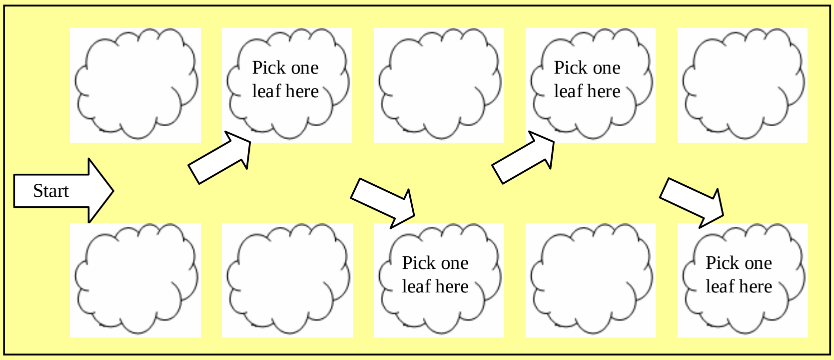
NQF Level: 2 US No: 116053

Learner Guide

Primary Agriculture

Understand Basic Soil Fertility and Plant Nutrition



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Before we start…

Dear Learner - This Learner Guide contains all the information to acquire all the knowledge and skills leading to the unit standard:

Title:	Understand basic soil fertility and plant nutrition				
US No:	**116053**	**NQF Level:**	2	**Credits:**	5

The full unit standard will be handed to you by your facilitator. Please read the unit standard at your own time. Whilst reading the unit standard, make a note of your questions and aspects that you do not understand, and discuss it with your facilitator.

This unit standard is one of the building blocks in the qualifications listed below. Please mark the qualification you are currently doing:

Title	ID Number	NQF Level	Credits	Mark
National Certificate in Plant Production	48975	2	120	❐
National Certificate in Animal Production	48976	2	120	❐
National Certificate in Mixed Farming Systems	48977	2	120	❐
National Certificate in Plant Production	48975	2	120	❐

Please mark the learning program you are enrolled in:

Your facilitator should explain the above concepts to you.

Are you enrolled in a:	Y	N
Learnership?	❐	❐
Skills Program?	❐	❐
Short Course?	❐	❐

This Learner Guide contains all the information, and more, as well as the activities that you will be expected to do during the course of your study. Please keep the activities that you have completed and include it in your **Portfolio of Evidence**. Your PoE will be required during your final assessment.

You will be assessed during the course of your study. This is called *formative assessment*. You will also be assessed on completion of this unit standard. This is called *summative assessment*. Before your assessment, your assessor will discuss the unit standard with you.

What is assessment all about?

You will be assessed during the course of your study. This is called *formative assessment*. You will also be assessed on completion of this unit standard. This is called *summative assessment*. Before your assessment, your assessor will discuss the unit standard with you.

Assessment takes place at different intervals of the learning process and includes various activities. Some activities will be done before the commencement of the program whilst others will be done during programme delivery and other after completion of the program.

The assessment experience should be user friendly, transparent and fair. Should you feel that you have been treated unfairly, you have the right to appeal. Please ask your facilitator about the appeals process and make your own notes.

How to use the activity sheets…

Your activities must be handed in from time to time on request of the facilitator for the following purposes:

- The activities that follow are designed to help you gain the skills, knowledge and attitudes that you need in order to become competent in this learning module.
- It is important that you complete all the activities and worksheets, as directed in the learner guide and at the time indicated by the facilitator.
- It is important that you ask questions and participate as much as possible in order to play an active roll in reaching competence.
- When you have completed all the activities and worksheets, hand this workbook in to the assessor who will mark it and guide you in areas where additional learning might be required.
- You should not move on to the next step in the assessment process until this step is completed, marked and you have received feedback from the assessor.
- Your facilitator should identify sources of information to complete these activities.
- **Please note** that all completed activities, tasks and other items on which you were assessed must be kept in good order, as it becomes part of your **Portfolio of Evidence** for final assessment.

Enjoy this learning experience!

How to use this guide …

Throughout this guide, you will come across certain re-occurring "boxes". These boxes each represent a certain aspect of the learning process, containing information, which would help you with the identification and understanding of these aspects. The following is a list of these boxes and what they represent:

What does it mean? Each learning field is characterized by unique terms and **definitions** – it is important to know and use these terms and definitions correctly. These terms and definitions are highlighted throughout the guide in this manner.

You will be requested to complete **activities**, which could be group activities, or individual activities. Please remember to complete the activities, as the facilitator will assess it and these will become part of your portfolio of evidence. Activities, whether group or individual activities, will be described in this box.

Examples of certain concepts or principles to help you contextualise them easier, will be shown in this box.

The following box indicates a **summary** of concepts that we have covered, and offers you an opportunity to ask questions to your facilitator if you are still feeling unsure of the concepts listed.

My Notes …

You can use this box to jot down questions you might have, words that you do not understand, instructions given by the facilitator or explanations given by the facilitator or any other remarks that will help you to understand the work better.

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What are we going to learn?

What will I be able to do?		**6**
Learning Outcomes		**6**
What do I need to know?		**6**
Session 1:	**The properties and structure of soil**	**7**
Session 2:	**The role of minerals in soil health**	**19**
Session 3:	**The basic symptoms of nutritional deficiencies**	**27**
Session 4:	**Procedures for the preparation of nutrients**	**34**
	Am I ready for my test?	**42**
	Checklist for Practical assessment	**44**
	Paperwork to be done	**45**
	Glossary	**46**
	Bibliography	**47**
	Terms and Conditions	**48**
	Acknowledgements	**48**
	SAQA Unit Standard	

What will I be able to do?

When you have achieved this unit standard, you will:

- Be able to apply basic soil nutrient preparations in a safe, effective and responsible manner for the benefit of plant/crop growth with consideration to the environment.
- Gain specific knowledge and skills in soil nutrient and preparation and will be able to operate in a plant production environment implementing sustainable and economically viable production principles.
- Accurately prepare and measure the appropriate quantity and quality of required soil nutrient preparations.
- Take an appropriate sample for nutrient analysis.
- Understand the properties of soil and soil composition.
- Identify and interpret the basic symptoms of nutritional deficiencies in crops.

What do I need to know?

It is expected of the learner attempting this unit standard to demonstrate competence against the unit standard:

- NQF 1: Fertilise soil and attend to basic plant nutrition.
- NQF 1: Collect agricultural data.
- NQF 2: Demonstrate a basic understanding of the structure and functions of a plant.

Learning Outcomes

At the end of this learning module, you must is able to demonstrate a basic knowledge and understanding of:

- Fertilisers, mixtures, single, etc. if appropriate.
- Nutrient sources such as organic, compost, etc.
- Soil conservation.
- Soil preparation and improvement.
- Basic ecological principles.
- Sampling (soil, leaf, and fruit).
- Basic soil properties.

Session 1 The properties and structure of soil

After completing this session, you should be able to:
SO 3:.Understand the properties o soil and soil composition

In this session we explore the following concepts:

- The importance of soil in crop production.
- Soil structure and soil texture.

1.1 The importance of soil in crop production

The ability of plant roots to grow, take up nutrients and water, and "breathe" is influenced by the physical and chemical properties of the soil. It is therefore essential that these properties are well understood.

In most cases, the soil available for crop cultivation is not ideal. This means the farmer has to correct or improve on these soil conditions.

In almost all cultivation practices, plants require soil to grow in. Plants need soil for four main purposes, they are:

- **Stay Upright** – Plant roots anchor the plant in the soil. This means that the roots must be able to penetrate the soil sufficiently to enable the plant to be anchored.
- **Nutrient Absorption** – Plants take up, or absorb, nutrients from the soil through their roots. Plants can also absorb nutrients through their leaves, or foliage, but most often they use their roots.
- **Water Absorption**– Plants absorb water through their roots from the soil.
- **Absorption of Oxygen (Air)** – The roots of a plant, like the rest of the plant above the soil, has to absorb the air that the roots need for metabolic processes.

1.2 Soil structure and soil texture

Soil properties can be divided into two groups, physical properties and chemical properties.

Physical Soil Properties

The physical properties of soil are to a great extent fixed and cannot easily be changed in the short term. These properties play a vital role in the sustainable productivity of soils. The physical properties can be evaluated visually.

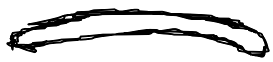
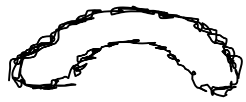
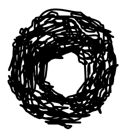
The most important physical properties of soils are:

- Texture.
- Structure.
- Depth.
- Layering or stratification.
- Aeration.

Soil texture is generally determined in a laboratory, but can be estimated fairly accurately in the field. To do the field, estimate the following:

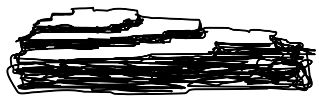
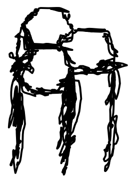
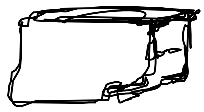
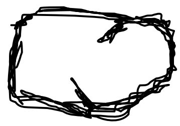
- Take about 50g soil;
- Add water to wet the soil;
- Knead the soil into a thick paste;
- Roll the soil between the palms of your hands into a sausage; and
- Shape the soil "sausage" into a circle.

The soil textural class can then be determined as follows:

Textural Class	Shape of Sausage	Clay Content	Illustration
Sand	It is not possible to roll a sausage in the palm. The soil does not stick together.	Less than 10%	
Loamy Sand (LoSa)	It is possible to roll a sausage, but the sausage cannot be bent at all without cracking or breaking.	10 to 15%	
Sandy Loam (SaLo)	The sausage can be bent slightly, with the tips bent downwards for about 10mm without the sausage cracking in the middle.	15 to 25%	
Sandy Clay Loam (SaClLo)	The sausage can be bent down at the tips to about 20mm without cracking in the middle.	25 to 35%	
Sandy Clay	The sausage can be bent to form a semi-circle without cracking in the middle.	35 to 50%	
Clay	The sausage can be bend to form a complete circle without cracking in the middle.	>50%	

- ### Soil Structure

Soil structure refers to the manner in which all the soil particles, including organic material, are arranged to form structural units. The structural units are named according to their physical appearance, as follows:

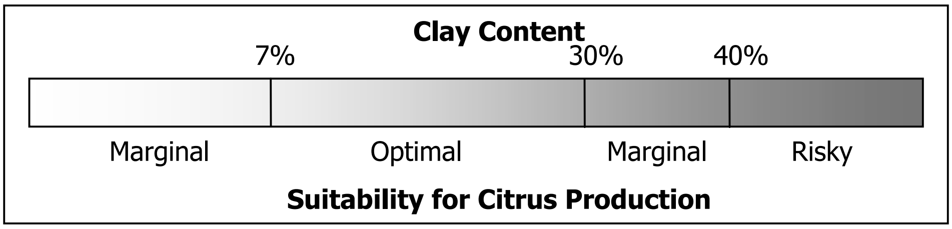
Structural Unit	Description	Illustration
No structure	This is usually the case in sandy soils where no aggregation of soil particles is present. The soil falls apart when removed from the profile.	
Plate-like	The natural cracks are horizontal.	
Prismatic	The vertical cracks are better displayed than the horizontal ones. The units are 2 to 5 times as long as they are broad.	
Blocky	The vertical and horizontal cracks are evenly developed and the dimensions of the units are about the same. The units have sharp edges and smooth faces. The units range in size from 1mm to 50mm.	
Granular	These units have rounded edges with rough faces. They range in size from 1mm to 10mm. When wet, these units trap more air than the blocky or prismatic units.	

Soil structure is a very important property that regulates processes related to plant production. These include aeration, water penetration and drainage. If the structure of the soil is destroyed, the soil becomes anaerobic (containing no oxygen) and waterlogged.

Soil can also be classified using other systems where the relationship between the percentage clay, silt and sand are presented in a triangle. This is a more sophisticated classification. This triangle shows twelve different textural classes. The sand section is for instance split into three different classifications, being course, medium and fine sand. The average size of the clay particles is <0.002mm, that of silt 0.05mm to 0.002mm and sand 0.05mm to 2mm.

An aspect of soil texture is the content of particles larger than 2mm. This fraction is referred to as gravel and/or stones. When the gravel content of the soil exceeds 10%, it should be taken into account when interpreting the chemical composition of the soil. Gravel dilutes the concentration of available nutrient elements.

Clay and organic matter (humus) are the active materials in soil. The humus content of soil can be intentionally increased, but it is more often decreased by agricultural practises. The clay content, however, is a fixed property and cannot be changed economically. The type and concentration of clay determines the cation-exchange capacity, water-holding capacity, aeration, and many other soil properties. The type of soil preferred by different crops differs between crops. The ideal soil for example for citrus production is one that contains less than 50% small particles (fine sand, silt and clay) and less than 25% clay. The figure below shows the relationship between clay content and soil suitability for citrus production.



Clay Content of Soil vs. Suitability for Citrus Production

Please complete Activity **1** at the end of the session

My Notes ...

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- **Soil Depth**

The depth at which impermeable layers and/or parent material are present determines soil-depth. Soils with a depth of less than 500mm are generally regarded as soil of low potential. The effective depth of a soil is the depth to which the crop roots can penetrate with ease.

- **Soil Layering or Stratification**

It takes about 1,000 years for a 25mm layer of soil to develop. During the formation of soil, soil particles are separated and accumulate at various depths. Soils are also carried and deposited by water and wind to form soil layers with different soil properties.

The soil layers have an influence on the potential of the soil. If the properties, especially the texture, of two underlying soil layers differ too much, plant roots will not grow into the next layer. Similarly water will not penetrated the second layer, but rather flow away along the merger of the two layers. A simple way to determine if layering could be a problem is by determining the texture of both layers. If the texture differs by more than 50% the layer will cause a problem. If for example, if the top soil contains 20% clay and the next layer more than 30% (50% of 20=10%), the stratification of the soil is too severe and will impede root growth and water movement.

♦ **Soil Aeration**

Plant roots respire (use oxygen and excrete carbon dioxide) and so soil oxygen must be replaced constantly. The rate at which oxygen-carrying air moves through soil depends on factors such as soil pore-size. The size of the soil pores depends on the texture, structure and strength of the soil.

The soil pores are filled with water and air, with the ratio between air and water being determined by the water content of the soil. At field water capacity (FWC), the soil air content is at its minimum. As the plant roots absorb the water in the soil, the air content in the soil increases. In soils that are poorly drained, the pores are filled with more water than at FWC and less air (oxygen) will be present. Water logged soil therefore contain very little oxygen and the anaerobic conditions that develop cause roots to die.

Field Water Capacity (FWC):

Field Water Capacity (FWC) is reached when there is no free water is present in the soil. All the water present is bound to the soil particles. This means that water does not move out of the soil profile through leaching.

Chemical Soil Properties

The chemical properties of soil are constantly changing, and can be changed. The most relevant chemical properties of soil are:

- pH.
- Resistance or electrical conductivity.
- Fertility.
- Salinity.
- Cation exchange capacity.
- Organic matter.

- **Soil pH**

pH is a measure of the concentration of the hydrogen ion (acid ion). A pH reading can range from 1 (extremely acidic) to 14 (extremely alkaline). A pH value of 7 is neutral.

When the pH of soil is measured, a suspension of the soil is prepared. pH values are reported as pH (water) and pH (KCl). Remember that the pH (water) is on average one unit higher than pH (KCl) for the same soil.

The optimal pH (water) of soil for most crops ranges between 6.50 to 7.50. When the pH (water) drops below 5.30, too much aluminium is present in the soil. Aluminium is toxic to roots and root growth will be affected. If the pH (water) exceeds 7.50, nutrient elements like phosphate, zinc and manganese become insoluble and deficiencies can be induced.

In soils with a neutral to acid pH, the pH of the subsoil will usually be lower than that of the topsoil.

- **Electrical Conductivity and Resistance**

Definition

Electrical Conductivity: Electrical conductivity refers to the ability of soil paste to conduct electrical current and can be expressed in various units of conductivity. The international standard (IS) unit is Siemen.

Resistance: Resistance is the opposite of electrical conductivity, and refers to the resistance of soil paste to the conductance of electrical current. Resistance is expressed in ohms.

The resistance of soil is an indication of the total dissolved salts in the soil solution. The measurement of resistance is a quick method to scan soils for salts. If the sample is too salty the electrical conductivity (EC) of the saturated paste is measured.

The resistance is expressed in ohm and the following general classification can be used:

Clay Content	Optimal Resistance
> 35%	250 to 500 ohms
20 to 35%	500 to 750 ohms
10 to 15%	750 to 1,000 ohms
< 10%	>1000 ohms

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- **Soil Fertility**

  Soil fertility is a collective expression to describe the status of the soil in terms of phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg) and to some extent, nitrogen (N). Fertile soil contains these nutrient elements in adequate quantities to sustain plant growth.

  If too little plant nutrients are present, it poses less of a problem in commercial agriculture than if too much is present. It is relatively quite easy and fairly cheap to add nutrient elements to the soil, but seldom easy and cheap, if possible at all, to remove excess nutrients.

- **Soil Salinity**

  Salts accumulate in soils due to poor drainage and irrigation using saline water. This is usually a slow process and affects the fertility of the soil and eventually also the physical properties and soil structure.

- **Cation Exchange Capacity (CEC)**

  Clay particles carry electrical charges of which the majority are negative. These negative charges can attract and bind with cations in the soil solution. The cations, which are positively charged forms bonds with the clay and can be displaced by other cations. The magnitude of negative charges present to absorb cations, is referred to as the cation exchange capacity (CEC) of the soil, and is expressed in *centi-molar charge per kg soil* (cmol+/kg). Organic matter also has a CEC, as well as an anion exchange capacity similar to the CEC, but that absorb negatively-charged anions.

  The CEC of soil depends on the clay content, the type of clay, and the organic matter content. Under certain circumstances CEC may be pH dependant, i.e. it will change when the pH changes.

- **Soil Organic Matter**

  Organic matter present in soil ranges from dead plant and animal material, organic debris, microbial debris and all stages of humus. Humus is processed and condensed organic matter and it takes thousands of years to reach a stable form. Humus contributes to the activity in soils and consists of humic acid (or humates, the salts of humic acids), fulvic acid (or fulvates, the salts of fulvic acid) and humins (a very stable form).

The Role of Soil Minerals

Soil is composed of minerals, most of which are essential nutrient elements for plant growth. Each essential nutrient element has a particular role or roles in the physiology of plants. These nutrients are called essential elements, because without them plants cannot complete their lifecycle from seed through the vegetative and reproductive stages to the seed formation stage. The essential elements are grouped into macro and micro nutrient elements.

Macro elements are required in relatively large amounts, while micro nutrients are required in very small amounts. The roll of each element is complex and elements are involved in many physiological processes of which some are still not understood.

Information – The Role and Function of Essential Nutrient Elements (Summarised)

Essential Nutrient Element	Function
Nitrogen (N)	Forms part of all protein and enzyme molecules and is therefore involved in almost every physiological process in plant production.
Phosphorus (P)	Is involved in all energy transfer reactions in the plant. It is also part of the nucleic acids in cells.
Potassium (K)	Has many rolls, including cell-division and transport of photosynthetic products from the leaves to the roots and other parts.
Calcium (Ca)	Forms a vital part of all cell-walls, keeping the cells together in the same way as cement in a brick wall.
Magnesium (Mg)	Forms the centre metal ion in the chlorophyll molecule, which is required for photosynthesis, apart from its role in other physiological processes.
Sulphur (S)	Is involved in the production of the sulphur-containing amino acids and in reproductive processes. A sulphur deficiency will reduce flowering and fruit set.
Sodium (Na)	Can replace potassium to some extend in certain plants.
Chloride (Cl)	Is in fact also a micro-nutrient, with plants requiring about 20mg per litre in their nutrient solution. Chloride is involved in the reactions where water molecules are split during photosynthesis.
Micro nutrient elements Cu, Fe, Mn, Zn, B and Mo	Are involved in many physiological reactions as catalysts.

ACTIVITY

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SO 3 AC 1-3

Identify and research

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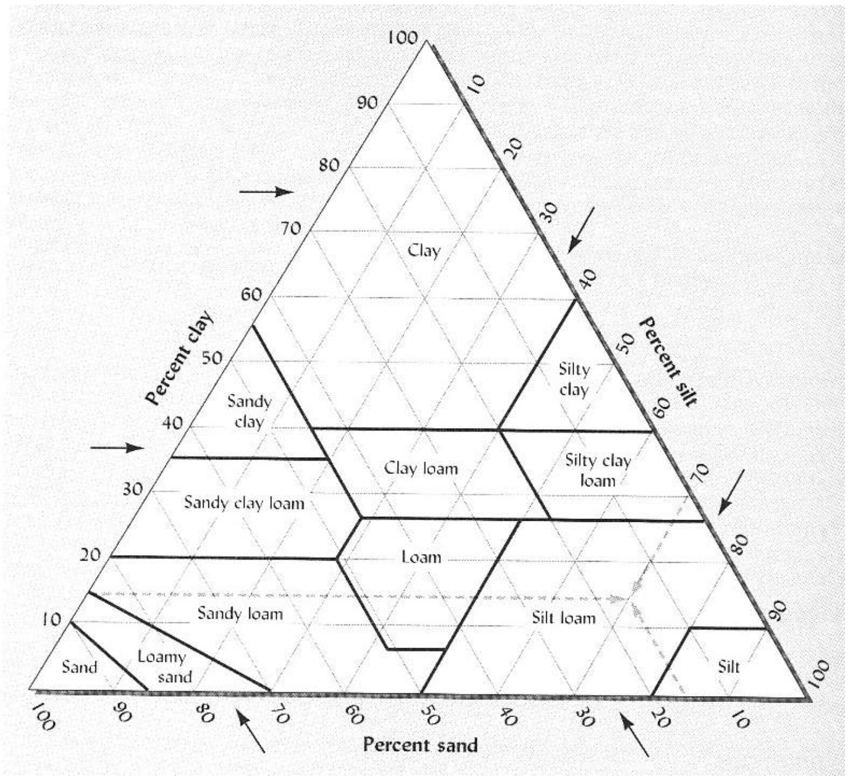
1 Take a handful of soil from the soil sample you have taken and mix it properly with water in a glass beaker. Let it stand for a day for the soil particles to settle down. Describe and explain your observation. Measure the layers in the beaker and determine the percentages of each. Use the textural triangle to determine the soil textural type. Write down your answer your Learner Guide.



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2 Take a handful of the same soil sample (from Activity 1.1) and wet it with a bit of water. Use this sample to determine the texture type by hand as explained in class. Now compare the results from this hand method with the results from Activity 1. Is it the same or does it differ? Write down your answer in your Learner Guide.

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Facilitator comments:

How am I doing?

Concept (SO3)	I understand this concept	Questions that I still would like to ask
Soil structure and texture are identified using elementary tests and observations, and based on this information the learner is able to express an opinion on its condition and remediation.		
The composition of soil based on elementary tests and observations is identified and, based on these results an opinion regarding the condition of the soil and its fertility requirements is demonstrated.		
The role of minerals in soil health and how this relates to plant production is described.		

My Notes ...

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Session 2 The role of minerals in soil health

After completing this session, you should be able to:
SO 2: Take an appropriate sample for nutrient analysis.

In this session we explore the following concepts:

- Nutrients that a crop plants needs in order to grow.
- How these nutrients are supplemented through fertilisers.

2.1 Collecting samples for soil and leaf nutrient analyses

Soil is made up of minerals. The colour, structure and texture of specific soil is determined by the minerals that it contains.

All plants need the following to grow and produce food, and to successfully complete their lifecycles:

- Sunlight;
- Water;
- Oxygen;
- Carbon dioxide; and
- Nutrients (food), also called *mineral nutrient elements* or *essential nutrient elements.*

Different plants require different quantities of specific nutrients. Plants source nutrients from the soil and irrigation water. The nutrients that are not supplied naturally are supplied as fertilisers.

If the soil that a plant grows in is managed well, it the plant will grow well and produce optimally. To manage soil we need to know:

- What nutrients the crop requires and in what quantities;
- The characteristics of the soil that will allow this plant to take up water and air optimally;
- The soil type that will allow the plant to anchor and grow optimally.

Once we know what the ideal soil is for the crop, we also need to determine what we could do to optimise the soil we have available.

2.2 Nutrient analyses

Nutrient deficiencies developed because certain physiological processes cannot be completed without a certain minimum supply of the specific nutrients. This results in a reasonably specific and identifiable symptom for each element.

Once the symptoms of a possible nutrient deficiency have been observed, the deficiency must be confirmed through leaf- or soil analysis. Not all abnormalities observed are necessarily due to nutrient deficiency. Pests and diseases may cause symptoms similar to those of nutrient deficits.

While it is important to have a good understanding of nutrient deficiency symptoms, it cannot be used in developing a fertilisation program. By the time nutrient deficiency symptoms appear, the deficiency has already impacted on the growth and production of the crop. It is essential to have a proactive approach to plant nutrition.

In order to take necessary interventions, we need to diagnose the nutritional status of the crop. This is especially true for perennial crops. Leaf and soil analysis are diagnostic tools that are used to monitor the nutritional status of the crop. Crop information is added to the data gathered from the analyses, and a refined diagnostics system is developed in this manner.

In order for an analysis to be conducted, representative samples must be collected and processed;

The first principle of any sampling action is that the sample must be **representative** of the bulk of the medium that is being sampled. A sample should not be viewed as a section of the whole, but rather the whole reduced to a manageable volume.

It is important that all sampling equipment , including cups, spatulas, buckets, and mixing equipment, must be thoroughly cleaned before sampling. This will avoid contamination of samples.

Sampling Procedures

In this section, we look at procedures used for taking the following samples:

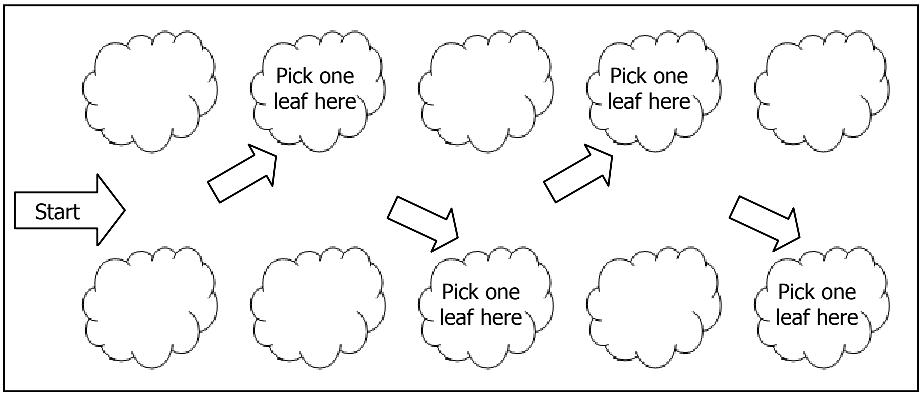
- Leaves.
- Soil.
- Fertiliser.

In the case of tree crops soil and leaf samples are taken at and from the same set of trees every year. This is to comply with the first principle of sampling, and to minimise the effects of other factors on the nutritional status of the trees. Two to four rows that represent the orchard in all respects are selected for sampling, and are referred to as the **index blocks** or **rows**. The rows are marked, and samples for that orchard are always taken from those trees.

Leaf Sampling Procedure

Leaf sampling must be done at the appropriate time of the season. In the case of citrus orchards sampling occurs between February and May. Sampling of a specific orchard – or the whole farm – should be done at the same time every year, for instance the second week of March. Leaves are picked from **behind fruit** and sampling should therefore be done before harvesting.

- Enter the path between two of the rows in the index block and pick leaves from every second tree on the left and right.



- Pick 50 to 100 leaves per sample;
- Pick only healthy undamaged leaves;
- Pick leaves that are between 1 and 2 metres from the orchard floor, i.e. between about the waist and head of a person of average height;
- Pick leaves from **fruit bearing** twigs.
- Place the leaves in a new, clean plastics bag;
- Squeeze the air out of the bag and close it tightly;
- Label the sample as is prescribed by the laboratory that will be conducting your analysis. **Never put a label inside the sample bag with leaves, as the moisture will damage your label. The ideal way of labelling is to place the sample in the plastics bag into a second bag. The label in then sandwiched between the two bags**.
- Keep the samples until they are dispatched to the laboratory in the shade or in a cool area, but do not freeze the samples.

Specific sampling procedures are available for other tree and field crops and vegetables. Depending on the specific crop you are working with, the learner should get hold of these procedures and collect plant samples accordingly.

Soil Sampling Procedure

- Take soil samples from the same index block where the leaf sample was taken;
- Identify areas under every second to fourth tree for collecting sub-samples;
- A soil sample is made up of a number of sub-samples, that are mixed together to form the sample.
- A total of between 15 and 20 sub-samples should be taken per index row;
- Remove any visible plant debris from the surface of the soil, but take care not to remove the top soil;
- Take the sub-sample from the surface down to a depth of 30cm depth using a spade or soil auger;
- Collect all sub-samples in a plastics bucket;
- Mix the soil in the bucket and place about 500g in a plastics bag;
- Seal the bag tightly;
- Label the sample as is prescribed by the laboratory. **Never put a label in the sample bag with the soil.**

Sampling Granular or Powdered Fertilisers

- Select at least 1% of the bags that are to be tested and take a sub-sample of 200g from each bag;
- Take the 200g to represent the top, middle and bottom of the bag;
- Put all these sub-samples in a plastics bucket and mix it thoroughly;
- Remove 500g of the mixed sample and place into a suitable clean plastic bag;
- Seal the bag properly;
- Label the sample as is prescribed by the laboratory to be used for analyses. **Never put a label in the sample bag with the fertiliser**.

A spatula used for taking grain samples can also be used. In this case press the spatula into the top, middle and bottom of the bags and collect these sub-samples in a bucket.

When sampling is done for a legal dispute, the Registrar of Fertilisers prescribes specific procedures and samples must be taken in the presence of both parties to the dispute.

Sampling Liquid Fertilisers or Fertiliser Solutions

- Select at least 1% of the containers to be tested and take a sub-sample of 200ml from each container;
- Put all the sub-samples in a plastic bucket and mix it thoroughly;
- Remove and place 500ml of the mixed sample into a suitable, clean plastics bottle;
- Seal properly;
- Stick or tie a label to the bottle, as prescribed by the laboratory to be used for analyses.

Labelling Samples

- Attach a label to the plastic bag or bottle, by either sticking it on, or tying it securely with string;
- Do not write the information directly onto the bag or bottle, as even permanent marker ink rubs off during transport;
- Never place a label inside the bag with the sample;
- If more than one sample is sent, at least one of the labels should contain all the details of the sender, including:
  - Name;
  - Address;
  - Telephone number;
  - Fax number;
  - Contact person
  - Details of analysis required in case of fertiliser samples and special instructions, where required;
  - Order number, where used;
  - Type of sample;
  - Sample reference, i.e. orchard number, store number. Remember that the sample reference (name or number) must mean something to the sender. The laboratory report will contain this reference and the sender must be able to connect the results with the relevant fertiliser batch. Keep the reference simple, however. A reference such as "Orchard 27 near dam" is unnecessary, if there is only one orchard 27. The word "orchard" can even be left out in the case of leaf, soil and fruit samples, as these samples are always taken from orchards. Be consistent in the manner in which references are used, so that all farm employees that

handle the samples will understand it. These simple rules make the whole process of recording, reporting and record keeping much easier.

- The labels on the remainder of the samples can reflect only the name, sample reference and type of sample.

2.3 Sample preparation and packaging

- Keep samples of all types in a cool, dry area away from direct sunlight until ready for dispatch. Ensure that the samples are kept away from possible sources of contamination;
- Before packing the samples, ensure that all the samples are labelled correctly, and that the labels are legible;
- Check the samples against a Samples Dispatched list as they are being packed;
- Pack the samples in a sturdy box and fill the box with packing material such as bubble wrap and/or newspaper, to steady the samples.

Please complete Activity **2** at the end of the session

My Notes ...

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My Notes ...

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ACTIVITY

2

SO 2 AC 1-3

Explore and research

My Name:
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My Workplace:
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My ID Number:
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2.1 Taking soil samples for analysis.

Study the procedures to take soil samples and use these in taking a representative soil sample of where your crop is growing and submit it for analysis. Request the lab to make recommendations for amendments.

Write a short report in your Learner Guide on the sampling performed and the recommendations which you received back from the lab.

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2.2 Taking leaf samples for analysis.

Study the procedures to take plant samples and use these in taking representative leaf samples of your crop and submit it for analysis. Request the lab to make recommendations for amendments.

Write a short report in your Learner Guide on the sampling performed and the recommendations which you received back from the lab.

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Facilitator comments:

How am I doing?

Concept (SO2)	I understand this concept	Questions that I still would like to ask
An appropriate sample is taken according to prescribed procedures.		
The sample is labelled according to required procedures.		
The sample is prepared and packaged according to specified procedures.		

My Notes ...

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Session

3 Basic symptoms of nutritional deficiencies

After completing this session, you should be able to:
SO 3: Identify and interpret the basic symptoms of nutritional deficiencies in crops.

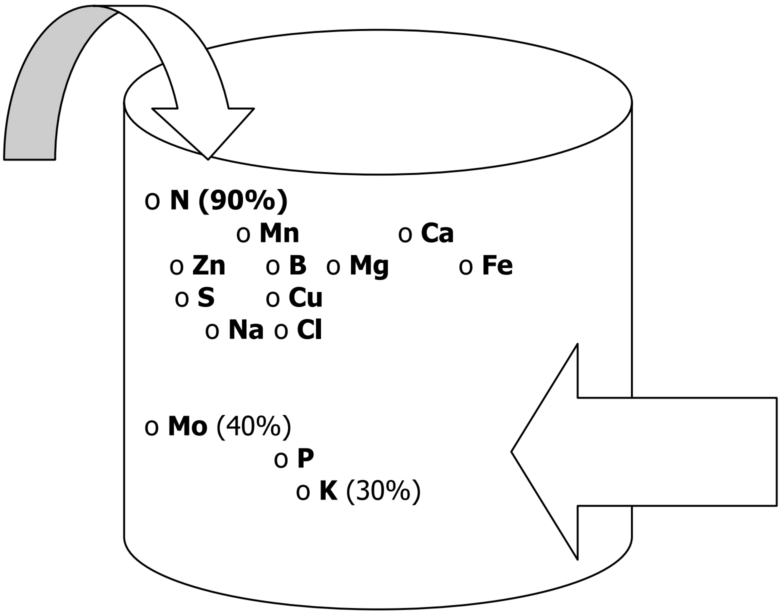
In this session we explore the following concepts:

- Identifying nutrient deficiencies in plants.
- Correcting nutrient deficiencies.

3.1 Introduction

Plant nutrient elements are divided into two groups called Macro- and Micro-elements. The effect of the most limiting nutrient element can be illustrated by trying to fill a drum or barrel with holes at various levels in its side. Each hole represents the relative optimal concentration of a nutrient element. In the sketch below, nitrogen (N) is present at 90% and potassium (K) at 30% of their respective optimal concentrations. To fill the drum, one has to first of all block the hole representing K. Thereafter, you can fill the drum to the level where phosphorus (P) becomes the most limiting nutrient element.

If you first block the nitrogen (N) hole before blocking the K hole you still will not be able to fill the drum more than 30%. Therefore, to fill the drum all nutrient elements must be present at their respective optimal concentration (100% level), but getting the N level to 100% and not the K level will not enable the plant to produce at 100% capacity. Although molybdenum is required in very small quantities compared to nitrogen, the shortage of this element will still cause the plant to produce at only 40% of its capacity in the example below.



Macro elements

Soil fertility is a collective term used to describe the status of the soil in terms of phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg) and to some extent, nitrogen (N). Fertile soil contains these nutrient elements in adequate quantities to sustain plant growth.

The symptoms of nutrient deficiences

Information – Symptoms of Nutrient Deficiencies

Nutrient Element	Plant Part (first to display symptoms)	Mild Expression	Severe Expression
Nitrogen (N)	Old leaves	Yellowing of all the old leaves, to a light yellow colour.	Yellowing of all leaves just before or during a new leaf flush which will result in leaf drop.
Phosphorus (P)	Fruit	Open centre resembling over-matured fruit.	Thick skins and puffy fruit with high acid level.
Potassium (K)	Fruit	Small fruit	Small fruit with thin skins combined with a low yield. On young trees the leaves may turn bronze.
Calcium (Ca)	Fruit	Increase incidence of creasing, (a physiological disorder) although not yet confirmed.	Chlorosis (yellowing) of very young leaves and dieback of growth tips.

Nutrient Element	Plant Part (first to display symptoms)	Mild Expression	Severe Expression
Magnesium (Mg)	Old leaves	Chlorosis of the front part of the leaf from the tip and sides of the leaf. An inverted green V with the open end of the V at the petiole side appears as the symptom develops.	Leaf drop and decrease in fruit set.
Sulphur (S)	New leaves	Yellowing to the colour of butter of emerging leaves on a green twig.	Extremely reduced fruit set.
Copper (Cu)	New leaves	Extra large leaves on strong new growth.	Gum pockets in the albedo (white part of the peel) of the fruit. Fruit is small, thin skinned and hard.
Iron (Fe)	New leaves	Yellowing of the lamina (leaf blade) of young leaves leaving a well defined network of small veins.	Reduced fruit set.
Manganese (Mn)	New leaves	Inter-veinal yellowing of a normal-sized leaf, almost over the entire leaf. Broad green areas around the veins and Chlorotic areas between veins are the most obvious symptoms.	Increase in the number of leaves affected.
Zinc (Zn)	New leaves	Interveinal yellowing of a small-sized leaf, starting at the tip of the leaf. Resembles manganese deficiency, but appears on small leaves and the chlorosis starts at the tip of the leaf.	Increase in the number of leaves affected and reduction in fruit size.
Boron (B)	New leaves	Corking of the midrib vein on the underside of the leaves. This resembles cold damage of leaves.	Gum pockets around the centre of the fruit. Fruit size is reduced.

3.2 Identifying nutrient deficiencies in plants

The most important features of nutrient element deficiencies are:

- The leaf should display the same symptom on both the left-hand and right-hand side of the midrib. This is important in distinguishing between nutrient deficiencies and leaf symptoms caused by other factors.
- Nutrient deficiency symptoms appear first on either new or old leaves. From there the symptom can spread to the entire plant.
- Certain nutrient deficiency symptoms appear first or are more noticeably on fruit.
- Nutrient deficiency starts with mild symptoms and develops into severe symptoms.

ACTIVITY

Please complete Activity **3** at the end of the session

My Notes ...

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3.3 Correcting Nutrient Deficiencies

The first response to detecting nutrient deficiency symptoms is to report it to the supervisor or manager.

The presence of nutrient deficiency symptoms is a sign of an unsuccessful fertilisation program. Deficiency symptoms generally appear after the shortage has had an impact on the plant and/or production. The fertilisation program should provide for methods to identify and correct short supplies of any essential nutrient element before it impacts on the crop.

Rectifying nutrient deficiencies is seldom a simple matter of applying the nutrient. Very often the deficiency is the result of factors other than an absolute short supply. A deficiency can be induced by other factors that convert the specific nutrient into an unavailable form. It could also be the nutrient has been converted to a less active form. To improve the supply of the specific nutrient, one needs to determine why its supply is not optimal (the best it can be) and try to correct that.

Once it has been applied to the plant, there is no guarantee that the active form will last long enough to result in the required physiological reactions. To maintain optimal concentrations of the available nutrient elements in the trees, enough of the nutrient in the available form must be present to be utilised by the plant.

The table below lists that most common causes of and factors associated with nutrient deficiencies, and the corrective measure that can be taken.

Symptoms of Nutrient Deficiencies in crops and potential corrective actions:

Nutrient Element	Causes of Deficiency and Factors that Can Induce a Deficiency	Corrective Actions
Nitrogen (N)	Too little applied	Increase the application.
	Too much lost due to leaching	Split the application and control the irrigation better.
	Phytophthora (root rot)	Treat the disease with foliar sprays.
Phosphorus (P)	Too little applied	Increase the application.
	Soil pH too high	Not much to be done.
	Soil pH too low	Apply lime to soil.

Nutrient Element	Causes of Deficiency and Factors that Can Induce a Deficiency	Corrective Actions
Potassium (K)	Too little applied	Increase the application.
	Mg supply too high	Apply K through foliar sprays.
	Trees old	Not much to be done.
	Nematodes	Treat the pest.
Calcium (Ca)	Too little applied	Increase the application.
	Climatic conditions	Increase the application during critical periods.
	Soil pH too low	Apply lime to soil.
Magnesium (Mg)	Too little applied	Increase the application.
	K supply too high	Apply Mg through foliar sprays.
	Soil pH too low	Apply lime to soil.
Sulphur (S)	Too little applied	Increase the application.
Copper (Cu)	Too little applied	Increase the application.
	Soil pH too high	Apply Cu though foliar sprays.
Iron (Fe)	Too little applied	Increase the application.
	Soil pH too high	Use soil application of a chelate that is stable at a high pH.
	Over-irrigation	Reschedule the irrigation.
Manganese (Mn)	Too little applied	Increase the application.
	Soil pH too high	Apply Mn through foliar sprays.
	Recent application of lime	Apply Mn through foliar sprays.
Zinc (Zn)	Too little applied	Increase the application.
	Soil pH too high	Apply Zn through foliar sprays.
	Too much P applied	Apply Zn through foliar sprays.
Boron (B)	Too little applied	Increase the application.
	Too low pH in the soil	Apply lime to soil.

ACTIVITY

3

SO 4 AC 1-2

Identify, explore and discussion

My Name:

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My Workplace:

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My ID Number:

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3.1 Compare the plant you have received with a healthy plant. Inspect your crop for any nutrient deficiencies and try to identify the deficiency. Take a photo of the healthy and affected plant and paste it in your Learner Guide, or write down characteristic symptoms of the two plants. Write down the cause of this deficiency.

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Facilitator comments:

How am I doing?

Concept (SO4)	I understand this concept	Questions that I still would like to ask
The colour change on plant leaves, and/or fruit/ plant abnormalities, is interpreted and related to the specific macro-element deficiencies compared with healthy plants.		
Steps are taken (or explain the steps needed) to rectify basic deficiencies.		

My Notes ...

Session

4 Procedures for the application of nutrients

After completing this session, you should be able to:
SO 1: Accurately prepare and measure the appropriate and quality of required soil nutrient preparations.

In this session we explore the following concepts:

- Calculating the total fertiliser requirement.
- Collecting fertiliser from storage.
- The description on the bags or containers.
- Preparing fertilisers.
- Measuring fertilisers.
- Applying fertilisers.

4.1 Introduction

Fertilisers are applied in one of the following manners:

- **Manual Application** – The application of granular and powdered forms of fertiliser to the surface of the soil by hand.
- **Mechanical Application** – The application of granular and powdered fertilisers, and slurries,-which are suspended fertilisers, by way of mechanical equipment.
- **Fertigation** – The application fertilisers in liquid and water-soluble powdered form by adding it to the irrigation water.
- **Foliar Application** – The application of fertilisers in liquid and water-soluble powdered form by adding it to water and spraying it onto the trees.

4.2 Calculating the total fertiliser requirement

In an orchard situation a fertilisation program normally indicates the amount of fertiliser that has to be applied per tree. To calculate the total amount of fertiliser required for a specific orchard, the following formula is used:

Total Amount of Fertiliser Required = Fertiliser per Tree (g or ml) x Number of Trees in Orchard

For field crops the amount of fertiliser required will be given as a dosage rate per hectare.

Example

Calculating the Total Fertiliser Requirement for an orchard.
The table below represents a typical fertilisation program for a citrus orchard:

Fertilisation Program - Citrus			
Orchard identity:	**Orchard 10**	**Size:**	**3.0ha**
Cultivar/Variety:	**Delta Valencias**	**No of Trees per ha:**	**316**
Fertiliser		**Quantity**	**Time of Application**
Soil Applications		**g per tree**	
Limestone Ammonium Nitrate (LAN)		500g	July
LAN		250g	August
LAN		250g	September
Potassium Chloride (KCL)		500g	September
Dolomitic Lime		4000g	October
Foliar Sprays		**g per 100l water**	
Low Biuret Urea		1000g	July
Manganese Sulphate		200g	October
Solubor®		150g	October
Remarks:			

The total amount of LAN needed for the July application is calculated as:

Number of Trees in Orchard = Orchard Size in Hectare (ha) x Number of Trees per Ha

= 3.0ha x 316

= 948 trees in the orchard

Total Amount of Fertiliser Required = Fertiliser per Tree g or ml) x Number of Trees in Orchard

= 500g x 948 trees

= 474,000g (/1,000 to convert to kg)

=474kg

This means that 474 kg of LAN is required for the July application of LAN to orchard 10.

Once the total amount of fertiliser required for the orchard has been calculated, the fertiliser can be collected from the store and prepared for application.

In a field crop situation, the fertiliser will be based on leaf and soil analyses. The recommendations will indicate the amount of fertiliser to be applied per m^2 or per ha. Before planting, fertiliser containing N, P and K will be broadcasted, while N will be applied as a top dressed later during the season. The required nitrogen is usually split into smaller amounts, which are then applied at intervals during the growing season.

4.3 Collecting fertiliser from storage

In line with the standards of **good agricultural practises (GAP)** fertilisers must be stored according to their type and packaging. Fertilisers have a fairly long shelf life, provided it is stored in the manner prescribed by the suppliers. However, contamination can occur and bags might lose their labels. If in doubt of the contents or concentration of any fertiliser, take samples and send it for analysis.

4.4 The description on the bags or containers

To ensure that the correct fertilisers are selected, double-check the following before loading:

The **concentration of the active ingredient** specified on the bag or container, because some fertilisers are supplied in more than one concentration. Zinc nitrate are supplied in formulations with an active ingredient (Zn) concentration ranging from 5.5% to 16%;

Granular and powdered fertilisers are supplied in 25kg or 50kg bags. LAN is mostly supplied in 50kg bags. In the case such as the example above, ten 50 kg bags, i.e. 500 kg of fertiliser will be collected from the store. Half a bag should be left after the application, and this should be returned to the store and sealed properly for future use. When collecting fertiliser from the store, check that there are no half-used bags that should be used first.

Once the correct fertiliser and its concentration are confirmed, the instruction to load the required number of bags or containers can be executed.

4.5 Preparing fertilisers

Granular and powdered fertilisers seldom need preparation before application. For manual application, fertiliser bags or containers are transported to the orchards and the required number of bags is off-loaded at each orchard.

For fertigation and foliar applications, the fertiliser is merely mixed with the amount of water prescribed in the fertilisation program.

When applied to field crops the fertiliser is either applied through the irrigation system (fertigation) for vegetables and pivot systems, or in granular form by hand or using spreaders.

4.6 Measuring fertilisers

It is important to apply the correct amount of fertiliser, because, apart from the cost implication, over-application can be as harmful to the tree as under-application.

In the case of manual application, the amount of powdered or granular fertiliser that is to be applied is normally stated on the fertilisation program in g/tree. This prescribed mass per tree cannot be weighed for every tree, as this would take a long time and be unproductive. Follow the steps below:

- Carefully weigh the prescribed mass of fertiliser;
- Determine the volume of the mass of fertiliser;
- Make scoops to hold the exact volume of fertiliser that is required, by for instance cutting used oil or canned fruit tins to the correct size. Apply one or two scoops of the specified fertiliser.

In the case of fertigation and foliar applications, the liquid or powdered fertilisers are measured or weighed carefully and added to the prescribed amount of water.

4.7 Applying fertilisers

The feeder-roots of a orchard trees are concentrated in the area around the trunk of the tree. This is normally the area, which is wetted during irrigation.

Fertilisers are applied manually in the following manner:

- Irrigate the orchard for about 30minutes before application to demarcate the area in which the feeder-roots grow;
- Scoop the required amount of fertiliser from the bag;
- Spread the fertiliser evenly on the wetted area, with little or no fertiliser against the trunk of the tree.

ACTIVITY

Please complete Activity **4** at the end of the session

My Notes ...

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ACTIVITY

4

SO 1 AC 1-3

Calculation.
Identify and research.

My Name:
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My Workplace:
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My ID Number:
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4.1 The returned nutrient analysis suggests that the land require 185 kg of nitrogen, 37 kg of phosphate and 185 kg of potassium per hectare. Now draw up the ratios and decide between the two lots of fertiliser (2:3:2 (22) and 5:1:5 (25)) which one would best suit your need. And how many 50 kg bags you would require.

Show all calculations and make short notes on what was done – write it in the Learner Guide.

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4.2 Making use of the information in Activity 1.1, work out how many kg of organic fertiliser would be required for the area. Remember that compost needs to be applied at about 30000 kg per hectare to supply an equivalent amount of 2:3:2 (26%).

Show all calculations and make short notes on what was done – write it in the Learner Guide.

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4.3 Go to the fertilizer shed and collect the following bags of commercial fertilizers:

- Limestone ammonium nitrate (28%)
- Potassium chloride (50%)
- Super-phosphate (21%)
- 2:3:2 (22%)

Measure out 630 g of each type of commercial fertilizer with the aid of:

- A food tin which contained baked beans/Pilchards fish or any other type of food stuff weighing 210 g,
- A measuring scale.

How accurately is using a food tin instead of a measuring scale?

Write short notes in your Learner Guide on what was done and also the outcome of the two ways of measuring.

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Facilitator comments:

Concept (SO1)	I understand this concept	Questions that I still would like to ask
Identify the appropriate nutrients for a specific context is demonstrated.		
Prepare and collect the correct amount of the appropriate nutrients from the storage area of an agricultural production environment is demonstrated (in the case of conventional systems, this would involve selecting the appropriate fertiliser; for organic systems it would involve storing manure optimally and making compost with due understanding of the processes outlined in the NQF 1 unit standard).		
Measure the required amount of soil nutrient accurately is demonstrated.		

My Notes ...

Am I ready for my test?

- Check your plan carefully to make sure that you **prepare in good time**.
- You have to be found **competent** by a qualified **assessor** to be declared competent.
- Inform the assessor if you have any **special needs** or requirements **before** the agreed date for the test to be completed. You might, for example, require an interpreter to translate the questions to your mother tongue, or you might need to take this test orally.
- Use this worksheet to help you prepare for the test. These are **examples** of **possible questions** that might appear in the test. All the information you need was taught in the classroom and can be found in the learner guide that you received.

1. ***I am sure*** *of this and understand it well*
2. ***I am unsure*** *of this and need to ask the Facilitator or Assessor to explain what it means*

Questions	1. I am sure	2. I am unsure
1. Did you find it difficult to identify the different commercial fertilizers (Activity 4.3)? If yes, what problem(s) did you experience?		
2. Did you find it difficult to measure the different commercial fertilizers (Activity 4.3)? If yes, what problem(s) did you experience?		
3. Were you able to calculate the required amounts of commercial and organic fertilizer (Activity 4.1 and 4.2)? If not, what problem(s) did you experience?		
4. Identify the tools necessary to apply nutrients to the crop field. Give some safety tips in handling and applying fertilizers.		
5. Explain the steps in taking a representative soil sample. From going to the field till sending off the soil sample for analysis.		
6. What instruments can be used in the taking of soil samples. How would you care for these instruments?		
7. Explain the steps in taking a representative plant sample. From going to the field till sending off the plant sample for analysis.		

Questions	1. I am sure	2. I am unsure
8. What other information should also be collected, which can be used when interpreting soil and plant analyses data? How can this information affect your interpretation?		
9. Define soil structure. What is the importance of soil structure in crop production?		
10. Explain the steps used in a simple test for determining soil structure, whilst in the crop field.		
11. Define soil texture. Give the different texture classes. What is the importance of soil texture in crop production?		
12. Describe step by step how you would determine soil texture, whilst in the crop field?		
13. Describe the method you would use to determine the soil texture in a laboratory.		
14. Define macro plant nutrients. Name the main macro-nutrients and give the functions of each in a plant.		
15. Define trace (micro) plant nutrients. Name the important trace nutrients.		
16. Define nutrient deficiency. Did you have a problem in identifying nutrient deficiencies on the crop plant? If yes explain why.		
17. Define nutrient toxicity. What causes toxicities and how can you rectify the problem?		
18. Explain the difference between commercial and organic fertilizers. Which of these would you recommend for use and why?		

My Notes ...

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Checklist for practical assessment …

Use the **checklist** below to help you prepare for the part of the practical assessment when you are observed on the **attitudes** and **attributes** that you need to have to be found competent for this learning module.

Observations	Answer Yes or No	Motivate your Answer (Give examples, reasons, etc.)
Can you identify problems and deficiencies correctly?		
Are you able to work well in a team?		
Do you work in an organised and systematic way while performing all tasks and tests?		
Are you able to collect the correct and appropriate information and / or samples as per the instructions and procedures that you were taught?		
Are you able to communicate your knowledge orally and in writing, in such a way that you show what knowledge you have gained?		
Can you base your tasks and answers on scientific knowledge that you have learnt?		
Are you able to show and perform the tasks required correctly?		
Are you able to link the knowledge, skills and attitudes that you have learnt in this module of learning to specific duties in your job or in the community where you live?		

- The assessor will complete a checklist that gives details of the points that are checked and assessed by the assessor.
- The assessor will write commentary and feedback on that checklist. They will discuss all commentary and feedback with you.
- You will be asked to give your own feedback and to sign this document.
- **It will be placed together with this completed guide in a file as part of you portfolio of evidence.**
- The assessor will give you feedback on the test and guide you if there are areas in which you still need further development.

Paperwork to be done ...

Please assist the assessor by filling in this form and then sign as instructed.

Learner Information Form				
Unit Standard	**116053**			
Program Date(s)				
Assessment Date(s)				
Surname				
First Name				
Learner ID / SETA Registration Number				
Job / Role Title				
Home Language				
Gender:	Male:		Female:	
Race:	African:	Coloured:	Indian/Asian:	White:
Employment:	Permanent:		Non-permanent:	
Disabled	Yes:		No:	
Date of Birth				
ID Number				
Contact Telephone Numbers				
Email Address				
Postal Address			Signature:	

Glossary

Term	Description
Aeration	The process by which air in the soil is replaced by air from the atmosphere
Aerobic	The environmental condition in which oxygen is not deficient for chemical, physical or biological processes
Anaerobic	The environmental condition in which oxygen is deficient for chemical, physical or biological processes
Anion	The part (ion) of a molecule like (KNO_3) with a negative charge (NO_3^-**)**
Auger	A kind of drill used as a tool for making holes in the ground or taking soil samples
Catione	The part (ion) of a molecule like Potassium Nitrate (KNO_3) with a positive charge (K^+)
Cation-exchange capacity	A measure of the total amount of exchangeable cationes (like K^+) that the soil can hold
Chlorosis	A condition in which a plant or part of a plant turns light green because of poor chlorophyll development resulting from disease or poor nutrition
Contamination	To soil, stain or infect through introduction of undesirable elements by means of contact or association
Electrical Conductivity	The transmission or flow of an electric impulse or current through the soil
Fertigation	The process of applying fertilisers that are dissolved in the irrigation water
Foliar fertilisers	Fertilisers that are dissolved in water and applied to the leaves
Midrib	The main vein of a leaf
Necrosis	Death of whole plant or areas on the plant associated with injury, disease or dehydration
Nutrient analyses	A process applied to determine the presence and amount of nutrients in a soil or leaf sample
Nutrients	Elements essential for plant growth like K^+ **and** NO_3^-

Term	Description
Optimal	The amount or degree that is most favourable to a particular act or process
Representative	A smaller portion or individual representing a large quantity or population
Resistance	The opposition offered to the passing of a steady electric current trough a substance like soil
Soil field water capacity	The percentage of water remaining in the soil two or three days after having been saturated and after drainage due to gravity has practically ceased
Soil pore size	The size of the openings (pores) between adjacent soil particles
Soil Structure	The arrangement of primary soil particles (clay and silt) into secondary units or peds with specific size or shape
Soil texture	The relative percentage of sand, silt or clay in a soil
Top dressing	Applying fertiliser on top the ground close to the root system of plants
Water holding capacity	The percentage of water retained by the soil particles after the excess water from the pores between particles has leached out

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ITSC: Pamphlet numbers B3, E4, E5, E6, E7 and E8 in The Cultivation of Citrus, Private Bag X11208, Nelspruit, 1200

Terms & Conditions

Acknowledgements

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SOUTH AFRICAN QUALIFICATIONS AUTHORITY

REGISTERED UNIT STANDARD:

Understand basic soil fertility and plant nutrition

SAQA US ID	**UNIT STANDARD TITLE**		
116053	Understand basic soil fertility and plant nutrition		
SGB NAME	**NSB**	**PROVIDER NAME**	
SGB Primary Agriculture	NSB 01-Agriculture and Nature Conservation		
FIELD		**SUBFIELD**	
Agriculture and Nature Conservation		Primary Agriculture	
ABET BAND	**UNIT STANDARD TYPE**	**NQF LEVEL**	**CREDITS**
Undefined	Regular	Level 2	5
REGISTRATION STATUS	**REGISTRATION START DATE**	**REGISTRATION END DATE**	**SAQA DECISION NUMBER**
Registered	2004-10-13	2007-10-13	SAQA 0156/04

PURPOSE OF THE UNIT STANDARD

A learner achieving this unit standard will be able to apply basic soil nutrient preparations in a safe, effective and responsible manner for the benefit of plant/crop growth with consideration to the environment.

Learners will gain specific knowledge and skills in soil nutrient and preparation and will be able to operate in a plant production environment implementing sustainable and economically viable production principles.

They will be capacitated to gain access to the mainstream agricultural sector, in plant production, impacting directly on the sustainability of the sub-sector. The improvement in production technology will also have a direct impact on the improvement of agricultural productivity of the sector.

LEARNING ASSUMED TO BE IN PLACE AND RECOGNITION OF PRIOR LEARNING

It is assumed that a learner attempting this unit standard will demonstrate competence against unit standards or equivalent:

- NQF 1: Fertilise soil and attend to basic plant nutrition.

< NQF 1: Collect agricultural data.

- NQF 2: Demonstrate a basic understanding of the structure and functions of a plant.

UNIT STANDARD RANGE

Range statements are neither comprehensive nor necessarily appropriate to all contexts. Alternatives must however be comparable in scope and complexity. These are only as a general guide to scope and complexity of what is required.

UNIT STANDARD OUTCOME HEADER

N/A

Specific Outcomes and Assessment Criteria:

SPECIFIC OUTCOME 1

Accurately prepare and measure the appropriate quantity and quality of required soil nutrient preparations.

OUTCOME RANGE

Soil nutrient preparations refer to either agro-chemical or organic production methods. These can include preparation of compost and liquid nutrients, management of lime, single or mixed fertilizers, or other substances.

ASSESSMENT CRITERIA

ASSESSMENT CRITERION 1

The ability to identify the appropriate nutrients for a specific context is demonstrated.

ASSESSMENT CRITERION 2

The ability to prepare and collect the correct amount of the appropriate nutrients from the storage area of an agricultural production environment is demonstrated (in the case of conventional systems, this would involve selecting the appropriate fertiliser; for organic systems it would involve storing manure optimally and making compost with due understanding of the processes outlined in the NQF 1 unit standard).

ASSESSMENT CRITERION 3

The ability to measure the required amount of soil nutrient accurately is demonstrated.

SPECIFIC OUTCOME 2

Take an appropriate sample for nutrient analysis.

OUTCOME RANGE

A sample refers, but is not limited to leaf, soil and fruit analysis samples.

ASSESSMENT CRITERIA

ASSESSMENT CRITERION 1

An appropriate sample is taken according to prescribed procedures.

ASSESSMENT CRITERION 2

The sample is labelled according to required procedures.

ASSESSMENT CRITERION 3

The sample is prepared and packaged according to specified procedures.

SPECIFIC OUTCOME 3

Understand the properties of soil and soil composition.

OUTCOME RANGE

Soil properties refer to the texture and structure, water holding and drainage capacity, and soil composition in terms of silt/clay/gravel ratios. Soil composition refers to the basic mineral content of soil. These should be related to the basic interaction between soil composition and productivity.

ASSESSMENT CRITERIA

ASSESSMENT CRITERION 1

Soil structure and texture are identified using elementary tests and observations, and based on this information the learner is able to express an opinion on its condition and remediation.

ASSESSMENT CRITERION 2

The composition of soil based on elementary tests and observations is identified and, based on these results, an opinion regarding the condition of the soil and its fertility requirements is demonstrated.

ASSESSMENT CRITERION 3

The role of minerals in soil health and how this relates to plant production is described.

SPECIFIC OUTCOME 4

Identify and interpret the basic symptoms of nutritional deficiencies in crops.

OUTCOME RANGE

Different crops may include (among others) field crops and horticultural crops. Macro elements may include (among others) Nitrogen, Phosphorous Potassium and Calcium.

ASSESSMENT CRITERIA

ASSESSMENT CRITERION 1

The colour change on plant leaves, and/or fruit/ plant abnormalities, is interpreted and related to the specific macro-element deficiencies compared with healthy plants.

ASSESSMENT CRITERION 2

Steps are taken (or explain the steps needed) to rectify basic deficiencies.

UNIT STANDARD ACCREDITATION AND MODERATION OPTIONS

The assessment of qualifying learners against this standard should meet the requirements of established assessment principles.

It will be necessary to develop assessment activities and tools, which are appropriate to the contexts in which the qualifying learners are working. These activities and tools may include an appropriate combination of self-assessment and peer assessment, formative and summative assessment, portfolios and observations etc.

The assessment should ensure that all the specific outcomes; critical cross-field outcomes and essential embedded knowledge are assessed.

The specific outcomes must be assessed through observation of performance. Supporting evidence should be used to prove competence of specific outcomes only when they are not clearly seen in the actual performance.

Essential embedded knowledge must be assessed in its own right, through oral or written evidence and cannot be assessed only by being observed.

The specific outcomes and essential embedded knowledge must be assessed in relation to each other. If a qualifying learner is able to explain the essential embedded knowledge but is unable to perform the specific outcomes, they should not be assessed as competent. Similarly, if a qualifying learner is able to perform the specific outcomes but is unable to explain or justify their performance in terms of the essential embedded knowledge, then they should not be assessed as competent.

Evidence of the specified critical cross-field outcomes should be found both in performance and in the essential embedded knowledge.

Performance of specific outcomes must actively affirm target groups of qualifying learners, not unfairly discriminate against them. Qualifying learners should be able to justify their performance in terms of these values.

- Anyone assessing a learner against this unit standard must be registered as an assessor with the relevant ETQA.

- Any institution offering learning that will enable achievement of this unit standard or assessing this unit standard must be accredited as a provider with the relevant ETQA.

- Moderation of assessment will be overseen by the relevant ETQA according to the moderation guidelines in the relevant qualification and the agreed ETQA procedures.

UNIT STANDARD ESSENTIAL EMBEDDED KNOWLEDGE

The person is able to demonstrate a basic knowledge of:

- Fertilisers, mixtures, single, etc. if appropriate.
- Nutrient sources such as organic, compost, etc.
- Soil conservation.
- Soil preparation and improvement.
- Basic ecological principles.
- Sampling (soil, leaf, and fruit).
- Basic soil properties.

UNIT STANDARD DEVELOPMENTAL OUTCOME

N/A

UNIT STANDARD LINKAGES

N/A

Critical Cross-field Outcomes (CCFO):

UNIT STANDARD CCFO IDENTIFYING

Problem Solving: Relates to all specific outcomes.

UNIT STANDARD CCFO WORKING

Teamwork: Relates to all specific outcomes.

UNIT STANDARD CCFO ORGANIZING

Self-management: Relates to all specific outcomes.

UNIT STANDARD CCFO COLLECTING

Interpreting Information: Relates to all specific outcomes.

UNIT STANDARD CCFO COMMUNICATING

Communication: Relates to all specific outcomes.

UNIT STANDARD CCFO SCIENCE

Use Science and Technology: Relates to all specific outcomes.

UNIT STANDARD CCFO DEMONSTRATING

The world as a set of related systems: Relates to all specific outcomes.

UNIT STANDARD CCFO CONTRIBUTING

Self-development: Relates to all specific outcomes.

UNIT STANDARD ASSESSOR CRITERIA

N/A

UNIT STANDARD NOTES

N/A
