Natural Resources Conservation and Development

Level – III

Based on March 2018, Version3 Occupational standards (OS).

Module Title: Implementing of Soil Health and Plant Nutrition Practices

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LG #70	Lo # 1- Determine relevant site and soil characteristics

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

- Defining goals and target site for assessment and development of program
- Accessing and reviewing relevant climate data, environmental context
- Determining soil, plant and water tests
- Developing soil, plant and water tests program
- Implementing and monitoring testing tasks
- Compilying and presenting data and readings
- Determining seasonal variations and requirements
- Characteristics, condition and nutritional status of soils and plant species

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

- Define goals and target site for assessment and development of program
- Access and reviewing relevant climate data, environmental context
- Determine soil, plant and water tests
- Develop soil, plant and water tests program
- Implement and monitor testing tasks
- Compily and present data and readings
- Determine seasonal variations and requirements
- Characterize, condition and nutritional status of soils and plant species

Learning Instructions:
1. Read the specific objectives of this Learning Guide. 2. Follow the instructions described below. 3. Read the information written in the "Information Sheets". Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them. 4. Accomplish the "Self-checks" which are placed following all information sheets. 5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks). 6. If you earned a satisfactory evaluation proceed to "Operation sheets 7. Perform "the Learning activity performance test" which is placed following "Operation sheets" , 8. If your performance is satisfactory proceed to the next learning guide, 9. If your performance is unsatisfactory, see your trainer for further instructions or go back to "Operation sheets".

Information Sheet 1- Defining goals and target site for assessment and development of program

1.1. Introduction

Soil health is defined as, the capacity of a specific kind of soil to function, within natural or managed ecosystem boundaries, to sustain plant and animal productivity, maintain or enhance water and air quality, and support human health and habitation. Relationships of soil microorganisms formed by intimate associations with plants and animals strongly suggest that they are major contributors to soil health. There is a current awareness that the quality of human health based on proper nutrition is provided by healthy foods grown in soils under sustainable farming practices that minimize the use of synthetic fertilizers and pesticides. Soil quality is the capacity of a specific kind of soil to function within natural or managed ecosystem boundaries to:

- sustain plant and animal productivity
- maintain or enhance water and air quality
- support human health and habitation

Characteristics, such as texture, mineralogy, etc., are innate soil properties determined by the factors of soil formation climate, topography, vegetation, parent material, and time. Collectively, these properties determine the inherent quality of a soil. They help compare one soil to another and evaluate soils for specific uses. Map unit descriptions in soil survey reports are based on differences in the inherent properties of soils. Soil quality assessments are thus used to evaluate the effects of management on the health of the soil. The guidelines provide information for performing the most typical soil quality assessments, which include:

- Comparing the effects of different management systems on soil quality between two or more fields with similar soil map units (soil types).
- Monitoring trends in one or more fields over time to determine the impact of management on soil quality and to identify soil resource problems

1.2. Determine objective and assessing soil health

Soil health assessment is a growing field of research in which the functions and complexities of soil, a vital natural resource on Earth, are quantified so that the overall health of the soil can be managed for longevity and sustainability, both for agricultural and environmental needs such as carbon sequestration. While momentum is building behind the concept of soil health as a major driver of improved global food security and climate change mitigation, it is still unclear how we can accurately measure the health of soil for the sake of economic, political, and agriculturally applicable reasons. Goals and target site for assessment and development of program are defined following a review of enterprise production plan and in consultation with landholder. This is the second step to take soil health development and plant nutrition program because after you defined the goals and target site for the assessment and development you can undertake the next process.

For example your goals may be to achieve appropriate soil conditions and hence depending on this you have to assess the area where to be developed based on the problems of soil health around there. Since different producers will have different goals for a soil quality evaluation, ask them to clearly state what they hope to achieve. Some producers may be seeking assistance to improve overall soil quality, because they recognize the direct impact this will have on the profitability and health of the operation. Other producers may have recognized soil quality degradation in specific fields and request assistance only in those fields. Some may require assistance in troubleshooting small problem areas.

Generally, their goals will fall into one of the following areas:

- Improve soil quality.
- Maintain soil quality.
- Stop or reverse soil quality degradation.
- Troubleshoot problem areas.

Results of comparisons of different management systems in different fields or in problem areas can often be obtained quickly. A few sets of measurements from each field or area can often provide important insight into the direct effects of management. Results of evaluations of new practices or information about long-term trends will not be available immediately. Explain to the producer that the first set of results provides baseline values that are specific to that farming system. Subsequent evaluations later in the season and in following years will be necessary to reach definite conclusions about the trends and levels of soil quality. Methods of soil quality assessment a variety of methods or approaches are currently used to measure and assess soil quality.

They are as follows:

- Soil Health Card
- Natural resource conservation Soil Health Card Template
- Soil Quality Test Kit
- Laboratory analysis.

These methods provide important information about soil quality, whether the goal is to determine changes in soil health over time or to compare management effects on soil quality in different fields or pastures. Various combinations of these methodologies may be used. No single one is inherently better or more effective.

1.3. Soil Quality Assessment Checklist format

Step	Summary	Done
1.Identify Problems and Opportunities	Contact farmer. Identify general resource problems, opportunities, and concerns. Collect information on general needs of farmer. Consult Conservation District long-range plans, soil maps, other resources.	
2.Determine Objectives: Assessing Soil Quality Goals	Define producers objectives for soil quality. Identify whether producer wants to improve or maintain soil quality or to troubleshoot problem or low productivity areas.	
3.Inventory Resources: Assessing Soil Quality	Collect background information. Determine which methods/indicators best meet the needs of the producer.	
4. Analyze Resource Data: Evaluating and Integrating Results	Look for patterns and trends in results. Compare results from different methods.	
5.Formulate alternatives	Formulate alternatives to meet the farmerís goals, address natural resource problems, and improve or protect resource conditions.	
6.Evaluate Alternatives	Consider side effects of alternatives, including ecological, natural resource, social, cultural, and economic impacts; size of farm; type of operation; and resource availability.	
7. Make Decisions	Help producer with final decision. Work together to sketch out a timeline for implementation. Prepare necessary documentation.	
8.Implement the Plan	Provide technical assistance. Apply relevant practices in the conservation plan. Supply technical support.	
9.Evaluate the Plan: Following Up	Make plans for follow-up evaluations and visits.	

Soil Quality Assessment Field Record

Instructions: Photocopy form for use in the field to record relevant information during soil Quality assessment.

General information			Date
Map location	State	Country	
Geographic location	Longitude	Latitude	
Field or site location		Field name /ID	
Land owner	Address		Phone
1.identify problem and opportunity			
Problem		General goal	
2. objective Specific goal			

Self-check 1	Written test

Name………………………………………… ID………………………… Date…….

Directions: Answer all the questions listed below.

Test I: Choose the best answer (5 point)

1. The second step to take soil health development and plant nutrition program?

A. Identify problem B. Determine goal C. A & B

2. Identify whether producer wants to improve or maintain soil quality or to troubleshoot problem or low productivity areas.

A. Determine goal B. Identify problem C. All

Test II: Short Answer Questions

1. What is soil health (5)

____

____

2. Soil quality is the capacity of a specific kind of soil to function within natural or managed ecosystem boundaries to: (10 point)

____

____

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

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

Answer Sheet

Score = ___________

Rating: ____________

Name: _________________________ Date: _______________

2.1. Introduction

Plant growth and geographic distribution are greatly affected by the environment. If any environmental factor is less than ideal, it limits a plant's growth and/or distribution. For example, only plants adapted to limited amounts of water can live in deserts. Either directly or indirectly, most plant problems are caused by environmental stress. In some cases, poor environmental conditions (e.g., too little water) damage a plant directly. In other cases, environmental stress weakens a plant and makes it more susceptible to disease or insect attack. Environmental factors that affect plant growth include light, temperature, water, humidity, and nutrition. It is important to understand how these factors affect plant growth and development. Several factors can directly or indirectly affect the nutritional quality of crops. Among these are soil factors, such as pH, available nutrients, texture, organic matter content and soil-water relationships; weather and climatic factors, including temperature, rainfall and light intensity; the crop and cultivar; postharvest handling and storage; and fertilizer applications and cultural practices. These factors are grouped in three basic categories known as technological (agricultural practices, managerial decision, etc.), biological (diseases, insects, pests, weeds) and environmental (climatic condition, soil fertility, topography, water quality, etc.). These factors account for yield differences from one region to another worldwide.

2.2. Environmental factors

The environmental factors can be classified into abiotic and biotic constraints. Actually, these factors are more intensified with global warming which leads to climate change. Abiotic stresses adversely affect growth, productivity and trigger a series of morphological, physiological, biochemical and molecular changes in plants. The abiotic constraints include soil properties (soil components, pH, physicochemical and biological properties), and climatic stresses (drought, cold, flood, heat stress, etc.). On the other hand, biotic factors include beneficial organisms (pollinators, decomposers and natural enemies), pests (arthropods, pathogens, weeds, vertebrate pests) and anthropogenic evolution.

2.2.1. Climate variability

Variations in annual rainfall, average temperature, global increase of atmospheric CO_2, and fluctuations in sea levels are some of the major manifestations of climate change, which negatively impact crop yields. Temperature and rainfall changes are expected to significantly have negative impact on wide range of agricultural activities for the next few decades. With the changing of climate, agriculture faces increasing problems with extreme weather events leading to considerable yield losses of crops. Most often, crop plants are sensitive to stresses since they were mostly selected for high yield, and not for stress tolerance. Climate change is the result of global warming. It has devastating effects on plant growth and crop yield which can affects directly, indirectly, and socio-economically reduce crop yields by up to 70%. Weather variations present positive and negative effects in the environment with very high expression of negative effects.

2.2.1.1. Temperature: Temperature influences most plant processes, including photosynthesis, transpiration, respiration, germination, and flowering. As temperature increases (up to a point), photosynthesis, transpiration, and respiration increase. When combined with day-length, temperature also affects the change from vegetative (leafy) to reproductive (flowering) growth. Depending on the situation and the specific plant, the effect of temperature can either speed up or slow down this transition. Low temperatures reduce energy use and increase sugar storage. Thus, leaving crops such as ripe winter squash on the vine during cool, fall nights increases their sweetness. Adverse temperatures, however, cause stunted growth and poor-quality vegetables. For example, high temperatures cause bitter lettuce.

2.2.1.2. Rainfall: Most growing plants contain about 90 percent water. Water plays many roles in plants. It is:

- A primary component in photosynthesis and respiration
- Responsible for turgor pressure in cells (Like air in an inflated balloon, water is responsible for the fullness and firmness of plant tissue. Turgor is needed to maintain cell shape and ensure cell growth.)
- A solvent for minerals and carbohydrates moving through the plant
- Responsible for cooling leaves as it evaporates from leaf tissue during transpiration

- A regulator of stomata opening and closing, thus controlling transpiration and, to some degree, photosynthesis
- The source of pressure to move roots through the soil
- The medium in which most biochemical reactions take place

2.2.1.3. Humidity- Is the ratio of water vapor in the air to the amount of water the air could hold at the current temperature and pressure. Warm air can hold more water vapor than cold air. Relative humidity (RH) is expressed by the following equation:

RH = water in air ÷ water air could hold (at constant temperature and pressure) Relative humidity is given as a percent. For example, if a pound of air at 75°F could hold 4 grams of water vapor, and there are only 3 grams of water in the air, then the relative humidity (RH) is: 3 ÷ 4 = 0.75 = 75% Water vapor moves from an area of high relative humidity to one of low relative humidity. The greater the difference in humidity, the faster water moves. This factor is important because the rate of water movement directly affects a plant's transpiration rate. The relative humidity in the air spaces between leaf cells approaches 100 percent. When a stoma opens, water vapor inside the leaf rushes out into the surrounding air and a bubble of high humidity forms around the stoma. By saturating this small area of air, the bubble reduces the difference in relative humidity between the air spaces within the leaf and the air adjacent to the leaf. As a result, transpiration slows down.

If wind blows the humidity bubble away, however, transpiration increases. Thus, transpiration usually is at its peak on hot, dry, windy days. On the other hand, transpiration generally is quite slow when temperatures are cool, humidity is high, and there is no wind. Hot, dry conditions generally occur during the summer, which partially explains why plants wilt quickly in the summer. If a constant supply of water is not available to be absorbed by the roots and moved to the leaves, turgor pressure is lost and leaves go limp. Plant nutrition often is confused with fertilization. Plant nutrition refers to a plant's need for and use of basic chemical elements. Fertilization is the term used when these materials are added to the environment around a plant. A lot must happen before a chemical element in a fertilizer can be used by a plant. Plants need 17 elements for normal growth. Three of them--carbon, hydrogen, and oxygen--are found in air and water. The rest are found in the soil. Six soil elements are called macronutrients because they are used in relatively large amounts by plants. They are nitrogen, potassium, magnesium, calcium, phosphorus, and sulfur.

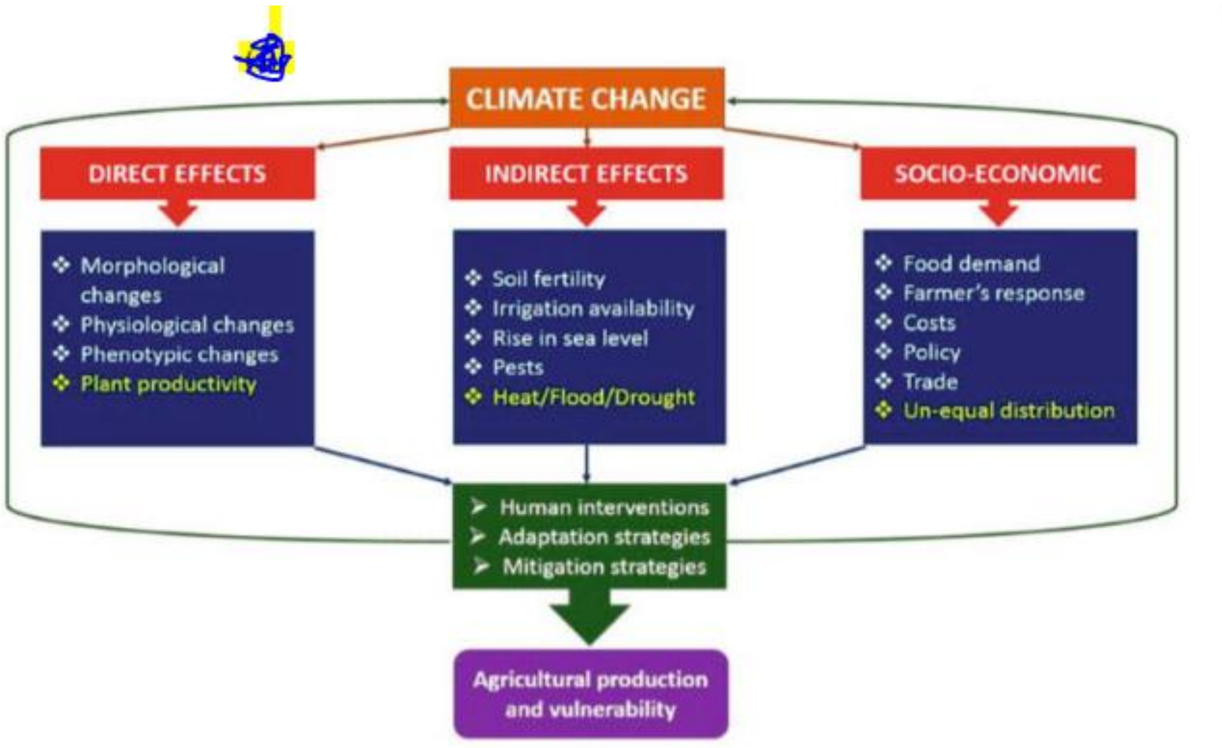


Figure: effect of climate change

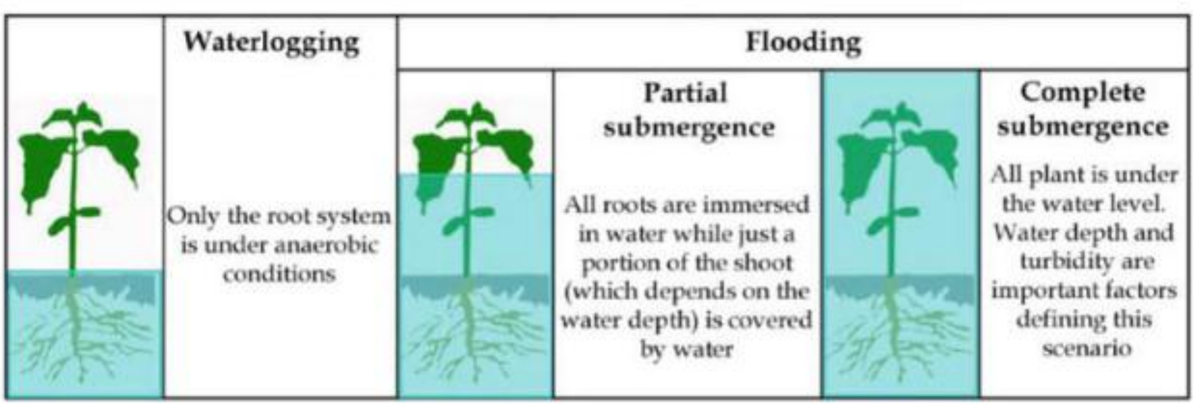


Figure 2: Different levels of excess of water in crop environment.

Self-check 2	Written test

Name………………………………………………. ID……………………….. Date…….

Directions: Short Answer Questions.

Test I: Choose the best answer

1. Environmental factors that affect plant growth include;

A. Humidity B. Temperature C. Water D. all **(**2 point)

2. The environmental factors can be classified into (3 point)

A. Abiotic B. Biotic C. All

3. Temperature and rainfall are climate variability that affects plant growth (5 point)

A. True B. False

Test II: Description

3. The abiotic constraints include (5 point)

____

____

2. Biotic factors include? (5point)

____

____

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

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

Answer Sheet

Score = ___________

Rating: ____________

Name: _________________________ Date: _______________

Information Sheet 3- Determining soil, plant and water tests

3.1. Soil Test

In agriculture, a soil test commonly refers to the analysis of a soil sample to determine nutrient content, composition, and other characteristics such as the acidity or pH level. A soil test can determine fertility, or the expected growth potential of the soil which indicates nutrient deficiencies, potential toxicities from excessive fertility and inhibitions from the presence of non-essential trace minerals. The test is used to mimic the function of roots to assimilate minerals. The expected rate of growth is modeled by the Law of the Maximum. Tap water or chemicals can change the composition of the soil, and may need to be tested separately. As soil nutrients vary with depth and soil components change with time, the depth and timing of a sample may also affect results. Composite sampling can be performed by combining soil from several locations prior to analysis. This is a common procedure, but should be used judiciously to avoid skewing results. This procedure must be done so that government sampling requirements are met. A reference map should be created to record the location and quantity of field samples in order to properly interpret test results. Soil testing is often performed by commercial labs that offer a variety of tests, targeting groups of compounds and minerals. The advantage associated with local lab is that they are familiar with the chemistry of the soil in the area where the sample was taken. This enables technicians to recommend the tests that are most likely to reveal useful information.

Figure: Soil test progress

The amount of plant available soil phosphorus is most often measured with a chemical extraction method, and different countries have different standard methods. Just in Europe, more than 10 different soil P tests are currently in use and the results from these tests are not directly comparable with each other.

A soil test is important for several reasons:

- To optimize crop production, to protect the environment from contamination by runoff and leaching of excess fertilizers,
- To aid in the diagnosis of plant culture problems,
- To improve the nutritional balance of the growing media and
- To save money and conserve energy by applying only the amount of fertilizer needed.

Always use the interpretative data for the specific soil testing method used to avoid incorrect interpretation of the results.

3.1.1. Soil Testing Checklist

- Conduct pre- plant media analyses to provide an indication of potential nutrient deficiencies, pH imbalance or excess soluble salts. This is particularly important for growers who mix their own media.
- Conduct media tests during the growing season to manage crop nutrition and soluble salts levels.
- Always use the interpretative data for the specific soil testing method used to avoid incorrect interpretation of the results.
- Take the soil sample for testing about 2 hours after fertilizing or on the same day. If slow-release fertilizer pellets are present, carefully pick them out of the sample.
- In a greenhouse where a variety of crops are grown, take soil samples from crops of different species.
- If a problem is being diagnosed, take a sample from both normal and abnormal plants for comparison.
- Be consistent in all sampling procedures each time you sample.
- Do not compare soil test results from one lab to those obtained from another.

3.2. Plant test

The nutrient content of a plant can be assessed by testing a sample of tissue from that plant. These tests are important in agriculture since fertilizer application can be fine-tuned if the plants nutrient status is known. Nitrogen most commonly limits plant growth and is the most managed nutrient. Laboratory tests often check for plant nutrients in three categories:

- Major nutrients: nitrogen (N), phosphorus (P), and potassium (K)
- Secondary nutrients: sulfur, calcium, magnesium
- Minor nutrients: iron, manganese, copper, zinc, boron, molybdenum, chlorine

Tissue tests are almost always useful, since they provide additional information about the physiology of the crop. Tissue tests are especially useful in certain situations;

- For monitoring the nitrogen status of the crop throughout the growing season. Soil tests are commonly performed before planting
- In highly controlled environments, such as hydroponic production in greenhouses, crops require a constant feed of nutrients in their water supply. Even a transient lack of nutrients can reduce yields. In these controlled environments, soil testing is unlikely to be sufficient to manage crop nitrogen status. Soil testing is more suitable when growing crops in slow-release composts and manures
- When there is a risk that the nutrient applications are toxic to the crop, such as during the application of poultry litter that contains micro nutrients such as copper.
- To guarantee that nitrogen levels in the crop do not exceed a certain limit. High concentrations of nitrates has implications to human health because nitrates can be converted into nitrites in the human digestive tract.

Nitrites can react with other compounds in the gut to form nitrosamines, which appear to be carcinogenic. Crops contain high concentrations of Nitrate when excess fertilizer is used. This is an issue in crops with high levels of nitrates, such as spinach and lettuce. Pre- plant media analyses provide an indication of potential nutrient deficiencies, pH imbalance or excess soluble salts. This is particularly important for growers who mix their own media. Media testing during the growing season is an important tool for managing crop nutrition and soluble salts levels. To use this tool effectively, you must know how to take a media sample to send for analysis or for in-house testing, and be able to interpret media test results. Determining the pH and fertility level through a soil test is the first step in planning a sound nutrient management program. Soil samples from soilless mixes are tested differently than samples from field soil. There are three commonly used methods of testing soilless media using water as an extracting solution: 1:2 dilution method, saturated media extract (SME), and leachate Pour Thru. The values that represent each method of testing are different from each other.

3.3. Water test

Water testing is a broad description for various procedures used to analyze water quality. Raw water quality characteristics of a water source prior to treatment for domestic consumption (drinking water). Many factors taken together determine the quality of water for irrigation of plants. The chemical constituents of irrigation water can affect plant growth directly through toxicity or deficiency, or indirectly by altering plant availability of nutrients. Once the source of water is identified, water to be used for irrigation should be tested by a reputable laboratory to determine the quality of the water to be used for irrigation, to aid in the choice of fertilizers for optimum plant growth, and to minimize the risk of discharging pollutants to surface or ground water. Prior to new construction, potential irrigation water should be tested. Monthly analysis is recommended for new water sources. Existing greenhouse operations should monitor water quality at least twice a year (summer and winter); more frequent monitoring is needed to alter production practices in response to changes in water quality.

3.3.1. Checklist of Water Analysis

- Test water to be used for irrigation by a reputable laboratory to determine the quality of the water for irrigation, choice of fertilizers for optimum plant growth, and to minimize the risk of discharging pollutants to surface or ground water.
- Test potential irrigation water prior to new construction.
- When collecting a water sample, run the water at full flow for five minutes before collecting one pint of water in a tightly sealed plastic bottle.

Self-check 3	Written test

Name…………………………………………… ID………………………… Date…….

Directions: Answer all the questions listed below.

Test I: Short Answer Questions

1. What is soil test? (2point)

____

____

2. Describe water and plant test? (3)

____

____

3. Write three categories plant nutrients? (5 point)

____

____

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

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

Answer Sheet

Score = ___________

Rating: ____________

Name: _____________________________ Date: _________________

Information Sheet 4- Developing soil, plant and water tests program

4.1. Soil Sampling

A soil sample should be composed of several sub-samples representing a seemingly uniform area or field with similar cropping and management history. There is no universally accepted numbers of sub-samples for different field situations. However, the following points can serve as guidelines:

- Composite Sampling
- Eight sub-samples are taken per hectare (ha) in a diagonal pattern for obtaining one composite sample.
- Other plans range from 5 to 25 borings or sub-samples per composite sample, with sample units varying from 2 to 8 ha.
- Fewer sub-samples are needed where little or no fertilizer has been used. Sampling areas are often traversed in a zigzag pattern to provide a uniform distribution of sampling sites.
- Correspondingly, more sub-samples are needed where fertility is variable due to hand broadcasting of fertilizers and/or with cropping-livestock systems. Indeed, banding of fertilizer poses serious problems for reliable sampling.
- Thus, the number of sub-samples taken by farmers should be realistic, considering the particular field situation.
- Sampling Time
- Soil samples can be taken any time that soil conditions permit, but sampling directly after fertilization or amendment application should be avoided.
- Samples taken during the crop growth period will help in knowing the nutrient status of the soil in which plants are actively taking up nutrients.
- It is recommended that sampling be carried out in autumn (before planting) if fertilization is intended at planting.
- It is important to sample at similar times year after year for comparing analysis at regular time intervals.

4.1.1. Sampling Depth

- For most purposes, soil sampling is done to a depth of about 20-cm.
- Available P, NO3-N, and micronutrients in such samples are related to crop growth, and nutrient uptake.
- In some cases, especially in irrigated areas, sampling to a depth of 60-100 cm is desirable, especially for monitoring nitrate (NO3-N) leaching.
- Depth-wise soil samples should also be taken where there is a concern about B toxicity.

Figure: soil profile

4.1.2. Sampling Tools

- A uniform slice should be taken from the surface to the depth of insertion of the tool; the same volume of soil should be obtained in each sub-sample.
- Augers generally meet these requirements. In areas where the topsoil is dry, e.g., during summer, topsoil sampling can be done by a metal ring, by digging out the soil inside the ring, because it is almost impossible to sample dry topsoil with an auger.
- Soil samples for micronutrient analysis should be taken using a stainless steel auger, or at least ungalvanized auger (because galvanized coating is zinc oxide).
- Researchers generally use augers for field sampling. Farmers or Extension Agents can use shovels or trowels, with almost the same result.
- If you do not have sampling tools, use a spade as follows: - Dig a V-shaped hole 15 to 20 cm deep.

Figure 2: Soil sampling tool: Auger

4.1.3. Instructions for Field Processing

- Disturbed soil samples should be put in plastic bags (tags and markers are required), or aluminum or stainless steel boxes
- Depending on the subsequent analysis samples may be kept cool until laboratory analysis.
- Bags should be examined for cleanliness as well as for strength.
- Soil samples can be transported to the laboratory in cardboard boxes or sacks.
- All information about samples is recorded, and each sample is given a laboratory number.
- Sketch your field. Diagram it the way you sampled it. Be sure sampled areas are labeled the same as sample containers. (This is so you have a record of which recommendations apply to which areas – do not rely on your memory).
- Information sheet should be clearly written with copying pencil. Fill out the information sheets. The more information you can provide with each sample, the better your recommendation will be.
- Do not sample unusual area, like unevenly fertilized, old channel, old bunds, area near the tree, and site of previous compost piles and other unrepresentative sites.
- Avoid any type of contamination at all stages. Soil samples should never be kept in the store along with fertilizer materials and detergents. Contamination is likely when the soil samples are spread out to dry in the vicinity of stored fertilizers or on floor where fertilizers were stored previously.

- Collect samples from the middle of the rows, when crops have been planted in rows, so as to avoid the area where fertilizer has been band-placed.

4.1.4. Soil Physical Analysis

Soil physical measurements are numerous, depending on the objective of the study for agricultural purposes. These measurements generally includes soil water purpose on the content, infiltration and hydraulic conductivity, evapotranspiration, heat, temperature, reflectivity, porosity, particle size, bulk density, aggregate stability, and particle size distribution. Soil moisture is routinely measured on field-moist samples, since all physical analyses are expressed on oven-dry basis (16-18 hours drying at 105 o C). As texture (e.g., whether sandy or clay) is quite important in relation to nutrient behavior, particle size distribution is often carried out, especially if more precision is needed than provided by the qualitative physical “feel” approach for determining texture.

Example: a. Soil Structure

Soil structure is defined as the arrangement of the soil particles. With regard to structure, soil particles refer not only to sand, silt and clay but also to the aggregate or structural elements, which have been formed by the aggregation of smaller mechanical fractions. The size, shape and character of the soil structure varies, which could be cube, prism and platter likes. On the basis of size, the soil structure is classified as follows: very coarse (>10 mm), coarse (5-10 mm); medium (2-5 mm); fine (1-2 mm); and very fine (<1 mm). Depending upon the stability of the aggregate and the ease of separation, the structure is characterized as follows: Poorly developed, weekly developed, moderately developed, well developed, and highly developed.

Particles into aggregates, and the pore space around them a) Aggregates. i. Aggregates can be natural or made by people (e.g., by tillage in wet soils; these aggregates are called clods) ii.

- Granular
- Blocky (angular and sub-angular)
- Platy
- Columnar and prismatic
- Single grain (non-structure)

• Massive (non-structure) iii. Size: Very fine, fine, medium, coarse, very coarse, thick, thin (see u Table 2.6, Size Classes of Soil Structural Units) iv. Aggregate stability is the ability to withstand wetting and drying, wind, and actions such as tillage. This is key for water infiltration, gas exchange, root growth, and long-term resistance to wind and water erosion, and is an indicator of soil health.

Lecture 2: Soil Properties

B. Soil Properties

1. Texture Non-technical definition: How the soil feels to the touch Technical definition: The proportions of sand, silt and clay in the soil

a) Soil separates (mineral part of soil)

i. Sand particles are the largest in the soil, ranging in size from 0.05 to 2.00 mm. Soil with high sand content feels gritty and doesn't hold well in a ball.

ii. Silt particles are moderate size particles and range from 0.002 mm to 0.05. Soils high in silt feel floury when dry and greasy when wet.

iii. Clay particles are the smallest in the soil, with sizes less than 0.02 mm •

Morphology: Most clay minerals consist of microscopic layers. These are called phyllosilicate minerals. (*Phyllo-* is from Greek for leaf, as in phyllo dough used to make baklava. Different types of clay have different kinds of layers and different properties.

Example Properties of clays

Cation Exchange Capacity (CEC): Clay particles have a net negative charge, and so can attract positive ions (cations), hold them, and then release them to the soil water when its cations have been lost through leaching or plant uptake. Cations such as potassium (K+), calcium (Ca+2), magnesium (Mg+2), iron (Fe+2 and Fe+3), and zinc (Zn+2) are essential plant nutrients, so the ability of soil to hold and release these ions later is important for plant growth and reproduction.

B. Texture Triangle (see figure below)

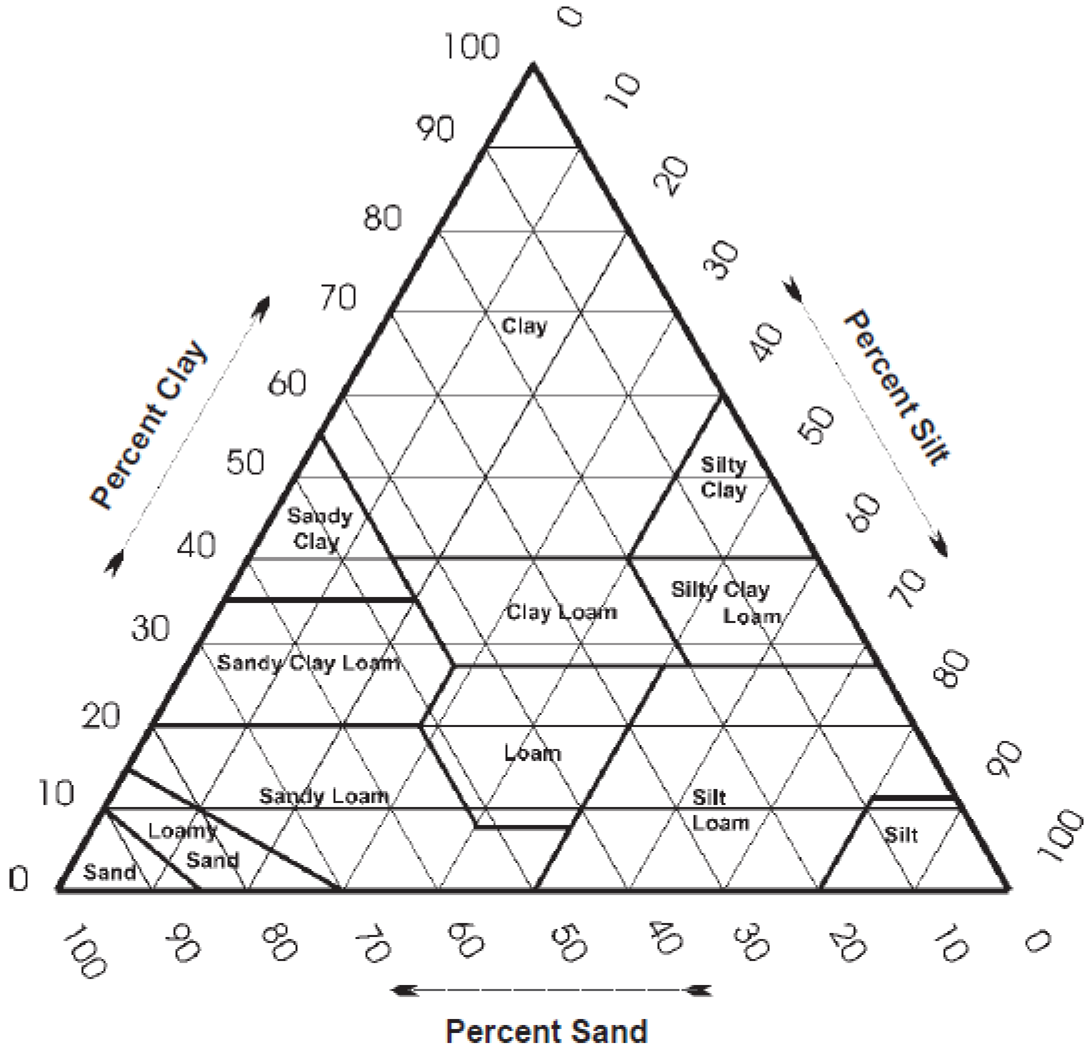


Figure: Soil texture triangle

4.1.5. Soil Chemical Analysis

Oil testing is one of several diagnostic tools used to evaluate soil quality, specifically pH, and soil nutrient and organic matter levels. Some of the basic soil chemical tests such as pH and organic matter, in combination with soil texture analysis, can indicate which crops will grow best on that soil.

Soil acidity

Soil acidity is a major environmental and economic concern. If untreated, acidity will become a problem in the subsurface soils, which are more difficult and expensive to ameliorate. Subsurface acidity is already a major problem for large areas of Western Australia and New South Wales. It is estimated that 12 to 24 million ha is extremely to highly acidic with pH values less than or equal to 4.8. Acidic soils cause significant losses in production and where the choice of crops is restricted to acid tolerant species and varieties, profitable market opportunities may be reduced. In pastures grown on acidic soils, production will be reduced and some legume species may fail to persist. Degradation of the soil resource is also of wider concern and off-site impacts must be considered. Off-site impacts mainly result from reduced plant growth. Deep-rooted species required to increase water usage may not thrive, increasing the risk of salinity. Increased run-off and subsequent erosion has detrimental impacts on streams and water quality. Increased nutrient leaching may pollute ground water.

Effects of soil acidity

Plant growth and most soil processes, including nutrient availability and microbial activity, are favoured by a soil pH range of 5.5 – 8. Acid soil, particularly in the subsurface, will also restrict root access to water and nutrients.

Example: PH Soil- pH is a crucial soil indicator, and is defined as the negative log of the hydrogen ion activity. Since pH is logarithmic, the H-ion concentration in solution increases ten times when its pH is lowered by one unit. The pH range normally found in soils varies from 3 to 9. Various categories of soil pH may be arbitrarily described as follows:

- Strongly acid (pH < 5.0)
- Moderately to slightly acid (5.0-6.5)
- Neutral (6.5-7.5)
- Moderately alkaline (7.5-8.5), and
- Strongly alkaline (> 8.5)

The significance of pH lies in its influence on availability of soil nutrients, solubility of toxic nutrient elements in the soil, physical breakdown of root cells, and CEC in soils whose colloids (clay/humus) are pH-dependent and biological activity. At high pH values, availability of P, and most micronutrients, except B and Mo, tends to decrease (see Box No. 2 for more details). Acid soils are rare in semi-arid, dryland areas of the world; they tend to occur in temperate and tropical areas where rainfall is substantial; conversely, soils of drier areas are generally alkaline, i.e., above pH 7.0, as a result of the presence of $CaCO_3$, and will visibly effervesce (fizz) when 10% hydrochloric acid (HCl) is added drop wise to the soil. Most soils in the region have pH values of 8.0 – 8.5. Calcareous soils with gypsum have somewhat lower pH values, while those with excess Na have values over 8.5 (sodic soils). Apparatus pH meter with combined electrode Reference electrode, saturated KCl Measuring cylinder Glass rod Glass beaker Interval timer Wash bottle, plastic Reagents De-ionized water pH 7.0 buffer solution pH 4.0 buffer solution

Procedure soil PH test

1. Weigh 50 g air-dries soil (< 2-mm) into a 100-mL glass beaker.
2. Add 50 mL DI water using a graduated cylinder or 50-mL volumetric flask.
3. Mix well with a glass rod, and allow standing for 30 minutes.
4. Stir suspensions every 10 minutes during this period.
5. After 1 hour, stir the suspension.
6. Calibrate the pH meter (see Box No. 3 for more details).
7. Put the combined electrode in suspension (about 3-cm deep). Take the reading after 30 seconds with one decimal.
8. Remove the combined electrode from the suspension, and rinse thoroughly with DI water in a separate beaker, and carefully dry excess water with a tissue.

Figure 3: soil PH determination

4.2. Plant Sampling and Processing

The effects of time of sampling, variety or hybrid and environmental factors, such as soil moisture, temperature, and light quality and intensity can significantly affect the relationship between nutrient concentration and plant response. Therefore, it is important that they be aware of the necessity of proper sampling. Otherwise, analyses that they are asked to perform on plant samples may end up to be meaningless and a waste of time. Field Processing Preparation for Sampling Preparation of a field trip for plant sampling has to be planned in advance. Always contact the people who will accompany you to the field for the necessary preparations, as follows:

- Plant samples must be put in labeled, perforated plastic bags or paper bags.
- Tags and markers are required.
- The bags should be examined for cleanliness as well as for strength.
- Plant samples can be transported to the laboratory in cardboard boxes.
- All information about samples is recorded; each sample is given a laboratory number.
- Clean tray or a clean cloth for collecting the plant and sub-sampling.
- Sketch your field. Diagram it the way you sampled it.
- Fill out the information sheets, writing clearly with a copying pen.

All plant samples taken from abnormal areas should be taken from just inside of the abnormal area. A separate plant analysis history must be completed for each sample taken as follow: Uniform Fields Where plant growth is uniform over the entire area and One composite sample is taken from at least 10 widely scattered areas in the field. One plant sample is necessary. One soil sample is recommended. Non-uniform Fields In areas where crop growth or appearance of one area differs from the rest of the field, plant analysis can often determine the cause of these differences and indicate the best method to correct the problem. Sample when abnormalities are discovered. Two plant and two soil samples are required. This includes collecting soil and plant samples from the normal area.

Sampling Time

- The recommended time to sample usually occurs just prior to the beginning of the reproductive stage for many plants. However, sampling earlier or even later than the specified time may be recommended for specific plants or circumstances.

- Sample plants that are showing a suspected nutrient deficiency symptom at the time or shortly after the visual symptoms appear.
- Amount of plant material all plant analyses require at least a rounded double handful of plant tissue.

4.3. Water Sampling and Processing

Water sampling and analysis is a vital part in agricultural and environmental applications for studying the quality of water treatment process, distribution system, or source of water supply. Therefore, water sampling program starts with collections of samples which accurately represent the characteristics of the bulk material and handled conveniently in the laboratory while still providing test results. The major source of error in the whole process of obtaining water quality information often occurs during sampling. Over 50 % of the faulty data that occur in laboratory test results are due to sampling error, rather than during laboratory analysis. Much of what is presented here is based on standard methods for the examination of waters and wastewaters. The correct sample container type and volume should be used for the required analysis in consultation with the laboratory requirements such as:

- Containers should be examined for cleanliness, ensuring it is strong and durable, so that it will not break in transit and that the cap does not leak once it is secured.
- Containers must not contain any of the compounds that samples are to be analyzed.
- Containers must be suitable for sampling the water.
- Container must be of the appropriate size.
- Containers must be high density polyethylene or glass containers
- Rubber and cork stoppers must not be used so as to avoid the risk of contaminating the sample.

Collecting a Water Sample

When collecting a water sample, run the water at full flow for five minutes before collecting one pint of water in a tightly sealed plastic bottle. For best results, fill a clean 5 gallon bucket with water and submerge the sample bottle, then seal with the cap under water. Do not use metal lids. The bottle should be totally full with no air space remaining.

Testing by Laboratories

Analysis for inorganic elements should include electrical conductivity (soluble salts), pH, alkalinity, nitrate nitrogen, ammonium nitrogen, calcium, magnesium, sodium, potassium, phosphorus, zinc, copper and aluminum. Testing water for pesticides, herbicides or fuel oil is very expensive, particularly if the contaminant is unknown. Analysis for biological or disease organisms is not generally recommended since many plant pathogens are always present in water at some level. A list of commercial greenhouse water testing laboratories is available under "Resources" at the end of the document. Electrical conductivity and pH are two characteristics of water quality that can be tested periodically at the growing facility. This helps the grower get an indication of the consistency of the water supply and check the results of treatments to reduce pH or soluble salts. PH meters range from inexpensive pen types to more sophisticated units. It is recommended to purchase one that can be calibrated using calibration solutions. This ensures that the meter is giving correct readings. Electrical conductivity meters are generally more expensive than pH meters. However, they are very useful for testing water quality and media fertilizer levels during crop growth.

Self-check 4	Written test

Name…………………………………………… ID………………………… Date…….

Directions: Answer all the questions listed below.

Test I: Choose the best answer

1. ______________is an example of physical soil test? (5)

A. soil PH B. soil structure C. soil moisture D. all E. none

Test II: Short Answer Questions

2. Write two types of soil test? (10 point)

____

3. Write an example of chemical soil test? (5)?

____

____

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

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

Answer Sheet

Score = ___________

Rating: ____________

Name: _________________________ Date: _______________

Information Sheet 5- Implementing and monitoring testing tasks

5.1. Test monitoring

Soil Test monitoring in test execution is a process in which the testing activities and testing efforts are evaluated in order to track current progress of testing activity, finding and tracking test metrics, estimating the future actions based on the test metrics and providing feedback to the concerned team as well as stakeholders about current testing process. Test Control in test execution is a process of taking actions based on results of the test monitoring process. In the test control phase, test activities are prioritized, test schedule is revised, test environment is reorganized and other changes related to testing activities are made in order to improve the quality and efficiency of future testing process. No matter how much and carefully we plan, something will go wrong. We need to actively monitor the project to:

- Early detect and react appropriately to deviations and changes to plans
- Let's you communicate to stakeholders, sponsors, and team members exactly where the project stands and determine how closely your initial plan of action resembles reality
- It will be helpful for the Manager to know whether the project is going on the right track according to the project goals. Allows you to make the necessary adjustments regarding resources or your budget.

Monitoring will allow you to make comparisons between your original plan and your progress so far. You will be able to implement changes, where necessary, to complete the project successfully. You should monitor the key parameters as below:

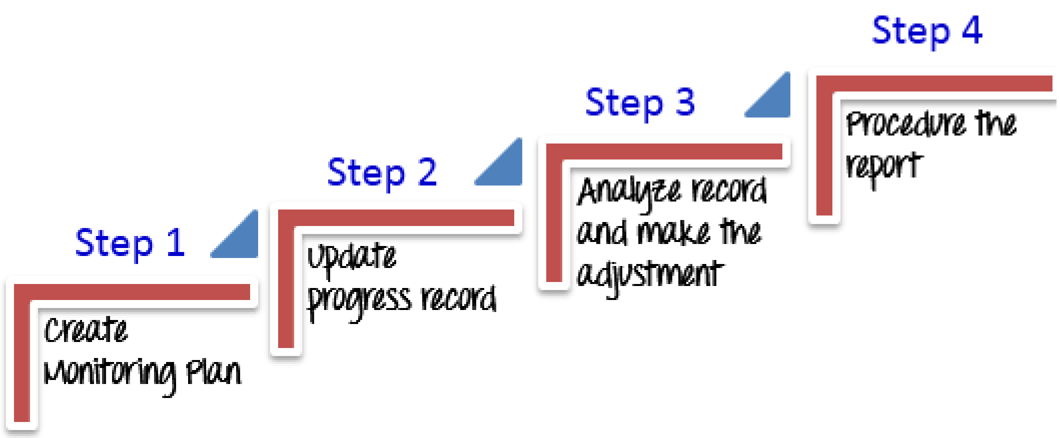
Step 1) Create Monitoring Plan

You cannot monitor progress unless you have a plan to monitor progress with defined metrics. Similar to Test Plan, Monitoring Plan is the first and one of the most important steps in progress monitoring.

Step 2) Update progress record. With time, your team member will be making progress on their project task.

Step 3) Analyze record and make the adjustment

Step 4) Produce the report



Best Practices in Test monitoring and control

- Follow the standards: One important consideration of project planning is to ensure standardization. It means that all the project activities must follow the standard process guideline.
- Documentation: You may forget them and lose many things. You should write down discussions and decisions at the appropriate place, and establishing a formal documentation procedure for meetings.
- Proactivity: Issues occur in all projects. The important thing is that you have to adopt a proactive approach to solve issues and problems that arise during project execution. Such issues could be budget, scope, time, quality, and human resources

5.2. Test Implementation

Implementation is the stage where all the planned activities are put into action. Before the implementation of a project, the implementers (spearheaded by the project committee or executive) should identify their strength and weaknesses (internal forces), opportunities and threats (external forces). The strength and opportunities are positive forces that should be exploited to efficiently implement a project. The weaknesses and threats are hindrances that can hamper project implementation. The implementors should ensure that they devise means of overcoming them. As such, the monitoring activities should appear on the work plan and should involve all stake holders. If activities are not going on well, arrangements should be made to identify the problem so that they can be corrected.

To implement soil test:

- Thoroughly clean the tools you're using to collect the soil sample.
- In the planting area, dig five holes 6 to 8 inches deep.
- Take a 1/2-inch slice along the side of a hole and place it in the bucket. ...
- Collect samples from different areas that'll be growing similar plants.
- Mix the soil in the bucket.

For plant test: It shows what nutrients are being taken up by the plant at that moment in time. It won't actually tell you what levels of micronutrients are needed, but simply whether or not they are there it's very important that tissue testing is used in conjunction with field soil tests. The following tips for getting the best possible results from plant tissue testing:

1. Time it right. To have an effect on this growing season, corn plants should be in the 8- to 12-leaf stage, soybean plants can be submitted from 4-8 inches tall and alfalfa from 6 inches to flowering.

2. Select the best, most representative samples. Never select diseased, drought stressed or damaged plants. Pick plants that most closely represent actual field conditions.

3. Collect the proper plant part and amounts. Pick at least half a lunch bag full of plants and choose leaves from the middle of the plant. Never send bottom leaves or immature leaves.

4. Handle the samples properly. Label your sample bags, make sure the labels match your submittal forms and send them promptly.

Self-check 5	Written test

Name………………………………………… ID………………………… Date…….

Directions: Answer all the questions listed below.

Test I: Short Answer Questions

1. Write the monitor key parameters? (2 point)

____

____

2. What is soil monitor? (5 point)

____

3. Write the best possible results from plant tissue testing? (3)

____

____

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

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

Answer Sheet

Score = ___________

Rating: ____________

Name: _________________________ Date: _______________

Information Sheet 6- Compiling and presenting data and readings

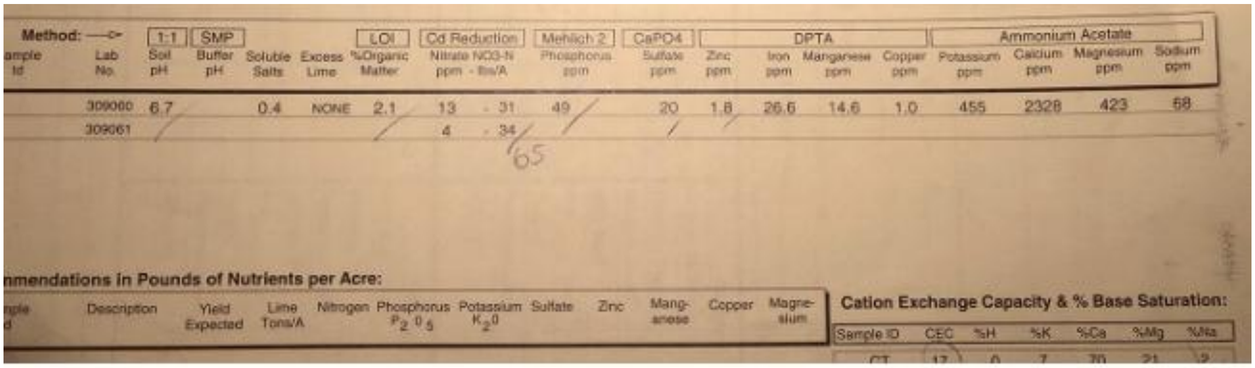
6.1. Introduction

Soil testing is used to assess what soil nutrients are present or may be needed for optimum plant growth and yield potential. Due to variability in soil, lab analysis, and reporting, guidelines specific to your region may exist. A local agronomist or extension specialist can provide information specific to your area. The results from a soil test list the concentration of each measured nutrient, an interpretation value (low, optimum, and high), and recommendations for amendments or nutrient application. You know that a healthy, rich soil will give you the best opportunity to achieve high yields. After you've collected a quality soil sample and delivered it to a soils laboratory of your choice. Reviewing your soil analysis report. The soil analysis report that you will receive back from the lab should consist of all the attributes of the soil test you selected when you sent off your samples. This can include a fertilizer recommendation for achieving the yield goal of the commodity to be grown, which are usually based on local university research for your particular area. But each laboratory can adjust these recommendations based on your specific needs and their expertise.

The quantity and quality of information you receive for the cost of the analysis makes soil testing a terrific value. A considerable amount of information is generated in any soil, plant, and water analysis laboratory. In order to economically justify the existence of a laboratory, it is necessary to have a record of the number of samples analyzed and the types of analyses performed. With the advent of the computer, such storage is easy and retrieval is greatly facilitated. Computer processing offers the advantage of:

- Easier manipulation of large data sets,
- Reduced errors in calculation of recommendations,
- Preparation of reports,

- Automated invoicing and addressing, and ready access to historical data



Method: —○—

ample Id	Lab No.	1:1 Soil pH	SMP Buffer pH	Soluble Salts	Excess Lime	LOI %Organic Matter	Cd Reduction Nitrate NO3-N ppm - lbs/A	Mehlich 2 Phosphorus ppm	CaPO4 Sulfate ppm	DPTA Zinc ppm	DPTA Iron ppm	DPTA Manganese ppm	DPTA Copper ppm	Ammonium Acetate Potassium ppm	Ammonium Acetate Calcium ppm	Ammonium Acetate Magnesium ppm	Ammonium Acetate Sodium ppm
	309060	6.7		0.4	NONE	2.1	13 - 31	49	20	1.8	26.6	14.6	1.0	455	2328	423	68
	309061						4 - 34										

nmendations in Pounds of Nutrients per Acre:

mple d	Description	Yield Expected	Lime Tons/A	Nitrogen	Phosphorus P_2O_5	Potassium K_2O	Sulfate	Zinc	Manganese	Copper	Magnesium

Cation Exchange Capacity & % Base Saturation:

Sample ID	CEC	%H	%K	%Ca	%Mg	%Na

Figure 3: Reading format

These vary from laboratory to laboratory, but usually include details of analyses required for the sample and information on the crop to be grown, the soil type, and previous cropping history, particularly with respect to fertilization. Such information enables one to answer questions on the extent of nutrient deficiency in any area from which the samples were obtained, and how fertility levels change over the years. Computer programs are increasingly used to interpret soil test data and making fertilizer recommendations. Standardized report forms for making fertilizer recommendations combine inputs of soil test data together with other soil and crop information. In order to do this, the tests used (soil NO3-N, available P, etc.) must be calibrated with field crop response. Where soil maps and rainfall data are available, the accumulated soil test values of known locations can help establish relationships with soil type, region, and climatic zone.

Figure 4: computer reading

Self-check 6	Written test

Name…………………………………………… ID………………………… Date…….

Directions: Answer all the questions listed below.

Test I: Short Answer Questions

1. Soil testing is used to assess what soil nutrients are present or may be needed for optimum plant growth and yield potential (5)?

   A. True B. False

2. Computer processing offers the advantage of (5 point)

____

____

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

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

Answer Sheet

Score = ___________

Rating: ____________

Name: _________________________ Date: _______________

Information Sheet 7- Determining seasonal variations and requirements

7.1. Introduction

Understanding the seasonal fluctuations of soil test measurements during the year can aid in the understanding and in interpretation of soil test results that vary from year to year or samples taken within the same year. Many factors can cause soil results to vary from year to year, with seasonal fluctuations being one of them. Seasonal fluctuations are mainly controlled by the uptake and release patterns of nutrients by the crop and by environmental conditions. If soil samples are taken from a field the same way and the same time each year and the results are higher or lower than expected, seasonal fluctuations can sometimes explain these results. A spring soil sample gives a more accurate picture of what will be available to the plant that year. However, a fall soil sample offers many advantages to the producer such as sampling during good weather, allowing time for planning of the coming crops, and giving lime time to react prior to spring planting. Understanding the seasonal fluctuations of soil tests will allow a producer to take fall soil samples that better represent the fertility in the soil and obtain a more efficient lime and fertilizer recommendation. Of the commonly reported soil test measurements, phosphorus (P), potassium (K), and pH are the most affected by seasonal fluctuations.

Seasonal fluctuations in pH are not unusual. They are affected by fertilizer rate, time of fertilizer application, organic matter, and root and bacterial activity as well as soil moisture. The pH is usually lower during the summer and early fall and then increases as the soil moisture increases. The reduction in soil pH during this time is generally attributed to soil drying, root and bacteria activity, and nitrification of nitrogen fertilizers. Nitrogen fertilizers containing ammonium are changed to nitrate (nitrified); this process releases acidity (hydrogen ions). The roots and bacteria in the soil produce carbon dioxide that temporarily lowers the pH during the height of their activity. The salts in the soil (natural and added as fertilizers) can concentrate near the soil surface as the soil dries and displace hydrogen ions (acidity) from the cation exchange complex into the soil solution that also lowers the pH.

Seasonal fluctuations in soil test Potassium (K)are seen almost yearly and can be large. As the crop grows and matures, uptake lowers the soil-available K. Large amounts of K are taken up by the plant, about 160 lb/ac of K2 0 in a 150 bu/ac corn crop. For corn, wheat, and grain sorghum, most of the K is in the vegetation with only about 25 to 30% in the grain. Once the grain is harvested, the K in the residue is washed back into the soil. The net effect is that soil test K drops until the crop reaches physiological maturity and then increases slowly as the K is leached from the residue. However, soybean grain contains about 60% of the total K taken up by the crop, so removal is higher, and the soil test K does not rebound to the same extent as other grains.

Seasonal fluctuations of soil tests for Phosphorus (P) are smaller than for pH and K. The quantity of crop P uptake is much lower than K, with most of the P ending up in the harvest grain. The smaller amounts left in the residue are not easily leached from the plant and require microbial decomposition for release (a much slower process). The soil is also a great buffer for P. Fertilizer P is converted to chemical compounds in the soil that greatly reduces its solubility, and it also stabilizes the soil test P and prevents rapid fluctuations.

Self-check 7	Written test

Name………………………………………… ID……………………… Date…….

Directions: Answer all the questions listed below.

Test I: Short Answer Questions

1. Soil test measurements that are most affected by seasonal fluctuations were:

(5 point)

____

____

2. Seasonal fluctuations are mainly controlled by the: (5)?

____

____

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

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

Answer Sheet

Score = ___________

Rating: ____________

Name: _________________________ Date: _______________

Information Sheet 8- Characteristics, condition and nutritional status of soils and plant species

8.1. Characteristic of soil test

Soil test results include the amount of macronutrients nitrogen (N), phosphorus (P), and potassium (K); secondary macronutrients sulfur (S), calcium (Ca), and magnesium (Mg); and micronutrients copper (Cu), iron (Fe), manganese (Mn), zinc (Zn), boron (B), chloride (Cl), nickel (Ni), and molybdenum (Mo) in the soil. Other soil characteristics that may be included in soil test results are organic matter (OM) content, soil pH, soluble salts (salinity), and cation exchange capacity. In addition to each element level that will be reported back, you will also receive a few other important soil characteristics as well:

Nitrogen - An adequate supply of N is associated with high photosynthetic activity, vigorous growth, and dark-green plant vegetation. There are two forms of plant available N: nitrate (NO_3^-) and ammonium (NH_4^+). Nitrate is measured most often in soil tests. Soil test results report nitrate-N in lb/acre. It is important to remember that nitrate levels on a soil test reflect what is immediately available and not what will be available in the future from mineralization of organic matter or lost from leaching or denitrification.

Phosphorus – Phosphorus is needed by the plant to store energy created from photosynthesis and carbohydrate metabolism to be used for plant growth and reproductive processes. Phosphorus is not as naturally abundant in the soil as other macronutrients and is relatively immobile. The amount of plant available P in the soil solution is related to soil pH. Different P extraction methods are used depending on the soil pH.

Potassium - Potassium helps plants activate enzymes, draw water into roots, produce phosphate molecules and CO2, translocate sugars, and uptake and assimilate N. Most soils contain K in large quantities, although it is not always available.

Sulfur - Sulfur has many important functions in plant growth and metabolism. Only a small fraction of the total soil S is readily available to plants and that form is sulfate (SO_4^{2-}). Sulfur can be mobile or immobile in soil depending on microbial activity and the quantity of carbon (C), N, and P. S-deficient soils have soluble SO_4^{2-} concentrations less than 5-10 ppm.

Calcium and Magnesium - Calcium enhances nitrate-N uptake and also regulates the uptake of cations, such as K+ and sodium (Na+). High Ca concentrations typically result in low concentrations of undesirable cations, but a low Ca content can contribute to soil acidity. Magnesium is needed for photosynthesis and in many other physiological and biochemical functions within the plant. Both Mg and Ca ions can easily be exchanged or removed from negative soil colloids.

Micronutrients - Although many of the micronutrients are reported on soil test reports, their levels do not currently affect fertilizer recommendations; with the exception of Zn.

Organic Matter - Organic matter affects many soil biological, chemical, and physical properties that influence nutrient availability. A general guideline is to reduce N recommendations by 20 lb/acre for soils with >3% OM and increase N recommendations for soils with <1% OM. Consult your regional guidelines for a more precise influence of OM on nutrient availability.

Soil pH - Soil pH is an indicator of the level of acidity or alkalinity of the soil, ranging from 0-14. A reading of 7 is neutral; crops typically grow best when pH is between 6 (slightly acidic) and 7.5 (slightly alkaline). Results of soil pH are reported on a logarithmic scale; a soil with a pH of 6 is 10 times more acidic than a soil with a pH of 7, and a pH of 5 is 100 times more acidic than a pH of 7. Nutrient availability may be hindered if soil pH is not within the optimum range. A buffer pH (BpH) test is used to determine lime rate requirements. The amount of lime needed to increase soil pH to a desirable level can be estimated by mixing a buffer solution (with a known pH) to soil and then measuring the change in pH. If the change in pH is large after the buffer is added, the soil pH is easily changed and a low lime rate will be recommended, but if the change is small it means the soil pH is difficult to change requiring a larger rate of lime.

Cation Exchange Capacity (CEC) - The CEC is not always part of a soil analysis. If it is included on a lab result, a CEC above 10 milli-equivalents per 100 grams (10 meq/100 g) is considered adequate. A high CEC is sought because it indicates a high capacity for the soil to hold cations (positively charged particles) such as K^+, NH_4^+, Cu^{2+}, Fe^{2+}, and Mn^{2+}. Many minerals in soils are negatively charged and, as a consequence, can attract and retain cations such as potassium (K), sodium (Na), calcium (Ca), magnesium (M), ammonium (NH4), etc. Cation exchange is a reversible process. Thus, elements or nutrients can be held in the soil and not lost through leaching, and can subsequently be released for crop uptake. Certain organic compounds contribute to cation exchange capacity (CEC). Also, the presence of high concentrations of Ca, especially in the form of gypsum, interferes with the determination of CEC, which is an important parameter for soil fertility and mineralogical characterization. Additionally, CEC is influenced by soil pH. A certain portion of the total negative charge is permanent, while a variable portion is pH-dependent.

Several methods are available for CEC determination. Most methods involve saturation of the soil with an index cation (NH4), removal by washing of excess cation, and subsequent replacement of the adsorbed index cation by another cation (Na) and measurement of the index cation in the final extract. Modified procedures have been introduced because of high Ca solubility in calcareous and gypsiferous soils. Cation exchange capacity is reported as centimoles of positive charge per kg of soil (cmol (+)/kg). The old unit milli-equivalents per 100 g (meq/100g), whereas **1 meq/100 g = 1 cmol (+)/kg**), should no longer be used. Values of CEC are in the range of 1.0 to 100 cmol (+)/kg, least for sandy soils and most for clay soils. Similarly, higher CEC values reflect the dominance of 2:1 clay minerals, and lower values reflect the presence of 1:1 clay minerals.

8.2. Nutritional statues of soil

The nutritional requirements of the crop are dependent on factors such as soil fertility, weather, planting age and crop load, all of which change over time. Therefore, the amount of nutrients the grower needs to provide the crop may also change over time. As the soil is the 'storehouse' for nutrients, the best approach to meeting the nutritional requirements is to establish your crop in fertile, well drained soils with the appropriate soil pH. Once the crop is planted, routine evaluation of plant nutrient status and soil composition are essential to developing sustainable nutrient management practices.

Many people confuse plant nutrition with fertilization. Plant nutrition refers to the needs of the plant and how a plant uses the basic chemical elements. Fertilization is the term used when these elements are supplied to the soil as amendments. Of these nutrients, three are found in air and water: carbon (C), hydrogen (H), and oxygen (O). Combined, C, H, and O account for about 94% of a plant's weight. The other 6% of a plant's weight includes the remaining 14 nutrients, all of which must come from the soil. Of these, nitrogen (N), phosphorus (P), and potassium (K), the primary macronutrients, are the most needed. Magnesium (Mg), calcium (Ca), and sulfur (S), the secondary macronutrients, are next in the amount needed. The eight other elements—boron, chlorine, copper, iron, manganese, molybdenum, nickel, and zinc—are called micronutrients because they are needed in much smaller amounts than the macronutrients.

1. Major non-mineral macronutrients: these are 90 – 95 % of dry-plant weight, and are supplied to the plant by water absorption and photosynthesis, i.e., carbon (C), hydrogen (H), and oxygen (O);
2. Primary macronutrients, i.e., nitrogen (N), phosphorus (P), potassium (K);
3. Secondary macronutrients, i.e., calcium (Ca), magnesium (Mg), sulfur (S); and
4. Micronutrients, i.e., boron (B), chloride (Cl), cobalt (Co), copper (Cu), iron (Fe), manganese (Mn), molybdenum (Mo), nickel (Ni), zinc (Zn).

Three major factors contributing to plant nutrition are:

- The amount of available nutrients in the soil;
- The soil's ability to supply the nutrients to plants; and
- Environmental factors that affect nutrient availability and plant absorption.

Measurements which involve characterization of the soil solution, and its constituents and of the composition of the inorganic and organic phases in soil are broadly termed chemical. This encompasses all nutrient elements and soil components which directly or indirectly influence such elements or components.

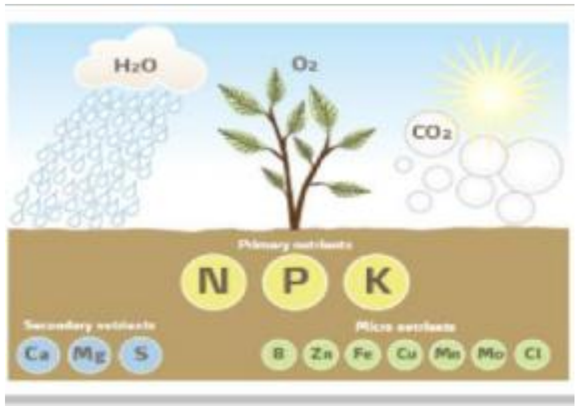


Figure 5: Primary, secondary and micronutrients

Self-check 8	Written test

Name…………………………………………… ID………………………… Date…….

Directions: Answer all the questions listed below.

Test I: Short Answer Questions

1. Soil test results include the amount of macronutrients; write an example of macro nutrient? (5 point)

____

____

2. Write the difference between macro and micro nutrient? (5)?

____

____

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

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

Answer Sheet

Score = ___________

Rating: ____________

Name: _________________________ Date: _______________

Operation Sheet -1	Soil sample analysis

Material required

Augers

Procedure

1. Take eight sub-samples per hectare (ha) in a diagonal pattern for obtaining one composite sample.
2. Plans range from 5 to 25 borings or sub-samples per composite sample
3. Use Fewer sub-samples needed where little or no fertilizer.
4. Correspond, more sub-samples are needed where fertility is variable due to hand broadcasting
5. Take number of sub-samples by farmers should be realistic, considering the particular field situation.

LAP TEST	Performance Test

Name………………………………. ID……………………………..

Date…………………………………….

Time started: ________________________ Time finished: ________________

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within 5 days. The project is expected from each student to do it.

Task-1 Within your group/team makes sure that you are able to write the soil test?

Task-2 Collect, identify and check tools and equipment used for determination of soil analysis?

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

Answer Sheet

Score = ___________

Rating: ____________

Name: _________________________ Date: _______________

Operation Sheet -2	To familiarize the determination of soil PH

Material required

1. Magnetic stirrer
2. Spade
3. Sample bag
4. Sensitive balance/analytical balance
5. Beaker
6. Watch
7. PH meter

Procedures

1. Collect a soil sample approximately 10grams from field
2. Place a soil sample in a 50ml beaker
3. Add 10ml distilled water to a beaker.
4. Stir the soil and the water for an hour
5. Then read t he value of the PH from PH-meter and glass electrode

LAP TEST	Performance Test

Name………………………………. ID……………………………..

Date…………………………………….

Time started: ________________________ Time finished: ________________

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within 5 days. The project is expected from each student to do it.

Task-1 Within your group/team makes sure that you are able to write the procedure of soil PH determination.

Task-2 Collect, identify and check tools and equipment used for determination of soil PH?

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

Answer Sheet

Score = ___________

Rating: ____________

Name: _________________________ Date: _______________

Operation Sheet -3	Plant tissue analysis

Material required

1. Potassium test paper (3 spots on the paper (3 spots on paper)
2. Nitrate powder
3. Sample bag
4. P-K reagent No1 and P-reagent No2
5. Sharp knife
6. Needle nosed pliers

Procedures

1. Take a plant sample (petiole or stem) from field
2. Cut the portion of the green plant tissue and place on folds test paper
3. Add nitrate powder to the tissue and squeeze together.
4. Observe the color changes and report to your instructor

LAP TEST	Performance Test

Name……………………………… ID……………………………..

Date…………………………………….

Time started: ________________________ Time finished: ________________

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within 5 days. The project is expected from each student to do it.

Task-1 Within your group/team makes sure that you are able to write procedure of plant tissue?.

Task-2 Collect, identify and check tools and equipment used plant tissue analysis?

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

Answer Sheet

Score = ___________

Rating: ____________

Name: _________________________ Date: _______________

LG #71	LO# 2- Define the requirements for plant production.

Instruction sheet

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

- Identifying OHS hazards
- Identifying different nutritional requirements of the plant
- Developing program
- Soil amendments, management practices and fertilizer requirements
- Identifying and costing resources, tools, equipment and machinery
- Cost-effective approach to soil management, soil amendment
- Identifying Environmental implications of program

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

- Identify OHS hazards
- Identify different nutritional requirements of the plant
- Develop program
- Soil amendments, management practices and fertilizer requirements
- Identify and cost resources, tools, equipment and machinery
- Cost-effective approach to soil management, soil amendment
- Identify Environmental implications of program

Learning Instructions:
1. Read the specific objectives of this Learning Guide. 2. Follow the instructions described below. 3. Read the information written in the "Information Sheets". Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them. 4. Accomplish the "Self-checks" which are placed following all information sheets. 5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks). 6. If you earned a satisfactory evaluation proceed to "learning guide.

Information Sheet 1- Identifying OHS hazards

1.1. Introduction

Many people believe that soil sampling contains little risk, but this is not true. Some of the potential risks include sampling in areas containing buried utilities, pit cave in, equipment failure, dehydration, muscle skeletal injury, and allergic reactions to plants and insect stings.

OHS hazard may include:

- Air, dust
- Chemicals and hazardous substances
- Disturbance or interruption of services
- Incorrect manual handling
- Uncovered machinery and machinery parts
- Moving vehicles
- Noise
- Sharp hand tools and equipment
- Slippery and uneven surfaces
- Soil and water-borne micro-organisms
- Solar radiation

Contamination is a most serious problem in any laboratory; therefore, its sources must be identified and eliminated. Some common sources of contamination are:

- External dusts blown from the surrounding environment
- Internal dust resulting from cleaning operations
- Cross-contamination derived from while handling many samples at the same time (e.g., handling plant and soil samples together)
- Failure to store volatile reagents well away from the samples
- Washing materials, particularly soap powder
- Smoking in the laboratory

Tools and equipment's: Various items of equipment and associated furnishings are generally found in soil, plant and water analysis laboratories, as indicated as follows:

- Laboratory working tables
- Appropriate racks
- Weighing benches
- Cupboards

- Laboratory desks and chairs
- Fixed suction unit
- Aerial photographs, charts and tables of soil
- Characteristics and plant soil parameters
- Air blowers
- Backpack spray equipment
- Irrigation systems set up for fertigation
- Pumps and pump fittings
- Rippers and spray equipment
- Seeders
- Tractors and trailed or three-point linkage spreaders
- Backhoe

As with any place of work, safety is an important consideration in soil, plant and water analysis laboratories, and one that is frequently overlooked. A safe working in a chemical laboratory needs special care, both in terms of design and construction of the laboratory building, and handling and use of chemicals. For chemical operations, the release of gases and fumes in some specific analytical operation are controlled through a fume hood or trapped in acidic/alkaline solutions and washed through flowing water.

To protect those hazards, the followings are the most important one:

- Appropriate use of PPE, including sun protection
- Appropriate use of safety equipment,
- Assessing and reporting risks
- Basic first aid available on site
- Cleaning, maintaining and storing tools, equipment and machinery
- Correct manual handling
- Identifying hazards
- Maintaining personal hygiene
- Reporting problems to supervisors
- Safe handling,
- Safe operation of tools, equipment and machine
- Body Protection
- Hand Protection
- Dust Mask
- Eye Protection
- Full Face Shield

Self-check 1	Written test

Name…………………………………………… ID………………………… Date…….

Directions: Answer all the questions listed below.

Test I: Choose Answer Questions

1. OHS hazard include one of the following? (1 points)

A. Soil and dust B. Solar radiation

C. Chemicals. D. Soil and water born microorganism. E. All

2. One of the following is tools and equipment of soil health? (1 points)

A. PPE B. Dust protection C. Eye protection D. All

Test II: Short Answer Questions

3. What are the most important to protect hazards? (5 point)

____

____

4. Write tools and equipment's of soil health? (3 point)

____

____

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

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

Answer Sheet

Score = ___________

Rating: ____________

Name: _________________________ Date: _______________

Information Sheet 2- Identifying different nutritional requirements of the plant

2.1. Introduction

Plants are unique organisms that can absorb nutrients and water through their root system, as well as carbon dioxide from the atmosphere. Soil quality and climate are the major determinants of plant distribution and growth. The combination of soil nutrients, water, and carbon dioxide, along with sunlight, allows plants to grow. In order to develop into mature, fruit -bearing plants, many requirements must be met and events must be coordinated.

2.2. Plant nutrient

Plant cells need essential substances, collectively called nutrients, to sustain life. Plant nutrients may be composed of either organic or inorganic compounds. An organic compound is a chemical compound that contains carbon, such as carbon dioxide obtained from the atmosphere. Carbon that was obtained from atmospheric CO_2 composes the majority of the dry mass within most plants. An inorganic compound does not contain carbon and is not part of, or produced by, a living organism. Inorganic substances (which form the majority of the soil substance) are commonly called minerals: those required by plants include nitrogen (N) and potassium (K), for structure and regulation. Macronutrients and Micronutrients are deemed essential nutrients to support all the biochemical needs of plants. Plants require light, water. These elements are called essential nutrients. For an element to be regarded as essential, three criteria are required:

- a plant cannot complete its life cycle without the element
- no other element can perform the function of the element
- the element is directly involved in plant nutrition

Nutrients that plants require in larger amounts are called macronutrients. About half of the essential elements are considered macronutrients: carbon, hydrogen, oxygen, nitrogen, phosphorus, potassium, calcium, magnesium, and sulfur. The first of these macronutrients, carbon (C), is required to form carbohydrates, proteins, nucleic acids, and many other compounds; it is, therefore, present in all macromolecules. On average, the dry weight (excluding water) of a cell is 50 percent carbon, making it a key part of plant biomolecules.

The next-most-abundant element in plant cells is nitrogen (N); it is part of proteins and nucleic acids. Nitrogen is also used in the synthesis of some vitamins. Hydrogen and oxygen are macronutrients that are part of many organic compounds and also form water. Phosphorus (P), another macromolecule, is necessary to synthesize nucleic acids and phospholipids. phosphorus enables food energy to be converted into chemical energy through oxidative phosphorylation. Light energy is converted into chemical energy during photophosphorylation in photosynthesis; and into chemical energy to be extracted during respiration. Sulfur is part of certain amino acids, such as cysteine and methionine, and is present in several coenzymes. Sulfur also plays a role in photosynthesis as part of the electron transport chain where hydrogen gradients are key in the conversion of light energy into ATP. Potassium (K) is important because of its role in regulating stomatal opening and closing. As the openings for gas exchange, stomata help maintain a healthy water balance; a potassium ion pump supports this process.

Magnesium (Mg) and calcium (Ca) are also important macronutrients. The role of calcium is twofold: to regulate nutrient transport and to support many enzyme functions. Magnesium is important to the photosynthetic process. These minerals, along with the micronutrients, also contribute to the plant’s ionic balance. The seven main micronutrients include boron, chlorine, manganese, iron, zinc, copper, and molybdenum. Boron (B) is believed to be involved in carbohydrate transport in plants; it also assists in metabolic regulation. Boron deficiency will often result in bud dieback. Chlorine (Cl) is necessary for osmosis and ionic balance; it also plays a role in photosynthesis. Copper (Cu) is a component of some enzymes. Symptoms of copper deficiency include browning of leaf tips and chlorosis (yellowing of the leaves). Iron (Fe) is essential for chlorophyll synthesis, which is why an iron deficiency results in chlorosis.

Table 1: Essential nutrient for plant growth

Essential nutrient for plant growth	
Macro nutrient	Micro nutrient
Carbon	Iron
Hydrogen	Manganese
Oxygen	Boron
Nitrogen	Zink
Phosphors	Cobalt
Potassium	Sodium
Calcium	Chlorine
Magnesium	Nickel
Sulphur	Manganese

Range of condition also identified includes:

- Crop load
- Crop quality requirements
- Cropping and fertilizer history
- Grazing intensity
- Growth media characteristics
- Irrigation methods and scheduling
- Seasonal influences
- Soil management practices
- Spraying program
- Weather

Self-check 2	Written test

Name…………………………………………… ID………………………… Date…….

Directions: Answer all the questions listed below.

Test II: Short Answer Questions

1. Write essential nutrients used for plant (2)?

____

____

2. What the essential criteria are required plant nutrient? (5 point)

____

____

3. Plant nutrients may be composed both; (3 point)?

____

____

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

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

Answer Sheet

Score = ___________

Rating: ____________

Name: ___________________________   Date: _________________

Information Sheet 3- Developing program

3.1. Introduction

More and more, producers understand that healthy soils are more productive and lead to healthier crops. Dig into this interactive info graphic to learn more about sustainable production practices that can help build healthy soil. Explore the on-farm benefits of using cover crops, crop rotation, manure amendments, composting and more on the complex web of life below the surface of the soil. Plant nutrients, which come primarily from chemical fertilizers, manure, and in some cases sewage sludge, are essential for crop production. When applied in proper quantities and at appropriate times, nutrients (especially nitrogen, phosphorus, and potassium) help achieve optimum crop yields. However, improper application of nutrients can cause water quality problems both locally and downstream**.** Nutrition program in the horticultural or agricultural industry and defines the standard required to: recognize a range of common causes of nutrient deficiency; prepare fertilizers and other products for application to plants; apply fertilizers and other products; clean up and maintain tools and equipment; record work. Nutrient management is the practice of using nutrients wisely for optimum economic benefit, while minimizing impact on the environment.

To develop plant production the following are the most important:

- Signs of Nutrient Deficiencies: Describe nutrient deficiency symptoms and recognize environmental causes of nutrient deficiencies. Understand the interdependence of nutrients and their uptake.
- Soil Test and Analysis: Interpret soil test results based on macronutrients (N-P-K) and other characteristics. Example: pH, cation exchange capacity, drainage, structure.
- Fertilizer Labels: Understanding the information provided on a standard fertilizer label.
- Fertilizer Calculations: Calculate the amount of fertilizer to be applied and calibrate equipment to apply the prescribed amount of fertilizer.

3.1.1. Land preparation

When establishing a new date plantation, certain actions need to be implemented to ensure the long term success of the plantation. One of these actions involves the initial land preparation which should be done prior to transplanting of the plant material. The purpose of land preparation is to provide the necessary soil conditions which will enhance the successful establishment of the tissue culture plants received from the nursery. Considering the nature of the date palm, one cannot save on this operation and hope for long term sustainability of the plantation. The aim is to enable the date grower to plan and structure the implementation process in advance, ensuring the successful establishment of the date plantation. Planning forms part of the initial preparation and will help to limiting unnecessary stoppages during the implementation phase.

3.1.1.1. Field selection

The area selected for the establishment of the date plantation can infl uence the cost of land preparation to the extent that it may not be viable to proceed with the development at all. The authors' aim is to highlight the critical areas to be considered when selecting the land for the establishment of a new date plantation. Although not always realised, the date palm requires a rather large quantity of water for sustainable growth. Critical factors regarding water for irrigation purposes are:

- The sustainability of the water source,
- The quantity of water available for irrigation,
- The distance to the fi eld, and
- The quality of the water.

In time date palms grow very tall and become top heavy especially during the fruit bearing stage. They therefore need sufficient room for proper root development to support the palms. Besides the importance of root development, soil depth also infl uences drainage and leaching possibilities. Any obstructive layers must be evaluated to determine whether they will influence root development and whether they can be corrected. Date palms can grow and produce in different types of soil in both hot arid and semi-arid regions. Adaptation could go from a very sandy to a heavy clay soil. The soil quality is related to its drainage capacity mainly when soils are salty or the irrigation water is characterized with a high salt content. Sandy soils are common in most date plantations of the old world. Rare cases of clay soils (i.e. Basra-Iraq) with drainage systems are found allowing the culture of date palms. The optimum soil conditions are found where water can penetrate to at least 2 m deep.

When evaluating the soil quality, attention must be given to:

- The soil texture which will influence the water retention capacity, and
- The nutrient content to determine the corrective measures necessary for soil improvement.

Plant growth is influenced by either saline or acid soil conditions which, in the end, will result in a loss of potential yield. Saline and alcaline soils are common in date plantations and are characterized by a high concentration of soluble salts, and exchangeable sodium, respectively. Soluble salts present in these soils belong to cations: sodium, calcium and magnesium and to chloride and sulphate anions. Saline soils can be recognized by the presence of a white layer on the surface of the soil resulting from the high salt concentration which may harm the growth and development of date palm. These types of soil are usually difficult to correct coupled with a low production resulting from low content of calcium and nitrogen. However, it is recommended to eliminate the excess of sodium by the addition of acidifying agents (gypsum, sulphate of iron or sulphur).

- Saline and alkaline soils are usually the result of:
- An increase of the underground level caused by excessive drought situations (high evaporation);
- The use of high salt content water, and very poor drainage system.

Where date palm grows in climates of little rain, but great heat and much evaporation, irrigation or flood water evaporates quickly, and its salts are left on the surface of the soil.

Self-check 3	Written test

Name…………………………………………… ID………………………… Date…….

Directions: Answer all the questions listed below.

Test I: Short Answer Questions

1. To develop plant production what are the most important? (5 point)

____

____

2. What are critical factors regarding water for irrigation purposes are (5 point)

____

____

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

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

Answer Sheet

Score = ___________

Rating: ____________

Name: _________________________ Date: _______________

Information Sheet 4- Soil amendments, management practices and fertilizer requirements

4.1. Soil amendment

A soil amendment refers to any material added to the soil to improve its physical or chemical properties. With fresh fruits and vegetables, food safety concerns are most often associated with biological contamination by pathogens in manure-based soil amendments. However, chemical hazards associated with inorganic fertilizers can represent a chemical risk to crops as well as to those who apply the fertilizers. Many inorganic fertilizers are federally regulated so the first rule is to always follow the label because the label is the law. Proper storage practices and controlling access to these chemicals is also important to meet federal requirements and reduce the chance of chemical contamination on the farm.

Soil Amendments include the use of:

- Mulch
- Manures
- Compost
- Ph Levels
- Leaves and Mulches
- Plastic
- Crop Rotation

1. Manure (Animal dung)-When a crop is grown on land on which raw manure has recently been applied, there is a risk that the crop could be contaminated because of the likelihood of foodborne illness pathogens being present and the increased risk of crop contamination. If raw manure is used as a soil amendment or fertilizer, it should never be applied during the growing season and always be incorporated into the soil within 72 hours after application. The interval between raw manure application and harvest should be maximized. The required time frame between application and harvest varies throughout the industry. Aside from raw manure purposely applied to fields, it is important to consider manure that may enter the field through runoff, wildlife animal intrusion, or movement from adjacent lands that have domesticated farm animals. Manure-based soil amendments can harbor pathogens that can cause illness in humans and may contaminate produce when introduced into the production environment. Recommended time intervals from application of raw manure to the harvest of the produce crop vary from 90 days to 1 year. Composting manure can significantly reduce the risk of contamination.

2. Compost- Composting animal manure can reduce microbial pathogens and greatly reduce the risk of contamination to fruit and vegetable crops. Simply piling manure without actively managing and monitoring it, or using an anaerobic system (also called 'aging'), is not composting and therefore must be considered raw manure. If the same equipment or tools are used on raw, cured, or curing piles, be sure to clean and sanitize them after use on raw manure to avoid recontamination of the other piles. Compost must maintain a temperature of between 131 and 170°F for 3 days (enclosed system) or 15 days (windrow system), during which period the composting materials must be turned a minimum of five times. After these steps, the compost pile should cure for 45 days. Finished and curing compost piles should be covered in order to prevent recontamination.

Acceptable organic materials for compost include, but are not limited to:

- Animal manure,
- By-products of agricultural commodities processing,
- Yard debris, and kitchen wastes.

Detailed records should be kept of pile type (aerobic vs. anaerobic, enclosed, windrow, etc.), temperature and moisture management, dates turned, and the duration of high temperatures. Two overall objectives in soil nutrient management are to improve soil health and to meet the nutrient requirements of crops. Healthy soil, as defined by the Natural Resource Conservation Service, is the continued capacity of soil to function as a vital living ecosystem that sustains plants, animals, and humans. This definition specifies the need to meet nutrient requirements and crop productivity both in the short run and for long term production goals.

Determining crop nutrient requirements is a key starting point for creating a nutrient management plan. Often the nutrient-supplying capacity and physical makeup of a soil is determined through at-home or professional soil testing. Results from these soil tests will dictate which management practices and soil amendments will allow for an increase in crop yield or profitability, and should be performed on a regular basis dependent on the cropping regime. The nutrients that are often most critical for growers to consider are nitrogen, potassium, and phosphorous. An overabundance or excessive application of any of these nutrients may lead to environmental degradation through the release of nutrients into the surrounding environment. Soil testing will also reveal deficiencies of other nutrients and can provide a grower with information such as water holding capacity and soil acidity

Increasing soil organic matter is an important objective for improving soil health. The formation and decomposition of soil organic matter stores and releases energy and nutrients that, in turn, becomes available for plant uptake. In addition to nutrients, soil organic matter can improve soil texture, structure, and chemical balance, while providing habitat for a greater diversity of soil flora and fauna. Soil management techniques that are focused on increasing soil organic matter will tend to lead to systems with adequate nutrient supplies and storage capacity. Integrating the inclusion of cover crops, compost, or manure into a management system are all methods for increasing soil organic matter and nutrient availability without relying on chemical fertilizers. Using any of these techniques in a cropping system require assessing the site-specific nutrient needs and impacts that amendments may have. Under some circumstances, commercial fertilizers may be the most cost-effective and sustainable method for increasing soil health and managing nutrient uptake by crops.

3. Cover Crops- Professional growers will grow a cover crop in their field. The most common crop is an annual or winter rye grass. Alfalfa is also good. The grass sowed in the fall and plowed or roto-tilled in the spring. Cover crops benefit the field in two ways. First the grass adds nitrogen into the soil. Second, it can reduce soil erosion due to wind, rain and runoff during the long off season. This concept is commonly practiced in professional farming and is easily practiced in smaller home gardens. However, most home gardeners do not practice this.

4. Crop Rotation- Crop rotation means moving your crop from one area of your garden or field to another. This is and important concept for home gardeners as well as professional farmers in order to maintain the health of your soil. Rotating your crops helps to avoid depletion of nutrients and minerals in the soil. And, very importantly, it minimizes insect and disease as both of these can overwinter in your soil.

5. Saw dust-as mulch is usually a good practice if certain precautions are used to decrease the tie up of available soil nitrogen N-should be mixed with dry saw dust

Soil management strategy-The main objective of management for agriculture is to create favorable conditions for good crop growth ,seed germination ,emergence of the young plant , root growth and plant development ,grain formation and harvest.

Principle of soil management practice

Increase the soil cover-is the most important principles for sustainable soil management as it brings multiple benefits**:**

- Reduction of water and wind erosion
- Increase of the infiltration rate
- Reduction of moisture loss and increases moisture availability
- Reduction of soil temperature
- Improvements of conditions for germination
- Increase organic matter contain of surface
- Stimulation of biological activities in the soil
- Increase porosity

- Suppresses weed growth

Mechanisms to achieve a better soil cover-

- Leave all the crop residues in the field
- Practice a system of conservation tillage that leaves the residues on the surface and does not bury them as conventional tillage system
- Apply organic materials as manures or mulch to increase soil cover
- Increase the bio mass of (production of) bio mass in the field by sowing cover crop , inter crop , relay crop etc
- Grow crop that produce large quantities of residues
- Increase the chemical fertility of the soil through application of fertilizers and organic manure

Self-check 4	Written test

Name…………………………………………… ID……………………….. Date…….

Directions: Answer all the questions listed below.

Test I: Short Answer Questions

1. Define soil amendments? (5 point)

____

____

2. Soil amendments include? (10 point)

____

____

3. Write the principle of soil management practice? (5)?

____

____

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: _______________

Information Sheet 5- Identifying and costing resources, tools, equipment and machinery

5.1. Introduction

Agricultural machinery and equipment help farmers produce the goods that consumers want and need. Without the proper machinery and equipment, farmers would not be efficient enough to provide the food, clothing, and shelter that we need. Resources, tools, equipment's and machinery required during soil amending are:

- Back hoe
- Tractor
- PH test kit /electronic PH testing device
- Sample bags
- Tape measure
- Back pack spray equipment
- Plastic over lays
- Wheel bar
- Laboratory working tables
- Appropriate racks
- Weighing benches
- Cupboards
- Laboratory desks and chairs
- Fixed suction unit

- Baler
- Combine
- Crawler tractor
- Cultivator
- Drill
- Duster
- Geographic information system (GIS)
- Global Positioning System (GPS)
- Harrow
- Harvesting equipment
- Implement
- Mower
- Picker
- Planter
- Planting equipment
- Plow
- Sprayer
- Tillage equipment
- Tractor
- Wheeled tractor

Are may be needed at a time of soil amendment, management practice .Some of their picture is given below. To be effective, an amendment must be thoroughly mixed into the soil not merely buried, lumped in or placed on the soil surface.

Figure: tools and equipment's of machinery

The backhoe is a piece of heavy construction machinery made out of 3 main parts: a tractor, a front loader and a backhoe. It is generally used to move earth and dig trenches. In this room the more traditional analytical processes are carried out, e.g., pH, electrical conductivity, and anions and cations.

Self-check 5	Written test

Name…………………………………………… ID………………………… Date…….
Directions: Answer all the questions listed below.
Test I: choose the best answer

1. Without the proper machinery and equipment, farmers would not be efficient enough to provide the food, clothing, and shelter that we need? (5 point)

A.True B. False

2. Which one of the following is tools and equipment is used for soil health?

A. GPS B. GIS C. machinery D. all

Test II: Short Answer Questions

3. Write the equipment's and machinery required during soil amending? (5 point)

____

____

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: _______________

Information Sheet 6- Cost-effective approach to soil management, soil amendment

Soil amendment includes all inorganic and organic substances mixed into the soil for achieving a better soil constitution regarding plant productivity. Soil amendment does not include mulching, which includes substances lying on top of the soil. There are different substances for different soils and plants to optimize the soil conditions. A very common amendment is the addition of organic matter like compost, due to its low production costs. Soil amendments improve the physical properties resulting in better conditions for water storage, root development and soil ecosystems, Soil amendments enhances soil aeration, Soil amendments can be produced locally, especially organic amendments (e.g. compost), which are cheap to produce and Soil amendments can be applied almost everywhere by almost anybody.

Cost-effective approaches to soil amendments are:

- Use of manure
- Use of farm yard manure
- Proper incorporation of crop residues in to the soil
- Use of cover crop
- Inter cropping
- Crop rotation
- Fallowing and etc

Self-check 6	Written test

Name…………………………………………… ID………………………… Date…….

Directions: Answer all the questions listed below.

Test I: Short Answer Questions

1. What is cost effective approach of soil amendment? (5 point)

____

____

2. Cost-effective approaches to soil amendments were (5)?

____

____

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: _______________

Information Sheet 7- Identifying Environmental implications of program

7.1. Introduction

Adequate plant nutrition is essential for commercial crop production. Nutritional programs commonly use commercially prepared inorganic fertilizers applied to the soil by broadcast, through the irrigation system or by foliar sprays. Application of fertilizers and soil amendments are subject to a number of different regulatory schemes. Nutrient content of soil amendments may vary and should be documented. Fertilizer budgets based on expected plant nutritional needs for each growing season should be assessed to insure that fertilizer applications are within plant needs. Excessive application of nutrients is uneconomical, can lead to lush growth that is more susceptible to disease and pests, and can cause ground and surface water pollution. Manure has historically been used as a source of plant nutrients and soil amendment in many agricultural systems. When based upon a sound waste management program, land application of manure can be an economically sound agricultural decision. However, if not managed properly, waste application can be an environmental hazard.

7.2. Factors to Consider When Choosing an Amendment

There are at least four factors to consider in selecting a soil amendment:

- how long the amendment will last in the soil,
- soil texture,
- soil salinity and plant sensitivities to salts, and
- salt content and pH of the amendment

Soil Texture: Soil texture, or the way a soil feels, reflects the size of the soil particles. Sandy soils have large soil particles and feel gritty. Clay soils have small soil particles and feel sticky. Both sandy soils and clay soils are a challenge for Gardeners. Loam soils have the ideal mixture of different size soil particles. When amending sandy soils, the goal is to increase the soil's ability to hold moisture and store nutrients. To achieve this, use organic amendments that are well decomposed, like composts or aged manures. With clay soils, the goal is to improve soil aggregation, increase porosity and permeability, and improve aeration and drainage.

Soil Salinity and Plant Sensitivity to Salts: Some forms of compost and manures can be high in salts. Avoid these amendments in soils that are already high in salts (above 3 mmhos/cm) or when growing plants that are sensitive to salts. Raspberry, strawberry, bean, carrot, onion, Kentucky bluegrass, maple, pine, viburnum and many other landscape plants are salt sensitive.

Salt Content and pH of the Amendment: Always beware of salts in soil amendments. High salt content and high pH are common problems in soils. Therefore, avoid amendments that are high in salts or that have a high pH. Amendments high in salts and/or pH include wood ash. Ask for an analysis of the organic amendments that you are considering, and choose your amendments wisely. If no analysis is available, test a small amount of the amendment before purchasing a large quantity.

Wind erosion: Is particularly a problem in windy areas when the soil is not protected by residue cover. Wind erosion in the United States is most widespread in the Great Plains states, as can be seen in the map at right. Wind erosion is a serious problem on cultivated organic soils, sandy coastal areas, alluvial soils along river bottoms. **Impacts of soil erosion**: Soil erosion has both on-farm impacts (reduction in yield and farm income) and off-farm impacts (contaminated water due to the sediment and associated contamination from nutrients and pesticides carried on the soil particle).

On-farm impacts due to the loss of soil and nutrients include:

- lower fertility levels
- development of rills and gullies in the field
- poorer crop yields
- less water infiltration into the soil
- more soil crusting
- more runoff in the spring and after storms

When fertile topsoil is lost, nutrients and organic matter needed by crops often are removed along with it. Erosion tends to remove the less dense soil constituents such as organic matter, clays, and silts, which are often the most fertile part of the soil.

Self-check 7	Written test

Name…………………………………………… ID……………………… Date…….

Directions: Answer all the questions listed below.

Test I: Short Answer Questions

1. What are factors to consider in selecting a soil amendment? (5 point)

____

____

2. Write on-farm impacts due to the loss of soil and nutrients? (5 point)

____

____

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: _______________

LG #72	**LO # 3- Document the soil health and plant nutrition program and specifications**

Instruction sheet
This learning guide is developed to provide you the necessary information regarding the following content coverage and topics: • Establishing detailed plan, objectives, specifications and associated costs • Developing and documenting detailed on-site procedures and schedules This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to: • Establish detailed plan, objectives, specifications and associated costs • Develop and document detailed on-site procedures and schedules
Learning Instructions:
1. Read the specific objectives of this Learning Guide. 2. Follow the instructions described below. 3. Read the information written in the "Information Sheets". Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them. 4. Accomplish the "Self-checks" which are placed following all information sheets. 5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks). 6. If you earned a satisfactory evaluation proceed to "learning guide.

Information Sheet 1- Establishing detailed plan, objectives, specifications and associated costs

1.1. Introduction

Detailed plan, objectives, specifications and associated costs are established based on program requirements and are presented to land manager. To document the soil health and plant nutrition program and specifications it is important to establish the detail plan on soil health and plant nutrition program and this plan must have objective which indicates or answers the question why the plan is under taken and this objectives also have specifications which is describes the aim of your objectives and associated cost to undertake soil health development and plant nutrition program in terms of man power, equipment required, machinery required etc.

Soil health is not an end in itself. Soil, water, sunlight and air are the primary natural resources for agricultural production. Of these four, soil is the most complex component and is also highly sensitive to management. The term soil health conjures up the sense of soil as living, productive and, by implication, something that can at times be unhealthy, incapacitated and unproductive. Soil is a finite resource on the farm. The farm enterprise is adapted to this resource in terms of the total land area of the farm and soil quality. These factors combine with season temperatures and water availability to determine the choice of produce, the production system, and the productive potential of the enterprise. Soil health is important for sustainable farming because a healthy soil performs the functions that are expected of it. Annual maintenance costs to restore soil to a functionally healthy state can be avoided - e.g. changing from cultivation practices to zero tillage and controlled traffic systems reduces fuel costs and maintains soil structure. The costs of substituting management interventions for services that soil could provide can also be reduced or eliminated - e.g. soil borne disease management. There is also a bigger picture, beyond the farm. Environmental impacts of inadequate soil management include groundwater contamination, surface water quality degradation (nutrients and turbidity), and destruction of infrastructure (e.g. erosion and deposition). On the positive side, a soil health management plan for a farm potentially enhances property value, provides evidence that can be used in environmental accreditation for 'clean and green' products. Objective procuring entities when procuring goods, services or works should consider long term economic viability, minimizing any adverse environmental impact arising from procurement performance, as well as improve social conditions and stimulate the market to further innovate sustainable production. Environmental performance criteria in purchasing decisions may relate to maximum energy efficiency, minimum use of toxic chemicals and other pollutants, maximum use of products based on recycled materials and/or minimum use of unnecessary packaging and other superfluous material.

Costs Associated with soil test and plant nutrient program were:

The costs of a facility to the owner include both the initial capital cost and the subsequent operation and maintenance costs. Each of these major cost categories consists of a number of cost components. The capital cost for project includes the expenses related to the initial establishment of the facility:

- Land acquisition, including assembly, holding and improvement
- Planning and feasibility studies
- materials, equipment and labor
- Field supervision
- n financing
- Insurance
- Owner's general office overhead
- Equipment and furnishings not included in construction
- Inspection and testing

Self-check 1	Written test

Name…………………………………………… ID………………………… Date…….

Directions: Answer all the questions listed below.

Test I: Choose the best answer (5 point)

1. Detailed plan, objectives, specifications and associated costs are established based on program requirements**.**

A. True B. False C. A&B

Test II: Short Answer Questions

2. Write the primary natural resources for agricultural production.

____

____

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

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

Answer Sheet

Score = ___________

Rating: ____________

Name: _________________________ Date: _______________

Information Sheet 2- Developing and documenting detailed on-site procedures and schedules

2.1. Introduction

The idea that one could test or analyze a soil and obtain some information about properties especially its acidity or alkalinity and its nutrient status is long established, and can be traced back to the beginning of scientific inquiry about the nature of soil. Analyses of plants to reflect the fertility status of the soil in which they grew is more recent, although visual crop observations are as old as the ancient Greeks, if not older. In the last few decades, spurred on by commercialization of agriculture and the demands for increased output from limited and even diminishing land resources, both soil and plant analysis procedures have been developed, and are still evolving. With the advent of chemical fertilizers, the need to know nutrient status of a soil in order to use such expensive and limited inputs more effectively became all the more crucial. However, if soil testing is to be an effective means of evaluating fertility status of soils, correct methodology is absolutely essential. A soil or a field may be assessed for its capability of providing a crop with essential nutrients in several ways:

- Field plot fertilizer trials,
- Greenhouse pot experiments
- Crop deficiency symptoms
- Plant analysis
- Rapid tissue or sap analysis
- Biological tests
- Soil testing prior to cropping

While all these approaches can be used in research, the latter one is most amenable, and one upon which recommendations for farmers can be based. Detailed on-site procedures and schedules required for program are developed and documented. In this the description of on-site procedures which explain in detailed and the schedule required for program are developed and clearly documented.

Remark: 1.The air-dry moisture in a soil sample taken straight from a hot and humid storeroom (or a very cold one) may be different from that in a similar sample kept in an air-conditioned laboratory; both may be weighed for analysis at the same time as “air-dry’ samples.

2. The tap water supplied to a laboratory should be entirely free of pollution, as free as possible from insoluble matter, and under good and steady hydrostatic pressure. It may be necessary to filter the supply to certain pieces of equipment.

3. Drainage should be to a main drain if possible or to good-sized “soak-away”. Effluents from soil laboratories contain considerable quantities of waste soil in addition to acid and alkaline liquids. The facilities should be provided in the design of the drainage system for periodic cleaning and removal of solid matter.

At the end of the working day, wash the pipette with tap water and then several times with distilled water, Dry the pipette in an oven, Keep the pipette upside down in a special clamp.

Table: Reporting schedule format

Reporting schedule				
Report type/ event	Frequency (deadlines)	Audience/ purpose	Responsibility	Format/outlet
Add rows as needed.				

Self-check 2	Written test

Name…………………………………………… ID………………………… Date…….

Directions: Answer all the questions listed below.

Test I: True or false (4 points).

1. Air-dry moisture in a soil sample taken straight from a hot and humid storeroom may be different from that in a similar sample.

2. Soil or a field may be assessed for its capability of providing a crop with essential nutrients using scheduling and documenting.

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

Answer Sheet

Score = ___________

Rating: ____________

Name: _________________________ Date: _______________

LG #73	LO# 4- Monitor production and evaluate the program.

Instruction sheet
This learning guide is developed to provide you the necessary information regarding the following content coverage and topics: • Monitoring program implementation and results • Reviewing and refining Program • Identifying Non-compliance with documented objectives and specifications • Implementing remedial actions • Incorporating agreed changes This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to: • Monitor program implementation and results • Review and refine Program • Identify Non-compliance with documented objectives and specifications • Implement remedial actions • Incorporate agreed changes
Learning Instructions:

1. Read the specific objectives of this Learning Guide.

2. Follow the instructions described below.

3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.

4. Accomplish the “Self-checks” which are placed following all information sheets.

5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).

6.If you earned a satisfactory evaluation proceed to “learning guide.

Information Sheet 1- Monitoring program implementation and results

1.1. Monitoring

Monitoring is the continuous collection of data on specified indicators to assess for a development intervention (project, programme or policy) its implementation in relation to activity schedules and expenditure of allocated funds, and its progress and achievements in relation to its objectives. Degradation issues such as erosion, loss of organic matter, compaction and contamination, all which affect soil functions, are common around the world and will continue to grow as the need for food and fiber increases. Maintaining soil productivity while ensuring environmental health is an ongoing issue which requires soil quality to be defined and evaluated. Monitoring of the soil is essential to assess the sustainability of the soil resource in response to human induced pressures such as land use and soil contamination. Monitoring is defined as the repeated inventory of an item to determine trend and status. One method of monitoring soils is benchmark sampling. The basic principle of benchmark sampling is to sample at the same location each year. Benchmark sites are representative of larger areas and are usually about a quarter acre (0.1 ha) in size. Sampling with this method is less expensive and time consuming than traditional grid sampling and is more consistent because it assumes the benchmark area is less variable than the larger area which it represents. Monitoring can be carried out at the project, programme or policy levels. Monitoring provides managers and other stakeholders with regular information on progress relative to targets and outcomes. It is descriptive and should identify actual or potential successes and problems as early as possible to inform management decisions. A reliable flow of relevant information during implementation enables managers to keep track of progress, to adjust operations to take account of experience and to formulate budgetary requests and justify any needed increase in expenditure. Indeed, an effective management information system that performs these functions is an essential part of good management practice.

Monitoring systems provide managers and other stakeholders with regular information on progress relative to targets and outcomes. This enables managers to keep track of progress, identify any problems, alter operations to take account of experience, and develop any budgetary requests and justify them. This enables the early identification of problems so that solutions can be proposed. It is considered to be a critical part of good management. Thus, the key reasons for monitoring can be summarized under four headings.

1.For accountability: demonstrating to donors, taxpayers, beneficiaries and implementing partners that expenditure, actions and results are as agreed or can reasonably be expected in the situation.

2. for operational management: provision of the information needed to co-ordinate the human, financial and physical resources committed to the project or programme, and to improve performance

3. for strategic management: provision of information to inform setting and adjustment of objectives and strategies.

4. for capacity building: building the capacity, self-reliance and confidence of beneficiaries and implementing staff and partners to effectively initiate and implement development initiatives.

Soil Quality Program was established to determine the state of soil quality to determine the risk of change in soil quality with various management practices. The Soil Quality Program realized that soil quality models (i.e. crop growth models and soil degradation models) would need to be employed because of limited resources, a large diverse farming area and the time required observing measured changes in soil parameters. Consequently, a need for a monitoring network of sites to provide data to test and validate these models was identified. Soil quality program were established with the following objectives in mind:

• provide a dataset to test and validate simulation models
• provide baseline soil information
• evaluate landform effects on soil quality
• monitor changes in soil quality over time on a field landscape basis

Self-check 1	Written test

Name…………………………………………… ID………………………… Date…….

Test I: Short Answer Questions

1. What is monitoring? (5 point)

____

2. Write the key reasons for monitoring? (3 point)

____
____
____

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

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

Answer Sheet

Score = ___________

Rating: ____________

Name: _________________________ Date: _______________

Information Sheet 2- Reviewing and refining program

2.1. Introduction

Effective collaboration is characterized by dense, frequent sharing of knowledge among participants, with the aim of addressing the identified challenges. Members of highly effective groups interact frequently among themselves, focusing on refining and consolidating professional practice. They also connect outwards to gain new knowledge that will complement what they already know and to maintain connections with, and participate in, larger networks.

A review is a structured opportunity for reflection to identify key issues and concerns, and make informed decisions for effective project/programme implementation. While monitoring is ongoing, reviews are less frequent but not as involved as evaluations. Reviews as an internal exercise, based on monitoring data and reports. They are useful to share information and collectively involve stakeholders in decision-making. They may be conducted at different levels within the project/programme structure (e.g. at the community level and at headquarters) and at different times and frequencies. Reviews can also be conducted across projects or sectors. It is best to plan and structure regular reviews throughout the project/programme implementation.

Review techniques:

- Re-read to the original assignment to be certain your test addresses all of the requirements. Then read your paper section by section to make sure you're on target. If you're not, be prepared to add or delete large portions of text.
- Use the power of peer-review: find a classmate, a friend, or a writing tutor to review the paper with you and look for weaknesses and errors.
- If you finish in ample time, ask you person (expert) if he or she is willing to give.

Refining can be used the strategy he had refined during the turnover at Temple, which was writing and rewriting concepts until they lodged in his brain.

To ensure soil and plant nutrient program that you have planned, to implement it is necessary to review and refine as if it is responsive to changing conditions. You may simply ask your self-question like:

- Is it the plan bring change or not?.
- Is it the plan improve the soil health problems?
- Is it the plan solve plant nutrition problem?
- Is the plan appropriately meeting our objective requirements?

By answering that question you can review and refine the program.

Self-check 2	Written test

Name…………………………………………… ID………………………… Date…….

Directions: Answer all the questions listed below.

Test I: Short Answer Questions

1. Write review techniques for soil monitoring (5 point)

____

____

2. What is refining? (3 point)

____

____

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

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

Answer Sheet

Score = ___________

Rating: ____________

Name: _________________________ Date: _______________

Information Sheet 3- Identifying Non-compliance with documented objectives and specifications

3.1. Non-compliance

Noncompliance is defined as failure or refusal to comply with something (such as a rule or regulation) or a state of not being in compliance. Noncompliance is commonly identified in the following ways: A report or complaint received from a participant, research team member, or others. A report initiated by the Investigator through a Reportable Event Form. Information provided in a Continuing review. Human behavior, particularly compliance, is a central component of conservation program. Compliance with conservation rules (e.g., no hunting, no firewood extraction) is critical to the success of any conservation project, regardless of the scale of the conservation actions, the categories of biodiversity the project focuses on, or the means of conservation governance. Non-compliance with conservation rules (i.e., rule violations) can undermine conservation goals, and have wide-ranging impacts on the social–ecological systems in which all conservation actions are embedded. Non-compliance in biodiversity conservation is a global challenge, one that is growing increasingly complex and attracting the attention of a wider array of scholars and practitioners from the conservation field.

While reviewing and refining the program ,it is important to identify non-compliance with documented objectives and specification and take remedial action to alleviate or overcome identified short coming of the program.

Self-Check – 3	Written test

Name………………………………………… ID………………………… Date…….

Directions: Answer all the questions listed below.

Test I: Short Answer Questions

1. While reviewing and refining the program, it is important to identify_________________________ with documented objectives and specification? (5 points)

2. How noncompliance is commonly identified? (2 points)

____

____

3. Define noncompliance?(3) ____

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: _______________

Information Sheet 4- Implementing remedial actions

4.1. Introduction

A remedial action is a change made to a nonconforming product or service to address the deficiency. This also can refer to restoration of a landscape from industrial activity. Rework and repair are generally the remedial actions taken on products, while services usually require additional services to be performed to ensure satisfaction.

Plant nutrient improvement (remedial action) may include:

- Adjusting to soil amendment
- Changing to fertilizer application and soil amendment
- Nutrient application rates and methods
- Use of foliar spray if other methods

Integrated nutrient management

Adequate plant nutrient supply holds the key to improving the food grain production and sustaining livelihood. Nutrient management practices have been developed, but in most of the cases farmers are not applying fertilizers at recommended rates. They feel fertilizers are very costly and not affordable and due there is a risk particularly under dry land conditions. Therefore, INM plays an important role which involves integrated use of organic manures, crop residues, green manures, Biofertilizer. with inorganic fertilizers to supplement part of plant nutrients required by various cropping systems and thereby fulfilling the nutrient gap. The basic concept underlying the principle of integrated nutrient management is to maintain or adjust plant nutrient supply to achieve a given level of crop production by optimizing the benefits from all possible sources of plant nutrients. The basic objectives is to reduce the inorganic fertilizer requirement, to restore organic matter in soil, to enhance nutrient use efficiency and to maintain soil quality in terms of physical, chemical and biological properties. Bulky organic manures may not be able to supply adequate amount of nutrients, nevertheless their role becomes important in meeting the above objectives. Increase the soil cover-is the most important principles for sustainable soil management as it brings multiple benefits**:**

- Reduction of water and wind erosion
- Increase of the infiltration rate
- Reduction of moisture loss and increases moisture availability
- Reduction of soil temperature
- Improvements of conditions for germination
- Increase organic matter contain of surface
- Stimulation of biological activities in the soi
- Keeping water free of harmful bacteria (disinfection)
- Minimising harmful disinfection by-products
- Eliminating lead from pipework
- Preventing pesticides from entering our waters
- Managing risks to water supplies
- Ensuring all water treatment plants are effective

Self-Check – 4	Written test

Name…………………………………………… ID………………………… Date…….

Directions: Answer all the questions listed below.

Test I: Short Answer Questions

1. Write factors, which influence the cost of an inventory?

____

____

2. Identify cost and benefit in forest intervention?

____

____

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

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

Answer Sheet

Score = ___________
Rating: ____________

Name: _________________________ Date: _______________

Information Sheet 5- Incorporating agreed changes

5.1. Standardization Method

Results can only be validly compared to one another when they have been obtained using standardized methods. Collaboration between laboratories can be improved by exchanging reference materials and then comparing their results. Such materials are referred as External References. An example of such standardization is the exchange network of International Soil Reference and Information Center in the operating international soil and plant analytical exchange programs. Most external reference samples are costly, and their frequent use increases operating costs of the laboratory. Internal reference samples are usually much less expensive. Thus, if a relationship between external and internal reference samples can be firmly established, frequent use of internal reference sample, with occasional use of the external reference sample, can reduce costs, while still providing acceptable quality assurance.

Self-Check – 5	Written test

Name………………………………………… ID………………………… Date…….

Directions: Answer all the questions listed below.

Test I: True or False

1. Collaboration between laboratories can be improved by exchanging reference materials.

2. Relationship between external and internal reference samples can be firmly established.

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

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

Answer Sheet

Score = ___________

Rating: ____________

Name: _________________________ Date: _______________

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WEB ADDRESSES

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