HORTICULTURAL CROPS PRODUCTION

Level-II

Learning Guide-26

Unit of Competence: Determine Basic Properties of Soil/Growing Media

Module Title: Determining Basic Properties of Soil/Growing Media

LG Code: AGR HCP2 M07 LO1-LG-26

TTLM Code: AGR HCP2 TTLM 0120v1

LO 1: Collect soil samples for testing

Instruction Sheet	Learning Guide 26

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

- Preparing tools and equipment for collecting soil sampling
- Identifying areas for soil sampling
- Locating services using site plans
- Identifying OHS hazards and controlling measures
- Selecting, using and maintaining PPEs
- Taking and preparing soil samples for analysis
- Labelling and recording soil samples.

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 tools and equipment to collecting soil sampling
- ❖ Identify areas for collect soil sampling
- ❖ Locate services using site plans
- ❖ Identifying OHS hazards and controlling measures
- ❖ Select, use and maintain suitable safety PPEs
- ❖ Take and prepare soil samples
- ❖ Label and record soil samples.

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 to 5.
3. Read the information written in the information “Sheet 1 – 7’’ in page 3,12,15,17,22,26 and 35 respectively.
4. Accomplish the “Self-check 1 – 7.’’ In page 11,14,16,21,25,34 and 37 respectively.
5. If you earned a satisfactory evaluation from the “Self-check” proceed to “Operation Sheet 1 - 2” in page 38 and 39 respectively.
6. Do the “LAP test” in page 40 (if you are ready).

Information Sheet-1	Preparing tools and equipment for collect soil sampling

1.1. Introduction

Soil is the basis for life as it is the foothold for plants on which other lives are dependent.

Soil can be defined in either the following three ways as: -

(a) “The natural medium for the growth of land plants.

(b) A dynamic natural body on the surface of the earth, in which plants grow, composed of mineral and organic materials and living forms.

(c)The collections of natural bodies occupying parts of the earth’s surface that support plants and that have properties due to the integrated effect of climate and living matter acting upon parent material, as conditioned by relief over periods of time.

Soil is the major support systems of plants because it:

- provides anchorage for roots,
- hold water long enough for plants to make use of it, and
- hold nutrients that sustain life.

Soils are home to myriad micro-organisms that accomplish a suite of biochemical transformations from fixing atmospheric nitrogen to the decomposition of organic matter and to armies of microscopic animals as well as the familiar earthworms, ants and termites. In fact, most of the land’s biodiversity lives in the soil, not above ground.

Soil is made up of different material and organisms, including mineral matter, decayed organic matter, water, air, living plants and animals. Together they provide an environment in which plants can grow.

- How is soil formed?

Soil is made up of both weathered rock and organic material. Soil is formed by the weathering of the underlying rock, called the parent rock. When this rock is weathered and broken down, it becomes the parent material from which soil is formed.

Weathering of the parent rock and the formation of soil from the parent materials are influenced by environmental factors, such as the climate and surrounding animal and plant communities.

Climatic factors (such as exposure to the sun, rain and wind) result in the weathering of underlying rocks to produce the minerals found in the soil.

The breakdown of the organic material on the surface of the soil by the living animals and plants produces the organic matter in the soil. This makes up a large bulk of the soil.

- The constituents of soil

The ingredients or substances and materials that make up the soil are called constituents.

The major constituents include:

- mineral matter formed by the breakdown of rocks
- decayed organic matter
- water
- air
- living plants and animals

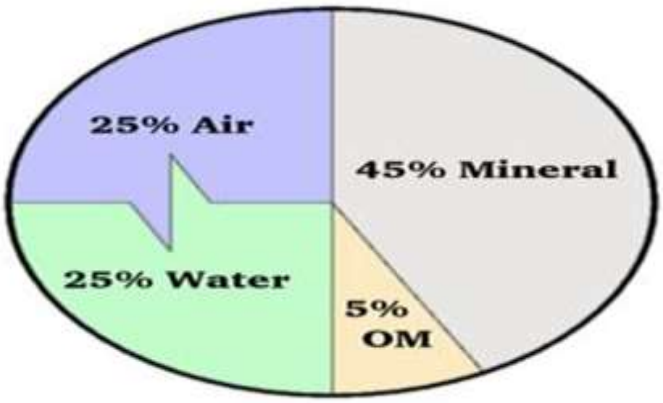


Fig.1 the four components of soil

The proportion varies greatly, e.g. with depth, location, texture, and other factors.

Subsoil has higher percentage of minerals and water and lower content of organic matter and air.

1. Mineral matter: Mineral matter is the inorganic part of the soil and is the end product of the weathering process. Mineral matter generally makes up over 90% of the weight of dry soil and includes sand, silt and clay. This mineral matter provides most of the mineral nutrients that are required for plant growth and is described further below:

2. Sand: Sand particles do not tend to stick together, and this makes soils with high levels of sand easier to dig. Sand does not add much to soil fertility, but it does have an important effect on the ease with which water and plant roots may enter the soil.
3. Silt: Silt is often a rich source of plant nutrients, especially potassium.
4. Clay: is the most important mineral part of the soil. The soil's ability to hold and supply water to plants depends on the type and quality of clay present in the soil.
5. Organic matter: is made up of dead and decaying plants and animals, as well as their by-products. Dead plants and animals, as well as the leaf litter produced by plants and droppings from animals, are left throughout the soil. Soil organisms such as insects, earthworms, fungi and bacteria use these products for food and nutrients. The presence and amount of organic material affects the fertility of the soil.
6. Soil water: Soil has spaces between the solid particles of mineral and organic matter.
   These spaces are called pore spaces. The pore spaces contain water and air.
   The water in the soil containing dissolved nutrients is called the soil solution. Without soil solution, plants cannot live.
7. Air: fills the spaces between the soil particles that are not filled by soil solution. Without air in the soil, plants cannot survive. If the spaces between the soil particles are full of water, the soil becomes waterlogged. This can cause plant roots to die, because they cannot breathe. If there is no air in these spaces, the soil is called anaerobic and it may develop a foul smell. It is important to remember that many small organisms, both plants and animals, live in the soil. These organisms require oxygen to survive and they get this oxygen from the air trapped in the soil spaces.
8. Organisms: The plants and animals living in the soil (called the soil biota, because bio means living) range from small organisms, such as insects and fungi, to organisms that can only be seen under a microscope, such as bacteria. These living organisms are essential to soil fertility. Their main job is to break down organic matter and change it to a form that plants can use. The following diagram shows some of the creatures commonly seen in the soil.
9. Nutrients: If a plant is to grow, it requires nutrients to provide it with energy and material that it will use to increase its size and shape. Plants get their nutrients from the soil. This

is where the roots of the plant are important. Plant roots cannot absorb nutrients in a solid form. Most plants can only absorb nutrients from the soil if the nutrients are dissolved in water.

- ✓ What is growing media?

Often also referred to as “substrate” or “potting soil”, a growing medium is a material, other than soil on the spot, in which plants are grown.

The material that your plants grow in is called the “growing medium or media” never dirt.

Growing media are used by the horticulture industry as well as consumers to support the development of plants.

The growing medium ensures that the plant can healthily grow by providing it with a range of essential elements:

1) supply roots with nutrients, air, and water,

2) allow for maximum root growth, and

3) physically support the plant.

4) Roots grow in the spaces between individual particles of soil.

Growing media are used to grow a wide variety of plants including vegetables, fruits, floriculture ornamentals, tree and shrub ornamentals and speciality plants.

Growing media are often formulated from a blend of different raw materials, usually enriched with fertilizers, lime and sometimes biological additives in order to achieve the correct balance of physical, chemical and biological properties for the plants to be grown. Having the right growing media mix is as important for an optimal plant growth as water and fertilisers.

In sum, the right growing medium provides growing conditions that are predictable and reliable for the grower, contributing to higher yields and more efficient growing.

- ❖ Growing Media constituents

The products supplied by Growing Media Europe members contain the complete range of available growing media constituents. Some of the most important ones include:

1. BARK**:** The tough protective outer sheath of the trunk, branches, and twigs of a tree or woody shrub. Bark is used as the sole constituent in orchid cultivation or as a constituent in potting mixes for tree nurseries and floriculture. Only certain barks are suited as growing media constituents. Bark is also used as a mulching material.

2. CLAY**:** This material is often added in the form of dried granules or as a powder. Clay has a high ability to bind water as well some nutrients. It therefore influences the water characteristics of the growing medium. It can also partly act as a nutrient buffer, making it possible to add more fertilizer without reaching to high salinity levels.
3. COIR PITH**:** Coir is obtained by mechanical processing of the husk of coconuts. This material has good wettability characteristics and is often mixed with other constituents in mixes for sowing, propagating and potting. Sometimes also used as the sole constituent of grow bag mixes in vegetable and flower cultures.
4. COMPOST**:** A material produced from organic waste materials such as tree branches, leaves, grass clippings and plant residues. These residual materials are decomposed by microorganisms under controlled conditions. Plants do not grow in 100 % compost, and the material must be diluted with e.g. peat. use of woody input material for energy production instead of composting.
5. BLACK PEAT**:** Peat is formed when plants such as peat mosses are submerged in water and only partly decomposed due to a lack of oxygen. In some area's peat accumulated over the years in small lakes, growing from the bottom to the top. The lower layers of peat are called "black peat". They are the oldest and most decomposed, characterised by hardly to non-recognizable plant structures and a dark brown to almost black colour.
6. WHITE PEAT**:** This peat is weakly to moderately decomposed and taken from the upper and younger layers of a peatland. It has visible plant structure and a yellowish brown to dark brown colour.
7. PERLITE**:** A material that is manufactured from naturally occurring hydrated volcanic rock (perlite), expanded by heat to form a cellular structure. Usually mixed into growing media in order to improve the flow-ability of a growing media mix, increase the air content and improve the water uptake.
8. RICE HULLS: Are the hard-protecting coverings of grains of rice and are obtained in the rice manufacturing industry. Rice hulls can be added to mixes to improve air capacity. It is a constituent of lower importance.

9. SAND: Are used in growing media to improve the flowability of the mix as well as to add weight where needed. These materials can also improve the water movement in the growing medium to some extent.
10. WOOD FIBRES**:** Fibres that have been obtained by mechanically or mechanically-thermally fraying of un-treated wood and/or wood wastes. Wood fibres are used in mixes for pot plants, trees, shrubs, etc. and used in combination with peat and other constituents.

Choosing the right media will depend on what is available, the type of system you are using and the plants you are growing.

1.2 Identifying tools and equipment for soil sampling

* Material: - is the substance or substances of which a thing is made or composed
* Tools: that hold in your hand and use for making things or repair things
* Equipment: things that are needed for particular purpose or activity

prepare tools and equipment for soil sampling include the following: -

- soil probe
- shovel/spade
- plastic bucket
- sample bags
- waterproof marker
- gloves
- measuring tape
- soil augers
- pH field test kit
- Munsell soil colour charts
- interpreting charts
- String
- Filed note book
- Litmus paper
- Balance
- spatula/knife
- distilled water
- water bottle



Fig: 1.1 tools and equipment needed for soil sampling and testing

Pre - operational checkup and maintenance of tools and equipment

Check all the tools and equipment before use, are all functional and sufficient in number Are all clean of any soil contaminants. During sampling any contaminant soil remaining on the sampling tools can affect the test of the new sample.

- Guideline's while check tools and materials
  - Checked tools and materials properly.
  - Done Effective and efficient inspections
  - Properly maintained Soil auger, bucket, shovel
  - Safe physical conditions with effectively controlled components,
  - Process equipment and materials.

- Safe work steps to check set up machines, start, and finish job or task.

If any faulty tool and equipment is found, maintain it:

- Shovel and spade- stiffen the handle and the head together and clean from soil remains
- Prepare the appropriate number and desired size of the paper bag
- Prepare the appropriate sieve size in diameter.

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 soil? (5pts)
2. List and discuss the importance of soil? (5pts)
3. List tools and equipment use of soil samplings? (5 pts.)

Answer sheet:

1.----------

2.----------

3.----------

Score = _____

Rating: _____

Note: Satisfactory rating – 15 points Unsatisfactory - below 15 points

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

Information Sheet-2	Identifying area for sampling

Identifying the area for sampling

Use either workplace records in your organization or contact your supervisor for instructions on which areas to collect samples from. Before taking any sample the first thing to do is to delineate the area for sampling and know which area the sample represents. It is sometimes important to have topographic and soil survey map of the area to easily point the sampling areas, therefore we need to have a sampling plan.

Learning experiences must address: Appropriate selection of soil/media sampling sites according to supervisors' instructions including:

- representation of soil/media type
- reference to maps
- history of area
- planned future use
- topography
- details of past soil/media test locations
- Paddock identifiers.
- Planted crop
- Fertilizing and management history

- Take samples from area before added
  - Lime
  - Fertilizer
  - Manure

2.1. Making the site plan for soil sampling

The goal of the sampling plan is to determine where and when to collect soil samples that are representative of the field to be fertilized. If soil is submitted from only a few locations that do not represent the entire area to be fertilized, the fertilizer added may be too much or too little for the majority of the area, causing decreased yields, reduced crop quality, or wasted fertilizer. Sampling depth and timing of sampling are critical components of a well-designed sampling plan. The sampling plan may be constructed in the sampler's head, but it may be more objective to sketch out the plan ahead of time. In addition, the actual sampling areas need to be recorded or flagged, to help the producer determine where to fertilize.

☞ Considerations in determining the sampling area:

- ✓ The sample should be truly representing the field/area it belongs to.
- ✓ A field can be treated as a single sampling unit if it is uniform. Generally, an area not exceeding 0.5 ha is taken as one sampling unit.
- ✓ Variations in slope, colour, texture, crop growth, and management practices are the important factors that should be taken in to account for sampling. Separate samples are required from areas differing in these characteristics.
- ✓ Recently fertilized plots, bunds, channels, marshy tracts, and areas near trees, wells, compost piles or other non-representative locations must be carefully avoided during sampling.
- ✓ Larger area may be divided in to appropriate number of smaller homogeneous units for better representations of the field.

Self-Check 2	Written Test

Name: _____ Date: _____

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

1. What is the sampling area? (5pts)
2. Which area is poor sampling area? (5 pts)
3. discuss the considerations during the determination of the sampling area? (5 pts)

Answer

Score = _____

Rating: _____

1.----------

2.----------

3.----------

Note: Satisfactory rating – 15 points Unsatisfactory - below 15 points

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

Information Sheet-3	Locating services using site plans

Locating services using site plans

The sites use for sampling should have the following accessibility of services and locate on the appropriate place:

※If we are establishing a site for sampling especially, the site selected should be near the water supply.

※These should have transport facilities, electricity supply and housing facilities for the workers near the sampling area (if possible).

※These should have telecommunication, gas and irrigation for the workers near the sampling area (if possible).

※These should have storm water and drainage for the workers near the sampling area

Self-Check 3	Written Test

Name: _____ Date: _____

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

1. What is the importance locating service using site plan? (5pts)

Answer

1.----------

Score = _____
Rating: _____

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

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

Information Sheet-4	Identifying OHS Hazards and Controlling Measures

4.1 Definition Occupational health and safety:

is concerned with health and safety of people in its relation to work in the working environment.

- Hazard: the potential source of human injury, anything which might cause injury or ill health to any one at or near the work place. e.g. electricity, chemicals, working up a ladder, noise, a keyboard, a bully at work, stress, etc
- Risk: is the chance high or low that any hazard will actually cause somebody harm.
- Hazard assessment: A first critical step in developing a comprehensive safety and health program is to identify physical and health hazards in the workplace

Occupational health should aim at: -

1. The promotion and maintenance of the highest degree of physical, mental and social well-being of workers in all occupation
2. The prevention amongst workers of departures from health caused by their working conditions.
3. The protection of workers in their employment from risks resulting from factors adverse to health.
4. The placing and maintenance of workers in an occupational environment adapted to his physiological and psychological capabilities and
5. To summarize the adaptation of worker to man and of each man to his job.

4.2 Identifying and controlling OHS hazards

Several hazards can be encountered in the field during sample collection due to different production chain as a result of bad agricultural practices.

Hazards associated with production flow that could be harmful to the worker

There are three main types of hazards associated with workplace:

- ❖ Biological
- ❖ Chemical
- ❖ Physical

➢ Biological hazards

Biological hazards pose risks for many workers in a wide variety of ways. For example, workers in exposure to biological hazards in the work environment can also occur when people are in contact with laboratory cell cultures, soil, clay and plant materials, organic dusts.

- Micro-organisms able to cause human disease may be found on raw produce. Sometimes they are part of the fruit or vegetable micro flora as incidental contaminants from the soil, dust and surroundings. In other instances they get introduced onto the produce through poor production and handling practices, such as the use of untreated manure, the use of contaminated irrigation water or unsanitary handling practices.

➢ Chemical hazards

Chemical contaminants in raw materials, chemicals compounds (pesticides, fertilizers), Heavy metals, powders, dusts and vapours that have the potential to impair health, have adverse effects on human reproduction, cause disease or have explosive, flammable, toxic or corrosive properties.

Harmful chemicals at high levels have been associated with acute toxic responses and with chronic illnesses.

➢ Physical hazards:

- ⌑ Phyical hazards including: plant, stone, falling objects, nois disturbance, machinery, uneven places, unproper handling, jewlery, equipment and items (and parts of them) that have the glass and sharp objects potential to cut, rip, tear, abrade, crush, penetrate, produce projectiles or cause sudden impact.

✓ Basic understanding of risk assessment including:

- Identify hazards
- Assess associated risks
- Strategies to control/eliminate risks.

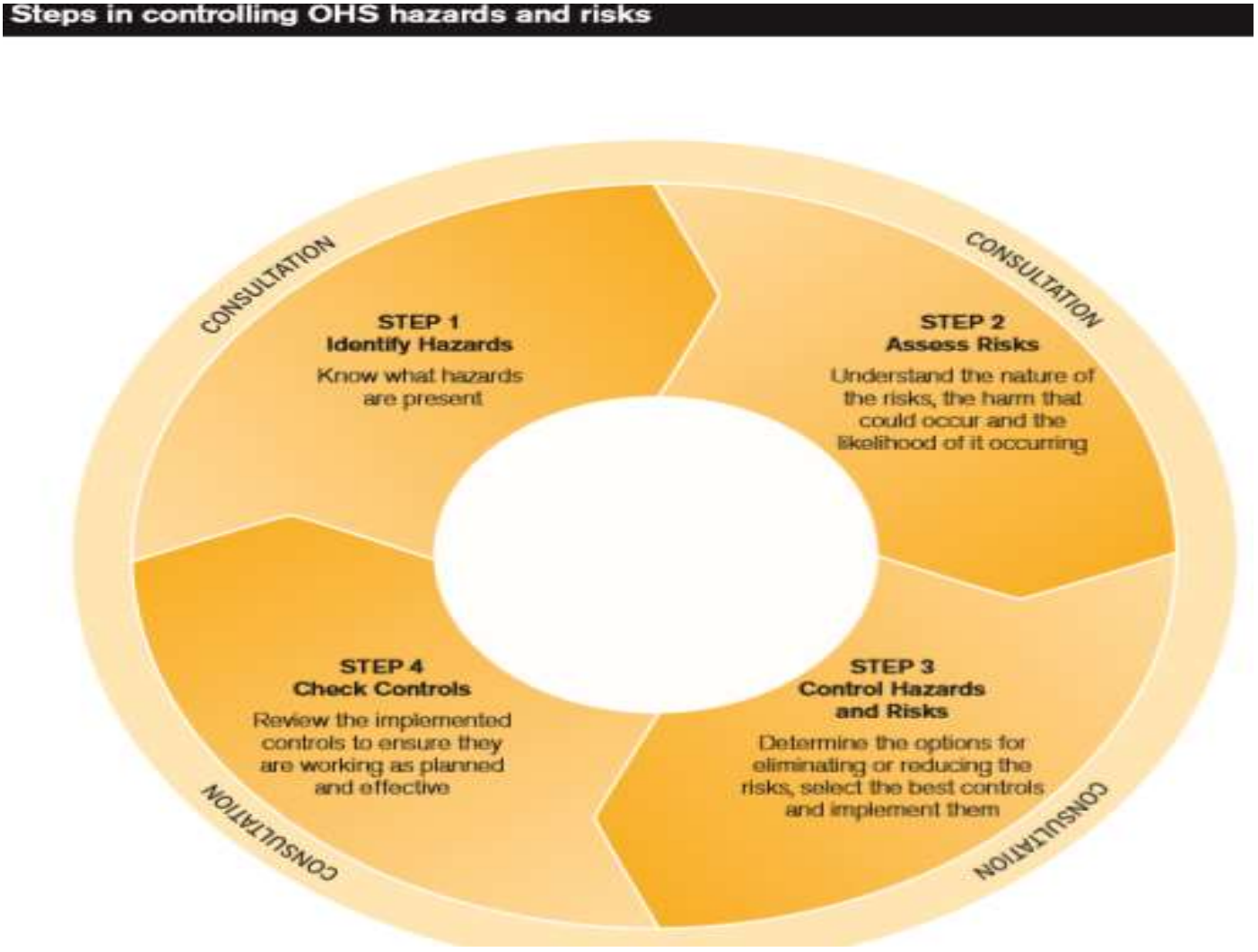


fig.4.2 controlling OHS hazards and risks

✓ An awareness of appropriate OHS strategies including:

- Select, use and maintain appropriate personal protective equipment (PPE)
- Sufficient drinking water
- Basic first aid training

- Access to first aid kit
- Safe work practice and procedure
- Access to appropriate communication device
- Emergency plan
- Safety sign
- Environmental polices
- Cleaning and disinfecting procedure

Self-Check 4	Written Test

Name: _____ Date: _____

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

1. What is occupational health and safety? (3pts)
2. List the aims of occupational health? (2pts)
3. Identify physical, chemical and biological hazards? (5)

Answer Sheet

1. **----------**
2. **----------**
3. **----------**

Score = _____

Rating: _____

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

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

Information Sheet-5	Selecting and using suitable PPEs

5.1 Definition of Personal protective equipment

Personal protective equipment is to include that prescribed under legislation, regulations and enterprise policies and practices. Face masks are available for rubbing back and painting.

5.2. Selecting personal protective clothing and equipment

Suitable personal protective clothing and equipment is selected, used, maintained and stored in accordance with Occupational Health and Safety requirements.

- Consider these factors when selecting PPE:
  - ⇨ Type of hazardous materials, processes, and equipment involved
  - ⇨ Routes of potential exposure (ingestion, inhalation, injection, or dermal contact)
  - ⇨ Correct size for maximum protection
  - ⇨ Minimal interference with movement
- Personal protective clothing and equipment may include:
  - Foot Protection- Boot/Footwear
  - Head protection -hard hat, sun hat and helmet
  - Body Protection- Overalls, Apron
  - Hand Protection - Gloves
  - respirator
  - Face Protection; Face mask
  - Hearing protection- Head phone, Ear plug
  - Eye protection – goggles, safety glasses and face guard
  - Skin protection- sun screen lotion
  - Water proof clothing

Different types of PPE are described below:

Equipment	Pictogram	Principle	Comments
Clothing (overall)		Cover as much of the body as possible, especially the neck, chest and forearms. Use washable fabric overalls.	Under hot conditions beware of perspiration – this can increase the rate of entry into the body
Gloves		Never use leather or cloth materials because they provide a constant source of contamination. Gloves should be unlined for this reason.	
Boots		Never use leather or cloth materials because they provide a constant source of contamination	Wear the trouser leg outside the boots
Head, face and eye protection		Hard hats, washable hats Goggles shields Spray helmets	Important when handling concentrates. Avoid splashes
Respirators		Dust mask for particles and larger droplets. Types of filtration	Use a mask that matches the job to be done. Replace cartridges

		available include mechanical, electrostatic and chemical. Choose the correct type and have the correct cartridge fitted.	regularly and write the date on each cartridge. Ensure there is an adequate fit on the face.

- Maintenance of PPE including:
  - Cleaning and decontamination
  - Correct storage
  - Regular checks for damage
  - Repair/replacement of worn, malfunctioning or damaged equipment/parts
  - Disposal of single-use equipment.
- Checking the PPEs for effective operation
- Inspect PPE prior to use
- Regularly check respiratory devices (every time before and after use)
- Clean/decontaminate all re-useable PPE in detergent and warm water using a soft cloth, then rinsed and dried.
- Avoid using any cleaning agents that are likely to scratch surfaces,
- Kept clean PPE.
- Remove damaged PPE from use
- Store PPE in clean

Self-Check 5	Written Test

Name: _____ Date: _____

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

1. List the factors considering when selecting PPE?(3)
2. List different types of PPE? (3pts)

Answer Sheet:

1.----------

2.----------

Score = _____

Rating: _____

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

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

Information Sheet-6	**Taking and preparing soil samples for analysis**

6.1. Definition of soil sampling

Soil sampling is a method of collecting soil samples in order to make soil amendment/ management program.

Importance of sampling:

Soil tests measure the relative nutrient status of soils and are used as a basis for profitable and environmentally responsible fertilizer application. The accuracy of a soil test result is influenced by the laboratory analysis but may be influenced even more by the quality of the soil sample. Sample collection is extremely important in the accuracy and repeatability of a soil test. Sample handling following collection is also important. A soil sample which does not represent the area being sampled will be misleading and result in over or under-application of fertilizer. It is therefore very important to collect and handle soil samples properly.

- ✓ In general, taking and preparing of soil sampling activities may include:
  - ❖ collecting
  - ❖ preparing
  - ❖ packaging and labelling soil samples for off-site testing and/or on-site testing and
  - ❖ Analysis.

☞ Types soil sampling

Soil sample may take in two ways, according to the kinds of test to be performed, these are:

a) Disturbed sample which do not represent exactly how the soil was in its natural state before sampling.

- Are used for the more simple tests that will be performed and particularly for those tests which you will perform you in the field.

b) Undisturbed sample which represent exactly how the soil was in its natural state before sampling.

- Undisturbed samples are necessary for the more sophisticated tests which must be performed in laboratory for more detailed physical and chemical analyses.

☞ Soil sampling techniques

There are so many different Sampling Strategies to take soil sample from different fields in order to test soils for different purposes. From those strategies the commons are using random sampling, diagonal or zigzag, W or X sampling methods are usual.

- Composite Random Sampling: Soil sampling as a basis for fertilization recommendations has traditionally used composite random. This strategy is the random collection of representative samples throughout the field, with areas of variability within the field avoided or sampled separately for other specific project objectives. In composite sampling, surface litter is removed, and subsamples collected and placed in a clean container and thoroughly mixed into one uniform (composite) sample.

- Diagonal and Zigzag Sampling: While composite random sampling is considered the ideal strategy. other strategies for uniform fields include the collection of eight subsamples per hectare in a diagonal pattern for one composite sample. Additional schemes range from 5 to 25 subsamples per composite sample, with sample units varying from 2 to 8 ha.

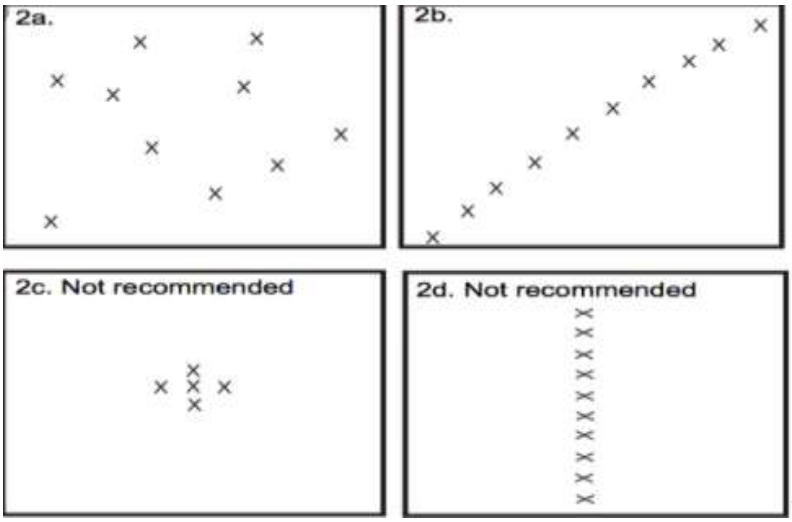


fig.6.1 sampling method

Considerations included in soil sampling:

- Before sampling, study the history of the area,
- The sample must truly represent the field it belongs to.
- Afield can be treated as a single sampling unit if the area is less than 0.5 ha
- Collect soil samples (15-20) from each transect at least every 2-3 years.
- Collect separate samples from fields that differ in colour, slope, drainage, past management practices like liming, gypsum application, fertilization, cropping system *etc*.
- Soil samples should be randomly selected avoiding fence lines, waterlines and animal matter.
- Collecting the soil sample for each distinct soil area you are sampling, take 5 to 10 subsamples and mix them together to obtain the final sample.
- Take the subsamples by selecting spots in a pattern that ensures a balanced representation of the whole area sampled.
- Use clean tools to sample soil, a clean container to mix it, and clean bags to store it. Small amounts of contaminants, especially fertilizer or lime, can distort the analysis results.

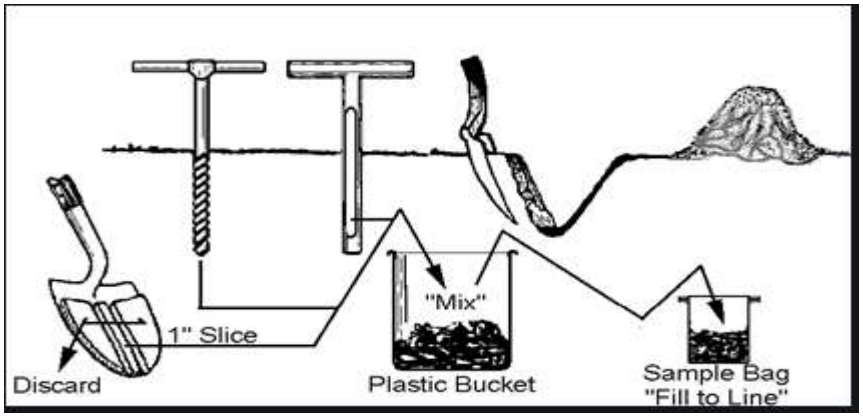
Do not sample from: -

- Back furrows or dead furrows
- Old fence rows
- Areas used for manure or hay storage and livestock feeding, and
- Areas where lime has been piled in the past.
- within 2-3 months following fertilizer application.
- Recently fertilized plots or fields must be avoided carefully
- Don’t sample spots that look atypical of the area being sampled.

Type’s crop in relation to their root depth must be checked before sampling the soil of that farm i.e. sampling depth depend on root depth of a given crops as.

- For cereals, vegetables and other seasonal crops, the sample should be drawn from 0 -15cm
- For deep rooted crops taken up to 30cm depth based on individual situation
- For plantation crops the sample must be drawn from 0-30, 30 -60 and 60-90cm
- For saline and alkaline soils, the sample must be drawn up to 15 cm depth

☞ Collecting and preparing soil sample



✓ Guidelines for sampling depth

S.No.	Crop	Soil sampling depth	
		Inches	cm
1	Grasses and grasslands	2	5
2	Rice, finger millet, groundnut, pearl millet, small millets *etc*.(shallow rooted crops)	6	15
3	Cotton, sugarcane, banana, tapioca, vegetables *etc*. (deep rooted crops)	9	22
4	Perennial crops, plantations and orchard crops	at 12, 24 and 36 inches	at 30, 60 and 90 cm

Why collect soil samples?

You may want to start an orchard or vegetable garden and want to be sure that you are choosing the right spot. Soils can look the same from place to place but there are many differences that cannot be detected without performing some routine tests. By taking soil

samples and testing them in a variety of ways you can find out how healthy your soil is, how you can improve it and what plants will grow well in it.

Collecting the soil sample For each distinct soil area you are sampling, take 5 to 10 subsamples and mix them together to obtain the final sample. Take the subsamples by selecting spots in a pattern that ensures a balanced representation of the whole area sampled

- When collect to soil sample
  - Analysing information and record review.
  - Develop sampling plan to identify number of sample needed
  - preformed collection location and analysis
  - Report sampling to test.
  - Received result and analysis
- Steps in collecting soil sample for analysis

1. Prepare materials need for taking soil sample.
2. Sample the area using appropriate way of sampling.
3. Clear the area for sampling
   - Remove or scrape away stones, rubbish or trash from the surface to expose the soil before sampling.
   - Soil samples should be collected away from fences, roads, building sites, straw or manure piles, and other abnormal occurrences in the field.
4. Push the soil sampler into appropriate depth
5. Get sample soil using spade, auger , trowel
6. Mix samples thoroughly representative sample of the plot
7. Air dries the sample. Here's how to do it:

☞ Spread soil sample on top paper board preferably on coarse

- Spreading thinly
- Remove bits of materials such as stone, shell, wood, root

- Dry the soil sample
- Let stay the sample to dry for 3-5 days and inspect whether the sample have already dried.

To spread up the drying process , break the sample into small pieces

8. Label and pack the sample into plastic bag.

✓ It should have a label with the following information:

- Date of collection
- Name of collector
- Name of the area
- Depth of pit
- Purpose of take soil sample

9. Bring or send the sample to the laboratory
   - Place the dried soil in a labelled plastic bag
   - Pack the soil samples properly before sending to a laboratory for analysis

6.2. Sample Preparation for analysis

After all cores for an individual sample are collected: -

- Placed in the bucket,
- Dry the sample,
- Crush the soil material,
- Discard any plant residues and other materials if present
- Sieve with 2mm diameter sieve and mix the sample thoroughly.

For certain types of analysis grind the soil further so as to pass through 0.2 -0.5mm sieves.

- Remix the sieved sample before analysis.
- Allow the sample to air dry in an open space free from contamination.
- Do not dry the sample in an oven or at an abnormally high temperature. When dry, fill the sample container with the soil.
- Break up clods while a sample is moist and spread out to air dry in a clean area**.**

6.3. Procedures Prepare soil sampling materials

- Divide your farm according to the kind of crops grown or to be grown, type of soil (sandy, clayey or loamy) and topography (level, flat, sloping or hilly).
- Collect soil samples separately from the different soil unit areas and place them in separate containers.
- Brush away stone, rubbish, trash or grass on the surface of the land.
- Using the shovel, push it down the surface or topsoil to a depth of approximately 15 cm and get a slice of soil sample and Place this in a container.
- Get similar samples at random from as many as 10 sites and mix them in a container.
- Get a composite soil sample of about 1 kilo to represent the soil unit area.

To do the soil sampling activity you will go to field and choose a non- cropped field of about 1hectar.

✓ Apply a systematic sampling technique:

Step1 prepare your tools and equipment that are needed for soil sampling

Step2. make the sampling plan in the chosen field of about one hectare

i. Is there any variability on the field in terms of slope, soil color, depth and texture?
ii. Consider also any other variability such as cropping history, fertilizer application

Step3. Following the variability, you observed divide the one-hectare field in to homogenous sampling units

Step4 taking one sampling unit area for one group, then locate the sampling points on you sampling unit.

iii. Choose a large distance/interval to locate the sampling points as your area is approaching to homogeneity
iv. In your group, if you approximately get about 0.25ha plot, then locate your sampling points in 15meter intervals (Systematic sampling) or use other method

Step5. Using the auger take at least 9 samples (or your own sample numbers) from the located points

v. Put the soil sample you take in paper bag first and
vi. Then composite the nine paper bag samples in to one clean bucket

Step6. _Finally take your composite sample to laboratory for preparation.

Composite soil/average soil = A collection /mixture of individual samples.

- ✓ Sampling techniques for collecting representative soil/media including:
  - Combining multiple cores to make a bulk sample
  - Cores taken from a representative area
  - Cores taken from across the representative area
  - Cores taken at constant depth.
- ✓ Procedures for handling soil/media samples Off- site analysis including:
  - Cores from one sample are bulked together into sealed bags
  - Store in appropriate storage
  - Accurate labelling.
- ✓ Procedures for handling soil/media samples On- site analysis including:
  - Cores from one sample are bulked together
  - Crushing bulked sample is into smaller particles and mixing
  - Sub-sample analysed by testing.

Self-Check 6	Written Test

Name: _____ Date: _____

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

1. What is composite sample?(3)
2. List soil sampling methods? (4)

Answer

1.----------

2.----------

Score = _____

Rating: _____

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

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

Information Sheet-7	Labeling/recording soil sample

7.1. Labeling information

When taking soil samples, it is important to keep clear records of what you do for number of reasons:

- You may be carrying out tests on number of different soil samples in an area.
- You may be carrying out some tests in the field while further tests will require special equipment and need to be carried out off-site under laboratory conditions.
- Soil samples may be stored over long periods as part of a monitoring program for your land.
- In each of these cases there may be more than one person handling the soil samples.
- To avoid confusion, it is important to make sure that the correct information is attached to each sample.
- It is also a good idea to standardize your recording technique so that it is easier to compare results from different samples.

7.2. Labelling and recording samples

Each container should be marked clearly with the following information requirements for labelling soil/media sample include:

- sampling date and location
- Details about person collecting the sample/Name of collector
- Depth of sample
- Description of soil type and surrounding vegetation
- Topography of sampling site (geographical district)
- Soil parent material
- History of area sampled e.g. last season crop, soil amendments etc.

- A record-keeping system doesn't need to be complicated, although some systems are:
  - ✓ Information should be organized by date or time, because every observation will have a time associated with it.
  - ✓ A paper-based record-keeping system can be just as useful.
  - ✓ A soil sampler should try to keep track of the following information from observation to observation. This is not an exhaustive list, nor is it necessary to record all of these items for every observation.
  - ✓ Generally, with more information available, better sampling decisions can be made.

Self-Check 7	Written Test

Name: _____ Date: _____

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

1. List the requirements included in labelling soil sample?(5pts)
2. Discus what are the importance of labelling? (5pts.)

Answer

1.----------

Score = _____

Rating: _____

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

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

Operation Sheet - 1	Soil sampling
Objective:	To take sample and prepare for test to determine soil fertility status
Materials required	✓ Sampling auger, spade or shovel ✓ Clean bucket ✓ Sample bags ✓ Strings ✓ Labels ✓ Field note
Procedure	✓ Site selection ✓ observe field for variations in soil color, texture, topography, drainage ✓ lay outing the field ✓ decide the sampling depth depends on the crop to be grown ✓ Prepare a sketch map of the field showing different sampling unit ✓ clean litter from the surface and expose the soil ✓ Push and take the soil from the sampling unit using auger or spade ✓ Place the soil in a clean bucket ✓ Remove roots and stones, which will not be part of the analysis ✓ Mix well the samples with hand to set the composite sample ✓ Weigh and labelling the composite soil for required KG
Precautions:	Do not take the top 5 cm soil Do not use galvanized or rubber buckets, as they will contaminate the samples
Quality criteria	Samples should be labeled in a clean plastic bag

Operation Sheet - 2	Soil sample preparation
Objective:	To know how to prepare soil sample for test or analysis
Materials required	✓ Sampling auger, spade or shovel ✓ Clean plastic sheet/sacks ✓ Sample bags/ buckets ✓ Labels ✓ Field note
Procedure	○ Placed sample in the bucket ○ Dry the sample ○ Crush the soil material ○ Discard any plant residues and other materials if present ○ Sieve with 2mm diameter sieve and mix the sample thoroughly. ○ For certain types of analysis grind the soil further so as to pass through 0.2 -0.5mm sieves. ○ Remix the sieved sample before analysis. ○ Allow the sample to air dry in an open space free from contamination. ○ When dry, fill the sample container with the soil.
Precautions:	Do not dry the sample in an oven or at an abnormally high temperature.
Quality criteria	Samples should be dry in a clean area.

LAP Test	Practical Demonstration
NAME_____	DATE_____
TIME STARTED_____	TIME FINISHED_____

INSTRUCTION

Instructions: Given necessary information, work site, tools and materials you are required to perform the following tasks within 4:30 hour.

Task 1: perform soil sampling

Task 2: sample preparation

Reference

https://www.controls-group.com/eng/soil-testing-equipment/

http://www.cglrc.cgiar.org/iita/soilSampling/9._Sampling_Tools_and_Sample_Preparation.htm

https://www.globalgilson.com/soil-testing-equipment

https://www.mfe.govt.nz/publications/environmental-reporting/3-preparing-fieldwork-and-soil-sampling

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https://www.westernsydney.edu.au/__data/assets/pdf_file/0020/12917/12917_Hazard_Identification,_Risk_Assessment_and_control_Procedure.pdf

HORTICULTURAL CROPS PRODUCTION

Level-II

Learning Guide-27

Unit of Competence: Determine Basic Properties of Soil/Growing Media

Module Title: Determining Basic Properties of Soil/Growing Media

LG Code: AGR HCP2 M07 LO2-LG-27

TTLM Code: AGR HCP2 TTLM 0120v1

LO2: Perform basic soil/media test

Instruction Sheet	Learning Guide 27

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

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

- Determining soil profiles
- Testing soil physical properties
- Testing soil chemical properties
- Recording results.

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 –

- Determine Soil profile.
- Test soil physical properties
- Test soil chemical properties
- Records results

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the information “Sheet 1- 4” in page 43,47,57 and 65 respectively.
4. Accomplish the “Self-check 1- 4’’ in page 46,56,64 and 66 respectively and proceed to operation sheet -1 in page 67.
5. Do the “LAP test” in page 67(if you are ready).

Information Sheet-1	Determining soil profiles

1.1. Definition of soil profile

Soil profile: is a vertical cross section through the soil in the field.

Soil horizon**:** is the layer of soil and process of forming first kind of soil profile.

A vertical section exposing a set of horizons in the wall of soil pit is termed as soil profile. Road cuts and other ready-made excavation can expose soil profile and several windows to the soil. In an excavation open for some time, horizons are often covered by soil material that has been washed by rain from upper horizons to cover the exposed face of lower horizons. To represent an individual soil, profile, the pit has to be wide enough to show lateral variation and deep enough the underlining the unconsolidated or consolidate layers that influence the behavior of the soil.

Soil profile shows layers approximately parallel to the soil surfaces, soil horizons. The subdivision of layers of soil develop due to soil forming processes (weathering) are called soil horizons (it is designated as O, A, E, B, and C system i.e. the five master soil horizons).

1.2. Soil profile description

The soil profile description/sampling point should be located as close as possible to the station.

- The purpose of the soil profile description is to:
    - Characterize the properties of each soil horizon classify the soil profile
    - Group classification for later analysis of soil type
    - Collect data required for soil structure and erode ability assessments
    - Collect samples for laboratory analyses to determine other soil parameters
    - Comply with soil survey sampling standards.

O – Horizons: The O - group is comprised of organic horizons that generally form above the mineral soil or occur in organic soil profile. The derived from dead plant and animal residues.

O - horizons found only in forest areas and are communally referred to as forest floor.

A – Horizons: The topmost mineral horizons generally contain enough partly decomposed (humified) organic matter to give the soil a color darker than that of the lower horizons.

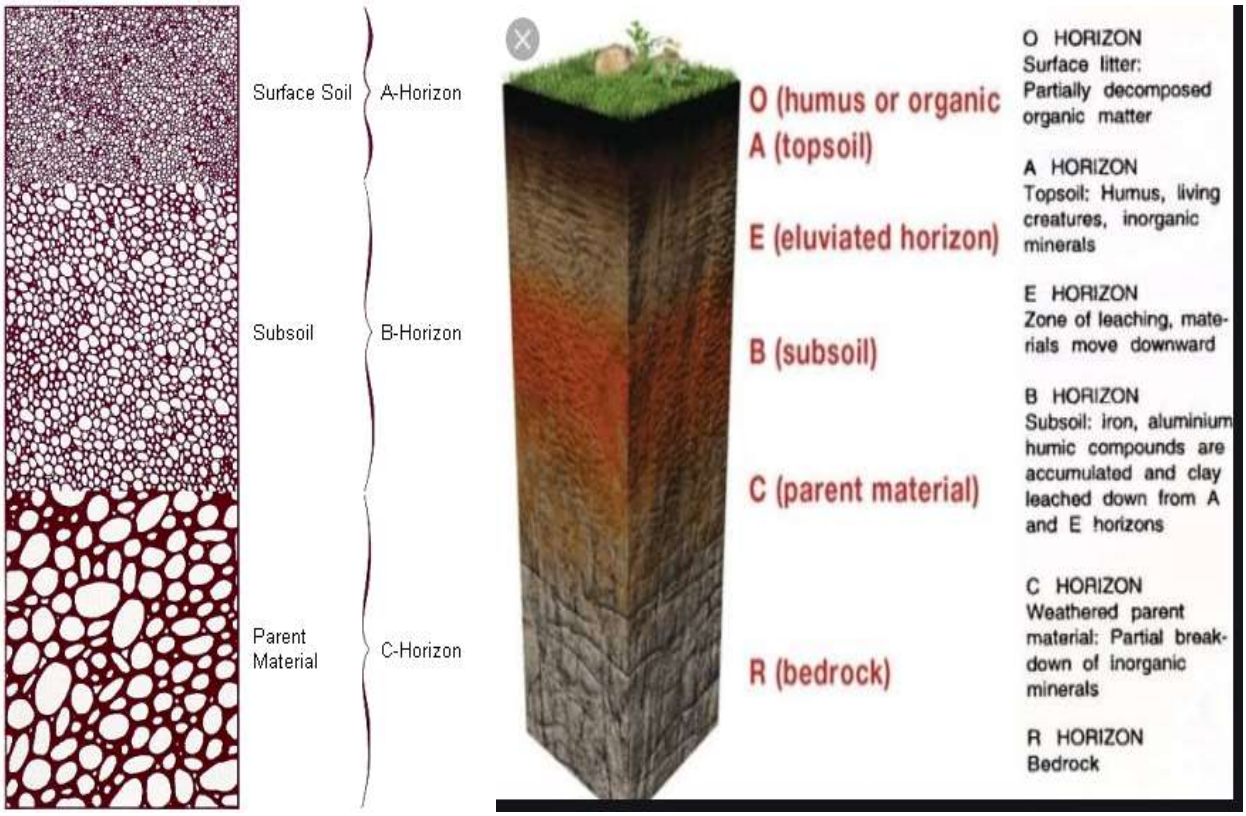
This horizon is coarser in texture.

E – Horizons: These are zones of maximum leaching or elevation of clay iron and aluminum oxides, which leaves a concentration of resistance materials. These horizons found underneath of A horizons and generally lighter in color.

B – Horizons: These horizons develop or found below O, A or E horizons and have undergone sufficient changes during soil formation processes (soil genesis). In humid regions, B - horizons are the layers of maximum accumulation of materials like iron and aluminum oxides and silicate clays in which some of them illuviated from the upper horizons and others formed in a place.

C – Horizons: It their un-consolidated material underlying the soil (A and B horizons). It may or may not be the same as the parent material from which the soil formed.

R – Horizon: Referred to consolidated bed rock. It cannot dig it with a shovel or backhoe



1.1 Figure showing soil profile/horizons

Self-Check 1	Written Test

Name: _____ Date: _____

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

1. What is soil profile?(3)
2. List five master soil horizons?(5)

Answer

1.----------

2.----------

Score = _____

Rating: _____

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

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

Information Sheet-2	Test soil physical property

2.1 Soil sampling/soil test

Soil tests measure the relative nutrient status of soils and are used as a basis for profitable and environmentally responsible fertilizer application.

Sample collection is extremely important in the accuracy and repeatability of a soil test. Misleading soil sample area can be result in over or under-application of fertilizer. Properly collect and handle soil samples are important to avoid over or under fertilizer application.

The general sampling instructions for sampling field soils for fertility assessment purpose involve collecting a composite sample from a given area.

The purpose of taking can make the composite sample ranging from 5 to 25. If each boring contributes equally to the composite sample, the analytical result provides an estimate of the mean fertility level of the area. The accuracy with which the mean value represents the area sampled depends on the range of fertility in the area and the number of auguring drawn for the composite.

Soil is characterized by its physical, chemical, biological and mineralogical properties. The focus of this topic is based on the physical and chemical property of the soil.

2.2. Physical property of the soil

Physical property of the soil refers to the function and management of soil in an ecosystem in determining the successes or failure of agriculture crop production based on the soil texture, Structure, Consistence &Color. Soils are porous and open bodies, yet they retain water. They contain mineral particles of many shapes and sizes and organic material which is colloidal (particles so small they remain suspended in water) in character. The solid particles lay in contact one with the other, but they are seldom packed as closely together as possible.

Permeability (the rate at which water moves through the soil) and Water-Holding Capacity (WHC; the ability of a soils micro pores to hold water for plant use) of the soil is affected by

- The amount, size and arrangement of pores
- Macro pores control a soil's permeability and aeration
- Micro pores are responsible for a soil's WHC Porosity is in turn affected by
    - Soil texture
    - Soil structure
    - Compaction
    - Organic matter

A. SOIL TEXTURE:

Soil texture refers to the proportion of the soil "separates" that make up the mineral component of soil. These separates are called sand, silt, and clay. It is important in determining the water-holding capacity of soil:

- Fine-textured soils hold more water than coarse-textured soils but may not be ideal
- Medium-textured soils (loam family) are most suitable for plant growth.

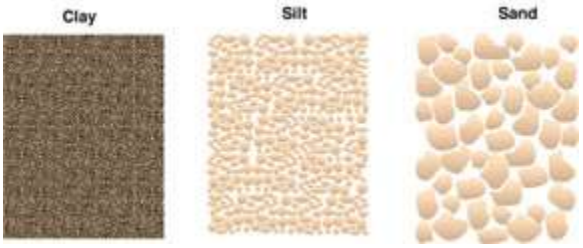
These soil separates have the following size ranges:

- Sand = <2 to 0.05 mm
- Silt = 0.05 to 0.002 mm
- Clay = <0.002 mm

Therefore, the texture of soils is usually expressed in terms of the percentages of sand, silt, and clay.

Sand and silt are the "inactive" part of the soil matrix, because they do not contribute to a soil's ability to retain soil water or nutrients. These separates are commonly comprised of quartz or some other inactive mineral.

Because of its small size and sheet-like structure, clay has a large amount of surface area per unit mass, and its surface charge attracts ions and water. Because of this, clay is the “active” portion of the soil matrix.



☞ Some characteristics soil texture

- Sands are:

- the largest particles and feel gritty
- rapid permeability ana large pores
- high infiltration rate and low WHC
- poor store house of plant nutrients
  - contain low organic matter.

- Silts are:

- medium-sized and feel soft
- Medium permeability & WHC
- Silky and Floury- powder fell when dry and is only moderately plastic and sticky when wet

- Clays are:

- the smallest sized particles
- feel sticky and are hard to squeeze.
- High water holding capacity and Low infiltration and Porosity

Relative size perspective: Sand > Silt > Clay

For all mineral soils, the proportion of sand, silt, and clay always adds up to 100 percent. These percentages are grouped into soil texture “classes”, which have been organized into a “textural triangle”.

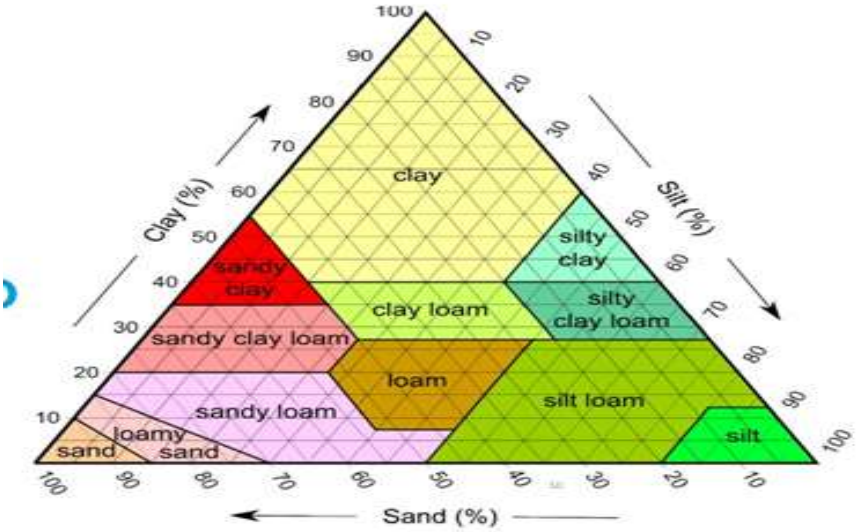


Fig.2.2 soil textural triangle

NB: - Soil containing equal amount of sand, silt and clay is called “loam”. sand + clay +silt = Loam 33% 33% 33% For ex. 15 % clay, 20% silt and 65% sand is called “sandy loam

☞ There are different methods to determine the soil sample’s textural class:

Method 1: Rapid Feel method

- ❖ Graininess test: Rub the soil between your fingers. If sand is present, it feels “grainy”. Determine if the sand constitutes more or less than 50%.
- ❖ Moist cast test: Compress some moist soil by clenching it in your hand. If the soil holds together, toss it from hand to hand. The more durable it is, the more clay is present.
- ❖ Stickiness test: Moisten the soil thoroughly and compress it between thumb and forefinger. Determine degree of stickiness by noting how strongly the soil adheres to the thumb and forefinger when pressure is released, and how much it stretches. Stickiness increases with clay content.
- ❖ Worm test: Roll some moist soil between the palms of your hand to form the longest and thinnest worm possible. The longer, thinner and more durable worm contains more clay.

- Taste test: Work a small amount of moist soil between your front teeth. Silt particles are distinguished as fine grittiness, sand is distinguished as individual grains and clay has no grittiness.
- Soapiness test: Work a small amount of wet soil between your thumb and fingers. Silt feels slick and not too sticky (=clay) or grainy (=sand). The slicker it feels, the higher the silt content. Generally, we can say that sand feels gritty, silt feels smooth and silky and clay feels sticky.

Method 2: On Field Test

A field test is carried out in the following way:

- a small soil sample is taken and water is added to the sample.
- Place the soil in your palm and knead it to break up aggregates
- Place a ball of soil between your thumb and forefinger.
- Push the ball with your thumb, squeezing it upwards into a ribbon.
- Allow the ribbon to emerge and extend over the forefinger. It should break from its own weight.
- saturate a small pinch of soil in palm and rub with forefinger.

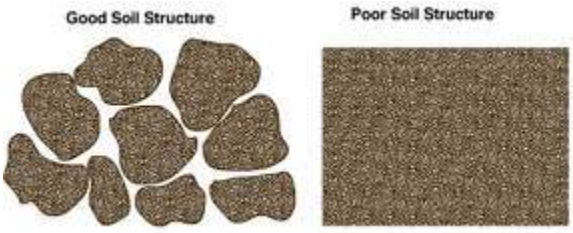
Data analysis

- If the soil does not remain in a ball when squeezed the soil is sand
- If the soil remains in ball when squeezed continue with the formation of ribbon. If the soil does not form a ribbon the soil has Loamy – Sand texture
- If the ribbon is less than 2.5 cm long before breaking and feels gritty, the texture class is
    - Sandy – Loam
- If the ribbon is less than 2.5 cm long before breaking and feels smooth, the soil is
    - Silt – Loam
- if the ribbon is less than 2.5 cm long before breaking and does not feel gritty and smooth, the texture is a Loam

- If the ribbon is 2.5-5.0 cm long before breaking and feels very gritty the texture class is Sandy – Clay – Loam
- If the ribbon is 2.5-5.0 cm long before breaking and feels smooth the soil is a Silty – Clay – Loam
- If the ribbon is 2.5-5.0 cm long before breaking and does not feel gritty and smooth, the texture is a Clay - Loam
- If the ribbon is strong, equal or more than 5.0 cm long before breaking and feels gritty, the texture class is Sandy – Clay
- If the ribbon is strong, equal or more than 5.0 cm long before breaking and feels smooth, the soil is a Silty – Clay
- If the ribbon is strong, equal or more than 5.0 cm long before breaking and does not feel gritty and smooth, the texture is a Clay

B. SOIL STRUCTURE

The soil separates can become aggregated together into discrete structural units called “peds”. These peds are arranged into a repeating pattern that is referred to as soil structure. Between the peds are cracks called “pores” through which soil air and water are conducted. Soil structure is most commonly described in terms of the shape of the individual peds that occur within a soil horizon.



☞ Properties of soil particle size.

Characteristics	Sand	Silt	Clay
Porosity	Mostly large pores	Small pores predominate	Small pores predominate

Permeability	Rapid	low to moderate	Slow
Water holding capacity	Limited	Medium	very large
Soil particle surface	Small	Medium	very large

C. Bulk Density

Bulk density is the proportion of the weight of a soil relative to its volume. It is expressed as a unit of weight per volume, and is commonly measured in units of grams per cubic centimeters (g/cc).

Bulk density is an indicator of the amount of pore space available within individual soil horizons, as it is inversely proportional to pore space:

Pore space = 1 – bulk density/particle density

D. Consistence

Consistence is a description of a soil's physical condition at various moisture contents as evidenced by the behavior of the soil to mechanical stress or manipulation. Descriptive adjectives such as hard, loose, friable, firm, plastic, and sticky are used for consistence. Soil consistence is of fundamental importance to the engineer who must move the material or compact it efficiently.

The consistence of a soil is determined to a large extent by the texture of the soil but is related also to other properties such as content of organic matter and type of clay minerals.

E. Color

The color of soils can be determined by minor components. Generally, moist soils are darker than dry ones and the organic component also makes soils darker. Thus, surface soils tend to be darker than sub-soils. Red and yellow hues are indicative of good drainage and aeration, critical for activity of aerobic organisms in soils. Gray hues

indicate poor aeration. Soil color charts have been developed for the quantitative evaluation of colors.

The first test that we have to make is to register the color of the soil. This process does not require any sophisticated technique. It is usually described from the Munsell color chart.

For our purposes, the simple identification of the main color of the soil is sufficient notice that wet soil looks darker than when it is dry.

Step 1: Take some soil ped from each soil horizon

Step 2: Break the ped

Step 3: Check the color of the ped according to the Munsell color chart. If the ped shows more than one type of color, indicate the dominant and the sub-dominant color. Key to use the Munsell

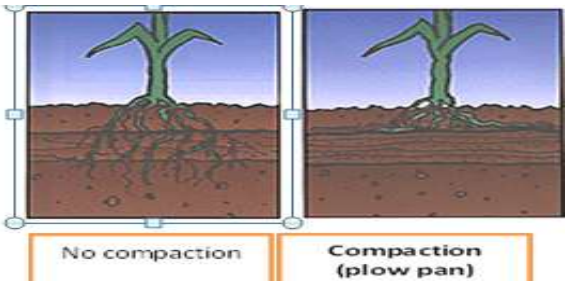
Data analysis: Soil can be categorized in six groups according to the color and tone of the sample. Brown to Dark Black, Black for surface horizon, Dark Grey to Bluish, White to Grey, Dark Red and Yellow to Reddish.

- Colors indication
  - Brown to black color: Result of organic matter or dark parent material. It gives faint chalky smell.
  - White to light grey*:* results when organic matter leached down of sandy soils and E-horizons. It caused by accumulation of lime, gypsum and other light materials.
  - Yellow to Red: results from an iron oxide that includes some water (limonite), i.e. slightly less well drained
  - Bluish grey*:* results from autoxidized iron, indicates lack of oxygen

F. Permeability- refers to the movement of air and water within the soil

- Permeability is the rate at which water moves through the soil) and Water-Holding Capacity (WHC; the ability of a soils micro pores to hold water for plant use)

G. Soil compaction: - Soil compaction restricts rooting depth, which reduces the uptake of water and nutrients by plants.



H. Porosity: is the percentage of soil volume occupied by pore space.

* Pore space of a soil is the space occupied by air and water between particles in a given volume of soil responsible for better plant growth
  - Sandy soil -low pore space
  - Clay soil - high pore space
  - Organic matter- increases the pore space

 Porosity depends up on

  - Texture
  - Structure
  - Compactness
  - Organic content of the soil

 As porosity Increase

  - Increase percentage organic matter in soil.
  - decreases as the soil particles
  - decrease in pore spaces
  - decreases with depth of the soil

I. Infiltration- is the downward entry of water into the immediate surface of the soil
  - Soils with a high infiltration rate are resistant to erosion because there is little runoff.

J. Water Holding Capacity- The capacity of soils to hold water available for use by most plants.

K. Depth- is an important consideration when evaluating a soil for a particular land use.

Self-Check 2	Written Test

Name: _____ Date: _____

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

1. List the physical characteristics of the soils?(3)
2. List classification of the soil based on soil textures gives?(3)
3. Define Soil porosity?(3)

Answer

Score = _____

Rating: _____

1.----------

2.----------

3.----------

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

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

Information Sheet-3	Test soil chemical property

3.1. Chemical property of soil

Chemical property of soil deals with the nature of colloids (organic and inorganic). It mainly focuses on the mineral and chemical composition, charges, and exchange of ions, salinity, and alkalinity and acidity of soil (PH). It is important from the point of view of nutrient availability for agricultural crops or plants.

The most important chemical characteristics of a soil are:

- its content of essential nutrients and their availability to plants;
- the cation exchange capacity;
- the buffering capacity(the ability of a soil to resist change in PH of the soil solution if acid or base is added)
- acidity or alkalinity; and salinity
- Content of inorganic and organic colloids (humus).

Perhaps the state of oxidation or reduction of the soil should be mentioned; this is ordinarily not of major importance but may be if a waterlogged or poorly drained soil is under consideration.

Soil Reaction (pH): by definition, “pH” is a measure of the active hydrogen ion (H+) concentration. It is an indication of the acidity or alkalinity of a soil, and also known as “soil reaction”.

The pH scale ranges from 0 to 14, with values below 7.0 acidic, and values above 7.0 alkaline. A pH value of 7 is considered neutral, where H+ and OH- are equal, both at a concentration of 10-7 moles/liter. A pH of 4.0 is ten times more acidic than a pH of 5.0.

The most important effect of pH in the soil is on ion solubility, which in turn affects microbial and plant growth. A pH range of 6.0 to 6.8 is ideal for most crops because it coincides with optimum solubility of the most important plant nutrients. Some minor elements (e.g., iron) and most heavy metals are more soluble at lower pH. This makes pH management important in controlling movement of heavy metals (and potential groundwater contamination) in soil.

In acid soils, hydrogen and aluminum are the dominant exchangeable cations. The latter is soluble under acid conditions, and its reactivity with water (hydrolysis) produces hydrogen

ions. Calcium and magnesium are basic cations; as their amounts increase, the relative amount of acidic cations will decrease.

- **Soil pH and plant growth -** Most plants grow well from 5.5 to 8.5
  - Strongly acidic soils undesirable – develop toxic levels of Al & Mn, microbe activity greatly reduce
  - Strongly alkaline soils have low micronutrient availability, P may be deficient
  - Affects the activity of soil microorganisms, thus affecting nutrient cycling and disease risk

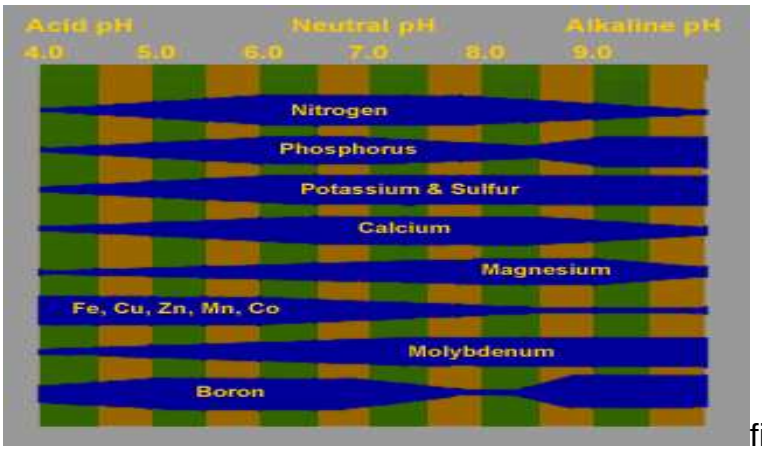


fig.PH with relation to plant growth

Soil pH Test

Method 1: pH Test

Soil pH analysis test uses the pH scale numerical system to measure the acidity or alkalinity of the soil.

- After filling the test tube with an indicator solution,
- Add some soil sample to the indicator.
- Cap the tube and gently mix the soil and indicator solution for 1 minute.
- After 10 minutes of waiting, match the colour of the solution with pH Colour Chart.

Data analysis

The color chart indicates the pH numeric value of the sample. It is not indicated by decimal values. According to obtained color, the soil sample belongs to one of the three main groups: alkaline, neutral or acidic. The Neutral point is 7.0 and the neutral range is between 6.0 and 8.0 (With other pH test methods, which are able to indicate decimal values, this range would

be considerably less). pH value less than 7.0 are considered acidic and values higher than 7.0 are considered to be an alkaline.

Method 2: pH in soil-water suspension (pH meter method)

The pH may be determined in soil water suspension of varying ratios but the results should be expressed along with the ratio adopted. Conveniently, the suspension is prepared in 1:2 or 1:2.5 ratio.

1. Take 10 g of soil sample in 50 or 100 ml beaker.
2. Add 20 or 25 ml of distilled water, stir well for about five minutes and keep for half an hour.
3. Again stir just before immersing the electrodes and take the pH meter reading.

Soil salinity- is a Potential problem in irrigated soils due to high evaporation rates and low annual rainfall leaving salts to accumulate.

- Salts
  - Come from irrigation water, fertilizers, composts, and manure.
  - Leached by slowly applying excess water.
- Soil Salinity and Interpretation
  a. Conductivity 4 or above; Severe accumulation of salts. May restrict growth of many vegetables and ornamentals.
  b. Conductivity 2 or 4; Moderate accumulation of salts. Will not restrict plant growth, but may require more frequent irrigation.
  c. Conductivity less than 2: Low salt accumulation. Will not affect plants.

Cation-Exchange Capacity- is a measure of the ability of a soil to hold and exchange cations.

- Cation Exchange Capacity;
  - Is the ability of a soil to absorb and release cations
  - Closely related to soil fertility
  - Is part of plant nutrient cations are part of CEC include Ca, Mg, K, NH3
  - Is positively charged Ion.: Ca2+, Mg2+, K +, NH4 +, Zn2+, Cu2+, and Mn2+.
  - Nutrients adsorb in the soil solution on the surface of clay and organic matter.
  - Is a measure of the quantity of cations that can be adsorbed and held by a soil?
- CEC depend up on amount of;-
  - Organic matter
  - Clay in soils and

- Types of clay.

☞ In general, the higher OM and clay content, the higher the CEC

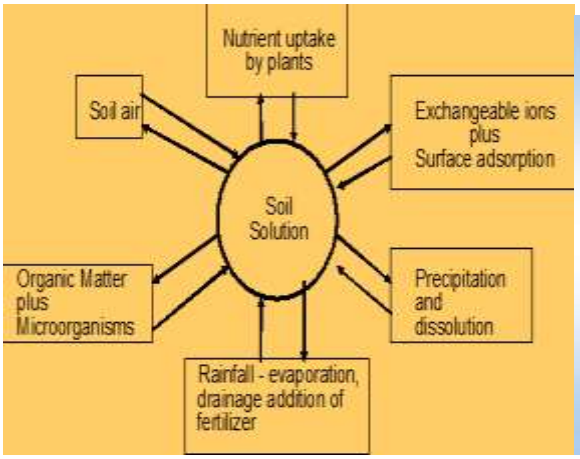
Soil Organic Matter - Beneficial impacts of SOM on soil properties:

- Physical - stabilizes soil structure, improves water holding characteristics, lowers bulk density, dark color may alter thermal properties
- Chemical - higher CEC, acts as a pH buffer, ties up metals, interacts with xenobiotic
- Biological - supplies energy and body-building constituents for soil organisms, increases microbial populations and their activities, source and sink for nutrients, ecosystem resilience, affects soil enzymes. Microorganisms are the driving force for nutrient release to plants.

C: N (carbon to nitrogen) ratios

- Low C:N ratios (<25:1) are indicative of mineralization and rapid rates of decomposition
- High C:N ratios (>25:1) indicate immobilization and slower decomposition rates
- Low C:N material (high nitrogen value)- Undiluted manure and blood meal, grass clippings (can get high), vegetable wastes
- Intermediate C:N materials- Most composts, leaf mulches, cover crop residues
- High C:N materials- saw, bark, wood chip, sawdust, paper, cornstalk, foliage

❖ **Basic Soil-Plant Relationships**



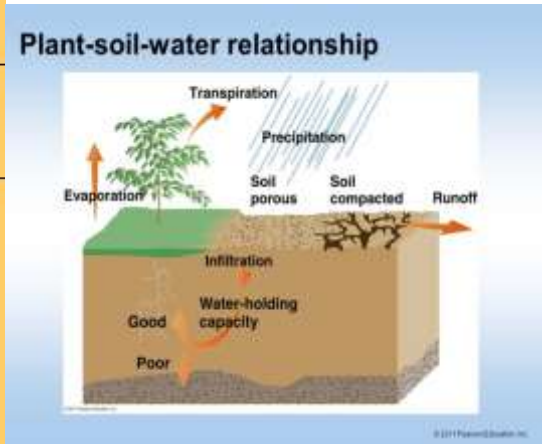


Fig.3.1 shows soil plant relationship

3.2. Apply techniques to ameliorate the soil

Definition: Soil amelioration is the process of modifying soils to provide what the native or existing soils do not naturally provide. The amelioration required can vary depending upon the existing soil and the traits of the soil that require alteration, be it improving the drainage of

a heavy clay soil, increasing the nutrient holding capacity of a highly sandy soil or repelling the negative effects of a saline soil near the coast with the application of calcium.

☞ **Considerations before amelioration**

To decide what is required prior to modifying a soil there are a number of steps that need to be considered. Initially, the palette of plants needs to be decided upon as each species of plant prefers certain soil conditions, of which an experienced and qualified horticulturalist will be aware. Secondly, the soil where the landscape will be planted should be inspected and basic information such as whether the soil is clay, loam or sand based can be determined, as can the moisture holding ability of the soil. The climatic conditions of the planting site as well as the irrigation source should be understood thoroughly and preferably soil and water tests performed.

Soil amending materials influence plant growth favourable by:-

- Improving physical conditions of the soil
- Increase nutrient availability
- Improving physical conditions of the soil

☞ **How to ameliorate the soils**

The process of soil amelioration varies from site to site, and plant to plant. It is however almost always beneficial to ameliorate the soils in some way. The major ameliorations performed are:

- Pre-plant fertilization – either an organic or slow release elemental form placed into the planting hole or pot.
- Soil structure modification – the addition of a peat type product to a sandy soil to increase moisture and nutrient holding abilities or the addition of sand or gravel to a highly clay soil to improve drainage and pore spaces to the root zone.
- Soil importation – where the site to be planted does not have suitable soil and a prepared and suitable soil is imported to the site.

Pre-plant fertilizer

Prior to planting provides a unique opportunity to apply nutrients directly to the rootzone of the plant. For this reason pre-plant fertilizer is usually spread directly into the excavated hole or pot to be planted. When applying pre-plant fertilizer care should be taken to provide

nutrients in a controlled manner, which release at the rate that the plant can uptake. This is vital as excessive fertilizer can have potentially fatal results for the plant.

Fully composted organic nutrient sources are preferred as they take longer to break down and are slowly released to the plant over a period of time. Recently “Controlled Release” elemental fertilizers are also being manufactured which can also be used very successfully where available. Depending upon soil test results, gypsum or other sources of calcium are also sometimes applied directly into the soils prior to planting.

Soil structure modification

This process is basically limitless depending upon the climatic conditions and usage of the area to be planted and the requirements of the plant. Generally in Asia, a significant annual rainfall is present and one of the major modifications required is to increase the drainage of a soil to remove sitting water and the potential for root-rot or similar. This process is usually performed by the addition of a sand or gravel product, along with sub-surface drainage if required, to allow both sufficient water holding capacity for the root zone and the free-draining of the moisture through the soil profile.

The opposite is true on naturally sandy soils, however, where the soil can be amended with a clay, peat or zeolite product to increase the soils natural nutrient and moisture holding abilities.

❖ **Techniques Soil ameliorating**

1. Amelioration of acid soils :- Increasing/raising the soil pH

a. Organic amelioration: Animal manure; Farm yard manure; Compost; Ash; Organic matter or clay-rich subsoil- allows water to reach the plant root; Use of deep tillage

b. Inorganic amelioration: Limestone (CaCo3); Carbonate; Oxides or hydroxides of Ca and Mg Compounds

- Limestone (CaCo3): - raises soil pH, reducing acidity

2. Amending alkaline soils:- Decreasing/lowering the soil pH

a. Organic amelioration: Animal manure; Farm yard manure; Compost; Organic matter or clay-rich subsoil- allows water to reach the plant root; Use of deep tillage

b. Inorganic amelioration: Gypsum (CaSO4.2H2O); Sulphur; Pyrite; Dolomite(CaMg (CO3)2; Vermiculite

- Gypsum (CaSO4.2H2O):Decreasing/lowering the soil pH; improves aeration of compacted soil; helping it drain more efficiently; releases nutrients and improves structure
- Sulphur: lowers soil pH, increasing acidity

Self-Check 3	Written Test

Name: _____ Date: _____

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

1. List the chemical characteristics of the soils?(3pts)
2. Describe soil amelioration?(3pts)
3. Define soil pH?(3pts)
4. List the soil amelioration techniques. (6pts)

Answer

Score = _____

Rating: _____

1.----------

2.----------

3.----------

Note: Satisfactory rating – 15 points Unsatisfactory - below 15 points

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

Information Sheet-4	Record result

- Recording soil/media testing results including:
  - Sampling location and details
  - Soil profile description
  - Physical analysis results
  - Chemical test results
  - Test results from off-site soil analysis
  - Test analysis interpretation
  - Management history

Self-Check 4	Written Test

Name: _____ Date: _____

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

1. List the points including in recording?. (5pts)

Answer

1.----------

Score = _____

Rating: _____

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

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

Operation Sheet - 1	PH test
Objective:	To know the learner how to test PH on field
Materials required	Pen, exercise book, phone, distilled water. Litmus paper, paper strips, glass, color chart, soil
Procedure	1. Prepare tools and equipment 2. Mix soil with water stir thoroughly 3. Insert paper strip and wait for two minutes 4. Remove paper strip from the water and compare with color chart 5. Record the PH value and interpret the result
Precautions:	• follow the properly procedure
Quality criteria	Trainees will be evaluating soil PH after this operation

LAP Test	Practical Demonstration

NAME_____ DATE_____

TIME STARTED_____ TIME FINISHED_____

INSTRUCTION

Instructions: Given necessary templates, workshop, tools and materials you are required to perform the following tasks within 1 hour.

Task 1: test soil PH in field

Reference:

https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/soil-profiles

https://casfs.ucsc.edu/about/publications/Teaching-Organic-Farming/PDF-downloads/2.1-soilphysical.pdf

https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/soil-chemical-properties

www.rhd.gov.bd/Documents/ConvDocs/Standard Test Procedures.pdf

http://www.rhd.gov.bd/Documents/ConvDocs/Standard%20Test%20Procedures.pdf

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