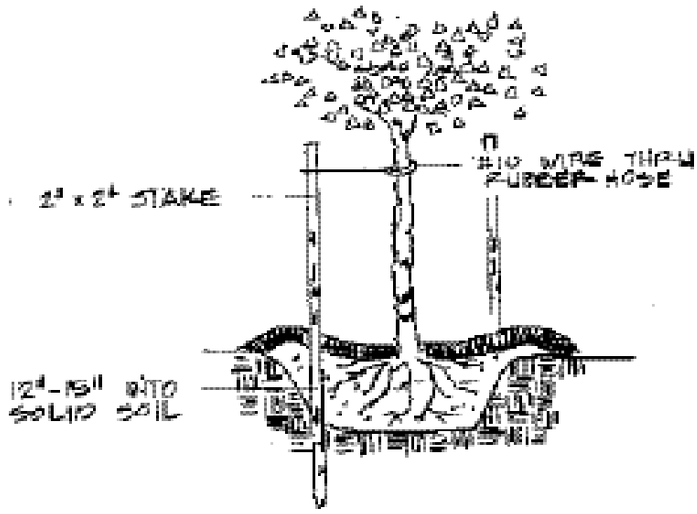
Mechanical shades include;

- ✓ Bamboo screen
- ✓ Bamboo lath
- ✓ Plastic shades
- ✓ Dried grass parts

Inspecting shade

- ➢ Constant checking schedule of shade tress is very important to minimize the cause in seedlings.
- ➢ It should be inspected based on their growth habit (height control), pest and disease resistance, economic life (age supervision), depth of root system or root checking.
- ➢ Relative crown diameter of species and potential rotation of species apart from their mixture of planting should be considered during shade inspection of seedlings.
- ➢ Maintenance of shade trees and manuring of shade trees are the basic inspecting items.

Staking is also vital supportive device.


#10 WIRE THRU RUBBER HOSE
2" x 2" STAKE
12"-15" INTO SOLID SOIL

Self-Check 3	Written Test

Name: _____ Date: _____

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

1. Write the advantage and effects of shade in transplants ?(3 pts)
2. What are mechanical materials used as shade of transplants ?(2 pts)
3. What are the parameters used to inspect shade ?(3 pts)
4. What are the factor used to determine planting depth ?(2 pts)

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

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Question

References

1. Produced by Communications and Marketing, College of Agriculture and Life Sciences, Virginia Tech, 2016.

HORTICULTURAL CROPS PRODUCTION LEVEL II

Learning Guide-51

Unit of Competence: Establish Horticultural crops

Module Title: Establishing Horticultural Crops

LG Code: AGR HCP2 M12 LO5-LG-51

TTLM Code: AGR HCP2 TTLM 1219v1

LO 5: Complete planting/ transplant operations

Instruction Sheet	Learning Guide # 51

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

- Caring after transplanting plant
- Cleaning, maintaining and storing tools and equipment
- Collecting and disposing waste
- Maintaining records of transplanting

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

- Care after transplanting plant
- Clean, maintain and store tools and equipment
- Collect and dispose waste
- Maintain records of transplanting

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described in number 89 to 107.
3. Read the information written in the “Information Sheets 1”. Try to understand what are being discussed. Ask you teacher for assistance if you have hard time understanding them.
4. Accomplish the “Self-check 1**”** in page 97.
5. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. (You are to get the key answer only after you finished answering the Self-check 1).
6. If you earned a satisfactory evaluation proceed to “Information Sheet 2”. However, if your rating is unsatisfactory, see your teacher for further instructions or go back to Learning Activity #1.
7. Submit your accomplished Self-check. This will form part of your training portfolio.

Information sheet 1	Caring after transplanting plant

1.1. Post-planting operations

- Are the series of activities carried out in a farm management system between the period of planting and harvesting.
- They are essential to achieve a reasonable yield

1.2. **Maintain transplanting**

- Maintain soil moisture
- Apply water after planting
- Use furrow irrigation from water source
- Excess/replacement seedlings
- Nutrient needs
- Row covers

Factors determine amount of water

- Climate condition
- Type of soil
- Crop species

1.3. Controlling of weeds and disease

Self-check-1	Written test

Name: _____ **Date:** _____

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

1. Define Post-planting operations? (3 pts)
2. Write all the activities used to maintain transplanting? (2 pts)
3. What is harvesting? (5 pts)

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

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Question

Information sheet 2	Cleaning, maintaining and storing tools and equipment

2.1. Cleaning

- Cleaning is just making farm equipment free of any dusts, soil, seeds, chemicals, etc.
- Try to clean tractors, trucks and other farm equipment as soon as possible.
- Delay will make dirt and silt harder to remove and may cause considerable rusting and corrosion.
- After cleaning farm equipment's should be maintained and stored in a safe place or at their storage place.
- Finally work out comes should be reported.

2.2. Handling materials and equipment

- Handling of material & equipment is all equipment that relates to the movement, storage, control and protection of materials, goods and products throughout the process of manufacturing, distribution, consumption and disposal.
- Handling of material & equipment is used to increase output, control costs, and maximize productivity.
- Storage and handling equipment is a category within the material handling industry. Equipment and tools must be maintained in sanitary condition.
- All the materials and equipment that serves to the field establishment needs required maintenance handling.
- This is essential to save their durability.
- Hence every materials and equipment while completing the required activity should handle by cleaning and sort them in the given store

2.3. Storage equipment

- Used for handling or buffering material over a period of time
- Positioning materials and Equipment
- Equipment used to handle material at a single location so that it is in the correct position for subsequent handling, transporting and storage.
- Prioritization in ordering and poisoning of the equipment's & tagging

2.4. Transport materials and equipment

- Materials & Equipment to move from one location to another.
- The major sub categories of transport equipment are while barrow, conveyors, Cranes and industrial tracks.
- It needs right way of loading and unloading activities, if minor errors happen in this activities, it may lead to great financial crises.

2.5. How to correct use, maintenance and storage of tools, equipment and machinery

- Safe and efficient materials depend on good co-operation and co-ordination between everyone involved including, client, contractors, suppliers and the construction trades.
- Correct handling, application, transport and storage of materials.
- safe posture (sitting, standing, bending and lifting)
- correct manual handling (lifting and transferring)
- hazard identification and risk control
- basic first aid training and access to first aid kits
- procedures to follow in the event of an emergency
- effective communication and teamwork
- fire extinguishers

Self-check1	Written test

Name: _____ **Date:** _____

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

1. What is cleaning? (5 pts)
2. Define storage equipment? (5 pts)

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

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Question

Information sheet 3	Collecting and disposing waste

3. **1 waste disposal**

3.2 .Store or dispose materials

Store

- means materials properly stored when not in use, to prevent damage or loss like;
- Personal protective equipment, fertilizers, Chemicals etc. & other tools & equipments

Dispose

- Set out of wastes.
- Wastes; - Unwanted material produced by human activity, which is usually referred to as garbage

3.3. Waste management

- The proper handling of the things we throw away in manner that does not harm anyone or anything, be it human, animals or the environment.

Proper waste disposal

- During horticultural production the remained discarded or left over product, and the waste should be collect in safe area and bury it in hull. To have save environment it is better to dispose it in safe area.

Proper uses of tools and materials

- You should have knowledge and know how about the material you use, in horticultural production, handling and losses, because if you don't have any knowledge about it causes damage.
- Use properly, and after work finished clean and put it at the right place.

Correct use, maintenance and storage of tools, equipment and machinery

- correct handling, applications, transport and storage of materials
- safe posture (sitting, standing grading, bending and lifting)
- correct manual handling (lifting and transferring)
- correct uses of firefighting equipment
- fire blanket
- hazard identification and risk control
- basic first aid training and access to first aid kits

Self-check3	Written test

Name: _____ **Date:** _____

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

1. Define wastes? (2 pts)
2. What is waste disposal?(1 pts)
3. Write the method of waste management? (2 pts)

Note: Satisfactory rating - 5 points **Unsatisfactory - below 5 points**

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Question

Information sheet 4	Maintain records of transplanting

4.1. Record of transplants

To provide information about the performance, cost and productivity of the seedling as well as to improve planning and operation in the future, a number of records have to be kept. These includes:-

- Worker attendance sheets and payrolls
- Seedling inventers
- Delivery reports
- How many seedlings of each species left in the nursery
- Their quality, date of delivery, who relieved the plants and to which site they were sent
- Plant development records
- How long it takes for species to grow to the right planting size
- Which species need additional fertilizer, more or less watering and shading, special precautions against pest and diseases.
- Nursery inventories.
- How many seedlings of the different species will be avail.

Self-check-4	Written test

Name: _____ **Date:** _____

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

1. Define records? (1pts)
2. list the information that records include?(4 pts)

Note: Satisfactory rating - 5 points **Unsatisfactory - below 5 points**

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Question

References

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Volk, Josh. 2009. Tools That Make Direct Seeding Easier. Growing for Market. www.growingformarket. com/articles/20090428_6

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Profile of trainers participate on special Horticultural Crop Production TTLM development for level II at Adama 2019