

ASSESSMENT GUIDE FOR ASSESSORS & FACILITATORS

Plant Nutrition & Soil Management

Level 5

Copyright ©



P.O. Box 461, Hillcrest, 3650
(031) 313-3364

Title:		Manage Soil Systems					
Applied Title:		Manage Soil Systems					
Field:		Agriculture and Nature Conservation					
Sub-Field:		Primary Agriculture					
SETA (SGB):		AgriSETA					
Skills Area:		Plant Nutrition and Soil Management					
Context:		Citrus Production					
US No:	116371	Level:	5	Credits:	10	Notional Hours:	100
Author:		H. Coetzee					

Based on the Production Guidelines of:



Supported by:



Unit standard alignment and assessment tool development:

Cabeton Training and Development

Project coordinator:

Jacomien de Klerk

Disclaimer

By accepting this document and reading its contents you agree to be bound by the terms of this disclaimer.

The use of the contents of this document is at your own risk. Neither the Citrus Academy nor the CRI or the CGA warrant that the content of this document is suitable for your intended use or that it is free of inaccuracies or omissions. The opinions and advice expressed in this document are not necessarily those of the Citrus Academy, the CRI or the CGA. The Citrus Academy, the CRI and the CGA, their directors, officers, employees, agents and contractors shall not be liable for any loss or damage of any nature suffered by any person as a direct or indirect result of the use of, or inability to use any advice, opinion or information contained in this document, or any misrepresentation, misstatement or omission, whether negligent or otherwise, contained in this document.

You indemnify the Citrus Academy, the CRI and the CGA against any claim by any third party against the Citrus Academy, the CRI or the CGA, their directors, officers, employees, agents or contractors arising from, or in connection with, the use of, or reliance on, the contents of this document. It is your responsibility to determine suitability of the contents of this document for your intended use.

Table of Contents

Directions 4

Step 1 5

Step 2 6

Step 3 7

Step 4 8

Step 5 9

Step 6 26

Step 7 28

Step 8 31

Step 9 32

Step 10 39



Directions

Please Note: There is a separate assessment guide for the learner. The learner must use this guide to prepare himself / herself for the assessment.

This assessment guide contains all necessary activities and instructions that will enable the assessor and learner to gather evidence of the learner's competence as required by the unit standard. This guide was designed to be used by a trained and accredited assessor whom is registered to assess this specific unit standard as per the requirements of the AgriSETA ETQA.

Prior to the delivery of the program the facilitator and assessor must familiarise themselves with content of this guide, as well as the content of the assessment guide for learners.

The assessor, facilitator and learner must plan the assessment process together, in order to offer the learner the maximum support, and the opportunity to reflect competence.

The policies and procedures that are applicable during the execution of this assessment are available on the website of the Citrus Academy, contained in a document named Policies and Procedures for Assessment, and must be strictly adhered to. The assessor must familiarise himself with this document before proceeding.

This guide provides step-by-step instructions for the assessment process of:

US No:	116371	Level:	5	Credits:	10
---------------	--------	---------------	---	-----------------	----

The step-by-step instructions agree and are conducted in concert with the steps described in the learner assessment guide. The steps are as follows:

Step	Description	Timeframe
1	Pre-Assessment Briefing and Checklist	Before delivery of program
2	Learner Declaration of Authenticity	Before delivery of program
3	Diagnostic Assessment of Learning Assumed to be in Place	Before delivery of program
4	Assessment Plan for Gathering of Evidence	Before delivery of program
5	Learner Formative Assessment Activities	During delivery of program, assessment after delivery of program
6	Strategy Design	After delivery of program
7	Integrated Summative Assessment Tool	After delivery of program
8	Re-assessment Procedures	After completion of assessment
9	Documentation	After completion of assessment
10	Administration and Completion of Portfolio of Evidence	After completion of assessment

Step 1

Pre-Assessment Briefing and Checklist

A pre-assessment briefing for learners is held before the delivery of the program. Use the checklist below to ensure that all these points are addressed and discussed with the learners.

Pre-Assessment Briefing Checklist		
	√	X
Organise resources – people, equipment, venue, etc.		
Explain the purpose of the assessment		
Discuss the standards or criteria to be used		
Discuss assessment roles and accountabilities		
Decide on assessment venues		
Negotiate evidence required, and where or how this evidence may be gathered		
Explain the methods of assessment that will be used during the gathering and summing up of evidence		
Negotiate the date of submission for the activity workbook and the date for the summative assessment		
Discuss resources required for the assessment e.g. equipment, materials, etc.		
Explain the procedure if the learner is found to be not yet competent		
Explain the appeal and review procedures		
Identify any potential learning barriers and negotiate strategies to overcome these		
Complete and sign the assessment plan with the learner		

The learner and assessor must sign the **Learner Contract** in the learner assessment guide.

Step 2

Learner Declaration of Authenticity

The learner is requested to complete and sign the Declaration of Authenticity in the learner assessment guide. This should be checked and co-signed by the assessor.

The format is as reflected in the learner assessment guide.



Step 3

Diagnostic Assessment of Learning Assumed to Be in Place

In the learner assessment guide, the learner is asked to indicate whether they have completed the learning assumed to be in place as prescribed by the unit standard.

The assessor must guide the learners through this step, explaining in detail the content of the mentioned learning areas, because names of learning programs do not always agree with the names of the unit standards, and learners might indicate the incorrect information.

If learners indicate that they have not yet completed the mentioned unit standards, the assessor should prescribe an action plan to allow the learner to obtain the skills required by recommending additional training, competence portfolios, or the relevant RPL assessment for the given unit standards.

The format is as reflected in the assessment guide for learners. Please read it and familiarise yourself with its content.



Step 4

Assessment Plan for Gathering of Evidence

A pro-forma assessment plan for this unit standard has been drafted in the learner assessment guide. Explained the plan to the learner and complete the dates and signatures as indicated.

The format for the assessment plan is as reflected in the assessment guide for learners. Please read it and familiarise yourself with its content. Make a note of the dates agreed upon in the table provided below.

Learner and Assessor Assessment Plan		
Unit Standard	Manage Soil Systems	
Registration Number	116371	
<i>Step</i>	<i>Description</i>	<i>Completion / Submission Date</i>
Step 5	Learner Formative Assessment Activities	
Step 6	Strategy Design	
Step 7	Integrated Summative Assessment Tool	
Step 8	Re-Assessment Procedures	
Step 9	Documentation	
Step 10	Administration and Completion of Portfolio of Evidence	

Step 5

Learner Formative Assessment Activities

The Learner Assessment Guide contains comprehensive activities and worksheets that the learner must complete during the delivery of the learning program. It is imperative that these activities be completed as part of the learning process in order to give the learner the opportunity to develop the skills, knowledge and attitudes that are required for competence.

Learners must complete all the activities in the workbook.

Learners must be encouraged to take control of their learning by indicating areas in the workbook where they experience difficulty.

Learners hand in the Learner Assessment Guide to the assessor or the facilitator, only if the facilitator is a subject matter expert, for the assessment of the formative assessment activities. The assessment of these activities must be done according to the prescribed benchmarks and according to the marking matrix that follows.

The learner must not move on to the next step before this step has been completed and learners show sufficient capacity and readiness for summative assessment. If problems areas are identified, the learner should be guided with a developmental action plan, which is documented separately and signed by the learner, the facilitator and the assessor.

Model answers are provided below.

Activity 1 – Worksheet
Complete the worksheet below in your own words.
Discuss the reasons why more than one method is used to determine the available P in soils.
Analytical methods for soils are developed to simulate absorption of nutrients by the plant. It does not determine the total nutrient content but only the available portion. Various methods were therefore developed to evaluate the relation between the method and plant response under certain sets of soil and plant conditions. The method that predicts plant response the best will then be used for the specific application.
What does the term K% on a soil analyses report mean?
K% means the ratio of available K to the sum of available Ca+K+Mg+Na
A soil analyses report states that the pH (water) of a soil from a citrus orchard is 5.1. Discuss the evaluation of this value.
Citrus performs best when the pH(water) of the soil is neutral to slightly acidic. Therefore the value for the optimal pH(water) will be 6.00 to 7.50. The pH in question is therefore too low, indicating that the soil is too acidic, and the soil needs to be limed to increase the pH to at least 6.00.
If an acid soil contains 15% Mg and 68% Ca, what type of lime is required?
The optimal Mg% is about 20% and the choice of lime will be dolomitic because dolomitic lime contains more Mg than calcitic lime.
Name and discuss the two major steps in the evaluation of leaf analyses results.

1. Ensure that the correct type of leaf was sampled.
2. Compare the results with the set of optimal values for the various citrus cultivars.

Why does a "normal" or optimum concentration of an element, such as nitrogen, in the leaf not always reflect an optimal status?

Nitrogen is a mobile nutrient and can be relocated to sites of high nitrogen demand. Therefore, when a plant experiences a nitrogen stress, N from old leaves will be relocated to younger leaves and the old leaves will be dropped prematurely. This results in less leaves per tree, with the remaining leaves having a higher N content as they would have if the full leaf cover is present. Less leaves with the same mass of N per tree will result in a higher concentration of N in the leaves.

Apart from the leaf analyses report and the reference standards, what else is required to make a fertilisation recommendation?

The measured chemical composition of the leaves is the result of the previous fertilisation applications and the crop produced. Hence to make a fertiliser recommendation, information regarding the fertilisers applied (what, how much, how and when) and the crop produced are required.

Recordkeeping of leaf analyses is important for reaching an optimal nutritional status. Discuss this statement.

A single value, say 2,3% N will only tell you that the N-status is within the optimal range but one cannot tell if it is increasing or decreasing, nor can you conclude if the application was enough, too little or too much.

Name the reasons why the timing of the application of nitrogen to bearing citrus is so important.

The N status of citrus trees during the period of budding and blossom determines the number of fruit and to some extent the size of the fruit. During this period the N-status must be high. During the ripening phase the nitrogen status must be low enough to facilitate accumulation of carbohydrates for the coming budding and blossoming stage and to ensure good quality (colour) for the current crop. The applications of N must be timed to facilitate these two requirements.

The reasons to recommend split applications of nitrogen are based on a number of factors. Name one.

- **Clay content of the soil – sandy soils will require more applications than clayey soils to overcome the problem of losses through leaching.**
- **Method of irrigation – where drip irrigation is used, the fertilisers must also be applied more often than with micro-jets.**

Single or double super phosphates are applied in a narrow strip below the drip line of the trees. Name two reasons for this practise.

Phosphate moves very slowly through soil and can be fixed by too low or too high pH levels and clay particles in the soil. To minimise these detrimental effects (fixation and slow movement), supers are placed in a narrow strip creating a zone less prone to fixation.

Name one main difference between the applications of nutrients when using drip and micro-jet irrigation.

With micro-jets, fertilisers that are not completely soluble can be used while with drippers the fertilisers must 100% water soluble.

With drippers the fertiliser must be applied frequently at low concentration, which might call for more than 20 applications per annum. More than four applications of the same fertiliser is seldom required with micro-jets.

The application of foliar sprays with urea is sometimes recommended for July and/or October. What are the reasons for the July and October sprays?

The application of urea during July is a method to manipulate the physiology of the trees to produce better quality flowers. Timing is very important and too late applications will either have no effect or reduce fruit set. The application in October is to supplement the nitrogen in the trees and timing is less important and can even be done up to December.

Apply the following information to evaluate the leaf and soil analyses and formulate fertilisation recommendations for orchard C:

Sunshine Farm

Hoedspruit, Limpopo

Orchard Information – Citrus

Orchard Information

Orchard Number:	C	Type of irrigation:	Micro-jets
Cultivar:	Navels	Fertigation:	No
Selection:	Washington	Area Planted:	3.5ha
Rootstock:	Rough lemon	Trees per Ha:	400
Sampling Date:	11 March 2005	Planting Date:	Oct 1983

Crop Information

Yield – Previous Season:		40t/ha	
Yield – Estimate This Season:		50t/ha	
Fruit size:	Too small	Juice %:	OK
Skin Quality/Colour:	OK	Acid %:	Too low
TSS:	OK	Physiological Disorders:	None

Fertilisers Applied (g or ml/tree)

Type	Quantity Date	Quantity Date	Quantity Date	Quantity Date
LAN	750g Jul 05	350g Aug 05	150g Sep 05	
Gypsum	2000g Aug 05			

Foliar Sprays Applied(g or ml per 100 litres water)

Type	Quantity Date	Quantity Date	Quantity Date	Quantity Date
Low Biuret Urea	1000g Jul 05			
Zinc Nitrate	150ml Oct 05			
Manganese Sulphate	200g Oct 05			

LEAF ANALYSES REPORT

Lab Number	L9912	
Your Reference Number	C	
Nitrogen (Total) %	2.84	Too high
Phosphorus %	0.11	Slightly too low
Potassium %	0.89	Optimal
Calcium %	3.72	Optimal
Magnesium %	0.23	Deficient

Sulphur	%	0.24	Optimal
Chloride	%	0.11	Optimal
Sodium	mg/kg	11	Optimal
Copper	mg/kg	3	Deficient
Iron	mg/kg	54	Optimal
Manganese	mg/kg	112	Optimal
Zinc	mg/kg	12	Deficient
Boron	mg/kg	161	Optimal
Molybdenum	mg/kg	0.06	Optimal

SOIL ANALYSES REPORT			
Lab Number		S33629	
Your Reference Number		C	
pH water		7.38	Slightly too high
pH KCl		6.91	Slightly too high
P Bray 1	mg/kg	15	Slightly too low
Potassium	AmAc mg/kg	285	Optimal to high
Calcium	AmAc mg/kg	1213	Slightly too low
Magnesium	AmAc mg/kg	376	High
Sodium	AmAc mg/kg	121	Slightly high
Potassium	%	7	Optimal to high
Calcium	%	58	Too low
Magnesium	%	30	Too high
Sodium	%	5	Slightly too high

Remarks and Recommendations:

- The too high N level is one reason for the too small fruit. Reduce the application of LAN by omitting the 150g LAN per tree in September. Consider substituting the LAN by a more acidifying nitrogen source like ammonium sulphate.
- The P level in the leaf and soil is too low. Apply the single supers in Sept in a narrow strip.
- The calcium level in the soil is still too low. Repeat the application of gypsum in August.
- Although the magnesium content in the soil is high, the trees cannot utilise it efficiently. Therefore one has to resort to foliar sprays.
- Note copper oxychloride and magnesium nitrate are NOT compatible.
- Apply low biuret urea in July. Urea and magnesium nitrate are compatible.
- Apply zinc nitrate in July and repeat in October. Zinc nitrate is compatible with magnesium nitrate and urea.

Use the fertilisation programs for orchards A and E in the example, and the fertilisation program compiled above for orchard C to compile the following foliar application program.

FOLIAR APPLICATION PROGRAM							
Month:	July 2006						
Product:	Low Biuret Urea						
<i>Orchard</i>	<i>Size (ha)</i>	<i>Litres per ha</i>	<i>*Total Litres</i>	<i>Recommend (g per 100l)</i>	<i>**Total Recommend per Orchard (kg)</i>	<i>Applied (g per ha)</i>	<i>Total Applied per Orchard</i>
A	2.80	4,000	11,200	1,000g	112kg		
C	3.50	4,000	14,000	1,000g	140kg		
E	4.15	4,000	16,600	1,000g	166kg		
Total					418kg		

Use the information provided in the example in section 3 and calculate the efficiency rate if the yield for the orchard was 40 tons per hectare. Assess the efficiency rate and discuss possible causes for it.

40 tonnes Navels will remove $2,50 \times 40 = 100\text{kg N}$ from orchard C. The application was $1,100\text{g LAN per tree}$ with $400\text{ trees per ha} = 440\text{kg LAN} = 123.20\text{kg N}$ ($440 \times 28 \div 100$). The efficiency rate therefore is $100 \div 123.20 \times 100 = 81.10\%$ which is excellent.

Activity 2 – Worksheet

Obtain a soil or leaf analyses report from the farm where you are completing your practical duties. Complete the worksheet below.

The answers for this activity will depend on the reports available and will be much the same as the previous activity.

What is the nutrient status of citrus in general?

The nutrient status refers to the degree to which the actual levels agree with the set of optimal standards. If the majority of orchards has a below optimal nitrogen level then the nitrogen status is in general too low. If most orchards have a high concentration of magnesium in the leaves the magnesium status is in general too high. The requirement of the orchards will then be in general more N and less Mg.

What is the nutrient status of the citrus varieties grown on the farm where you are completing your practical duties?

No model answer provided, contextualise for varieties on farm.

Write a detailed report of the information that you obtain from the analysis report.

No model answer provided, contextualise for report obtained.

Make recommendations in terms of nutrient additions to the soil based on the report. Motivate your recommendations.

No model answer provided, contextualise for report obtained. Recommendations must be based on the specifics of the report.

Activity 3 – Flow Diagram

Draw a flow diagram to explain how and why the nutrient requirements of a specific variety of citrus, grown on the farm where you are completing your practical duties, changes over a year.

As per learner but must reflect the following:

- Changes in the nutrient requirement of the trees are prescribed by the goals to be achieved. The goal main goal is to produce as much fruit of a certain quality that will maximise the returns. Although the production season already starts in May, the citrus producer only starts with the fertilisation program, for most cultivars, in July or August.
- A basic rule is that any deficiency should be addressed as soon as the application will not affect the current crop on the trees. Nitrogen, even when a deficiency is suspected, should never be corrected after January unless the citrus producer is willing to write-off the current crop.
- The type and magnitude of the changes will depend on the element it self.
- Nitrogen will be required at high rates at the onset of spring to promote quality flowers and improve the quality of the fruitlet. From fruitset onwards, the supply of N should taper off to reach a minimum during late summer and winter. This will promote the accumulation of carbohydrates which serve as energy reserves for the coming budding, flowering and fruitset periods.
- Although P is required in higher quantities during active root growth and cell division, the trees can store and relocate P wherever it is required. Hence no specific time of maximum and minimum required.
- Potassium and Mg can be accumulated and redistributed whenever it is required. Again no specific time for applications but to accommodate the absorption, K and Mg should be supplied during active root growth flushes (spring to early summer).
- Ca is immobile in the plant and the peak demand is from July to October.
- S is relatively immobile and the demand is during budding, flowering and fruitset.
- Cu can only be applied during July to August and then again when the fruit reached maturity.
- Fe is only economically effective if applied during August.
- Zn, Mn, Mo and B are fairly mobile and maintenance should be done during spring to early summer.

Activity 4 – Worksheet

Complete the worksheet below in your own words.

What is a soil utilisation plan and what is its purpose for a citrus farm?

An utilisation plan should be specific for a site, with the aim to optimise the growing conditions for the trees. This must include actions to improve what can be improved and to manage that cannot be improved.

An optimal soil is seldom found in nature and most soils need to be modified chemically or physically to get as close as possible to the optimal conditions. Thereafter, managing the soil and horticultural practises can add to the effective utilisation of a suboptimal soil. Another purpose is to prevent chemical and physical soil erosion.

From a survey, the following soil properties were identified as not being optimal and in need of attention. Evaluate the soil utilisation plan and make final recommendations.

<i>Property That Need to Be Corrected / Managed</i>	<i>Implications If Not Corrected</i>	<i>Possible Corrective Action</i>	<i>Recommendation</i>
pH (water) is 5.84	Retarded root development. Very difficult to mix to acceptable depth after planting.	Apply 8,000 kg calcitic lime per ha 50cm deep.	Liming is essential. Ensure that the mass lime recommended to correct the pH is mixed properly with the soil to a depth of 50cm.
Salt content is high (150 ohms) at a depth of	The salts are deep down in the profile and if not	Do not mix the soil in a down-up-manner and	The effective loosening depth

80cm	brought to the surface during soil preparations, should be harmless.	keep the salts at the bottom	should not exceed 60cm to avoid any soil from the +80cm layer being worked to top layers.
P (bray 1) = 2mg/kg	Retarded root development. Very difficult to mix to acceptable depth after planting.	Apply 1,250kg single supers per ha 50cm deep	As for lime, ensure proper mixing.
The soil is layered. 0-25cm contains 17%, 25-35cm 5%, 35-80cm 20% and 80+cm 38% clay .	Restricted water movement and root penetration.	The 0 to 60cm layer must be mixed to destroy the sandy layer at 25 to 35cm, but do not bring the soil below 60cm to the surface.	The actions required to mix the lime and phosphorus will also ensure that the layering is lifted in the 0 to 50cm layer.
Potential effective rooting depth is 70cm	Suitable for micro-jets and drippers provided the other limitations are corrected.	Create a homogeneous layer of soil from the top to 50 or at the deepest 60cm deep.	Ensure that nowhere the cultivation depth exceeds 60cm.

As a guideline the minimum soil depth is set at 500mm. What other factors will influence this decision?

The required depth is also a function of:

- The irrigation system and -type and the level of irrigation management,
- Soil texture
- Soil strength

Why is it better to incorporate the P-sources and liming material before planting?

Both P and lime move slowly through the soil profile. To ensure that the roots in the deeper layers will also have enough P and an acceptable pH for optimal growth, these materials must be mixed prior to planting. After planting applications is less effective due to a slow reaction in deeper layers.

Activity 5 – Worksheet

Complete the worksheet below in your own words.

Use the databases below to make recommendations for the application of lime and potassium. The minimum for pH (water) is 6.00 and for potassium 150mg/kg.

Orchard	2000	2001	2002	2003	2004	2005
5	6.71	6.62	6.46	6.31	6.17	5.94
6	5.56	5.88	6.43	6.31	6.16	6.05
7	5.89	6.42	6.58	6.44	6.37	6.31
8	6.33	6.52	6.34	6.37	6.24	6.17

Orchard	2000	2001	2002	2003	2004	2005
5	121	152	182	195	164	154
6	165	173	154	179	166	172
7	201	276	234	251	244	221
8	174	169	174	180	176	170

Liming: Orchards 5 and 6 need liming. Orchard 7 does not need lime, while liming orchard 8 can be postponed another year, but depending on other factors like minimum mass lime that can be ordered, logistics etc., can be limed at the same time than 5 and 6.

KCl applications: The concentration of K is above the minimum for all orchards. However, orchard 5 is just above the minimum and application is justified. However if the levels are the result of applications during the ensuing season then the rate must be the same for orchards 6 and 8, can be decreased for 7 and increased for 5.

Name two fixed, two temporary variable and two variable soil properties.

Fixed properties: Mainly physical properties like texture (clay, silt sand content), slope, aspect, total depth, water holding capacity.

Temporary variable properties: CEC, pH and effective depth.

Variable properties: Almost all chemical and biological properties like pH, EC, available P, K etc. and organic material.

How is fruit analyses data recorded?

No formal method exists but most citrus growers keep the record on a basis of exceptions. If the fruit is too small or too large, it will be recorded but not if it is acceptable.

Why are samples to determine the fixed properties taken more than once?

The composition of any field or orchard is not 100% the same over the entire area. To ensure that the evaluation of a fixed property is representative of the whole, the soil must be sampled more than once.

Activity 6 – Worksheet

For a citrus orchard on the farm where you are completing your practical duties, find a soil map and all the available soil information to date. This may include initial soil analyses reports and all records of actions taken. Attach all the documents to your workbook and answer the questions below.

List the documents that you found and explain the purpose of each document.

No model answer provided. Depend on the information and documents available.

Explain in your own words why records have been kept for this orchard to this extent.

No standard answer, depends on circumstances.

Activity 7 – Worksheet

Complete the worksheet below in your own words.

Name the five phases of the life of a citrus orchard.

- **Pre-planting**
- **Non-bearing**
- **Juvenile**
- **Mature**
- **Declining**

Name two important actions that need to be done during each phase.

- **Pre-planting: soil survey and soil preparation**
- **Non-bearing: managing inputs like fertilisation, pest control, irrigation and other practises to optimise vegetative growth**
- **Juvenile: taking actions to set enough fruit to ensure acceptable quality**
- **Mature: optimising conditions to ensure optimal yields, fruit size and quality and to extend the economic life of the orchard**
- **Declining: managing production inputs to reduce the impact of decrease in fruit size, dieback of twigs, slow or stunted shoot growth, inadequate leaf cover, small leaves, decrease in total yield, reduction in feeder roots**

Evaluate the following nutrient management plan:

<i>Type</i>	<i>Quantity Date</i>	<i>Quantity Date</i>	<i>Quantity Date</i>	<i>Quantity Date</i>
LAN	2x400g Jul 06	350g Aug 05	250g Sept	
KCl	250g Oct 06			

<i>Type</i>	<i>Quantity Date</i>	<i>Quantity Date</i>	<i>Quantity Date</i>	<i>Quantity Date</i>
Low Biuret Urea	1000g Jul 06	1000g Oct 05		
Copper Oxychloride	150g Jul 06			
Manganese Sulphate	2x200g Oct 06			
Zinc Nitrate	150ml Oct 06			

Name the two main soil preparation methods used in citriculture.

Loosening and mixing the soil

Describe the preparation procedures of a ridge.

Ridging is the process where some of the soil between rows of trees is moved to the areas where the trees will be planted, creating a ridge with a greater depth than the natural soil.

If the soil survey for instance indicates a suitable layer of soil to a depth of 30cm. Below this layer is a clayey layer, which will reduce internal drainage and cause all sorts of problems. The spacing of trees will be 7m between rows and 3m between trees. To create a ridge, strips of soil 3m wide and 30cm deep is moved from between rows and placed on a strip of 4m where the trees will be planted, creating a strip of suitable soil 3m wide at the crest, 4m wide at the base and 50cm to 60cm deep.

When lime is required, the application will be recommended before the pH of the soil in an existing orchard reaches the acid range of <6.00. What are the reasons?

Once the pH of the top layer reaches 6.00 the subsoil most probably has a pH of less than 6.00. In an existing orchard lime cannot be mixed with the soil and has to move into the root zone from the top, a very slow process. This could mean that the pH of the subsoil will even be less when the lime reaches that layer. Therefore start with the liming program before the pH of the sub layer is too acid.

Activity 8 – Mind Map

Draw a mind map to explain what a soil system management plan consists of and how it is applicable to the farm where you are completing your practical duties.

Pre-Plant Phase

- Identify the limiting factors in the soil profile and site layout, including slope, aspect, layering, soil depth.
- Select the most suitable method to correct the limitations and/or to manage the limitations.
- Preparation methods include loosening, loosening plus mixing or ridging.
- Create a homogeneous root zone of between 40 and 70cm depth.
- During preparation the chemical should be added to optimise the fertility.

Non-Bearing Phase

- Use a garden fork when making plant hole. A spade will create compaction on the sides, especially in clayey and wet soils.
- Protect soil surface against erosion and scorching by the sun. Mulches or live plant covers can be utilised. The latter must not compete with the trees – avoid invasive species.
- Apply nitrogen and micro-nutrients continuously. Nitrogen and micro-nutrients need to be applied at least monthly where micro-jets are used and at least weekly where drippers are used.

Juvenile Phase

- Control nutrient status, especially potassium, carefully to avoid poor quality fruit.
- Protect soil surface against erosion and scorching by the sun. Mulches or live plant covers can be utilised. The latter must not compete with the trees – avoid invasive species.
- Prevent crusting of the surface by optimising the calcium content of the soil.

Mature Phase

- Maintain optimum chemical conditions in the root zone using analyses and recordkeeping to do judicious applications of fertilisers. The parameters will include pH, fertility (status of P, K, Ca, Mg, and micro-nutrients in the soil and leaf) and salinity (Na, SAR and resistance).
- Maintain optimal physical conditions which will include soil strength (compaction), drainage, stability of structure especially on the surface, runoff (erosion protection), and water penetration.
- No parameters are available at this stage to evaluate and maintain biological factors.
- Maintain optimum physical and chemical conditions in the between-row areas. The most important aspects are erosion and surface draining.
- Maintain optimum physical and chemical conditions in the perimeter areas.
- Avoid soil compaction.

Declining Phase

During this phase the management plan will concentrate on those aspects that will lengthen the economic life of the trees. The components of the soil system management plan will therefore incorporate improvements in:

- Soil compaction – Corrective ploughing is an option and entails the loosening of the soil on one side of the trees the first and then the other side the next year. It is done after harvest and the irrigation at the cultivated side must be reduced until the roots had resettled in the loose soil. This method requires heavy tractors and an implement specially constructed for this purpose. A fairly new development which will also alleviate compaction is the introduction of soil fungi and organic material for them to proliferate. This is done with other crops but is not researched with citrus. Contact a specialist to assist with both methods.
- Treatments to control nematodes and Phytophthora are now required more frequently. Ensure that enough information is collected to make a proper financial decision on the profitability of the treatments.
- Foliar sprays to assist the restricted roots are a very successful method to keep the nutrient status optimal. Nitrogen, potassium, magnesium and the micro nutrient elements can be supplied by means of foliar sprays.
- The irrigation schedules must be adjusted to suit the decreasing water requirement of sick trees and to assist in treating the trees for Phytophthora.

Activity 9 – Report Writing

Refer to the soil map and initial analyses reports that you obtained for activity 6. Design a soil system management plan for the specific orchard.

No model answer provided. Depend on the information and documents available.

Now swap your soil system management plan with a class mate. Write a brief report on your class mate's plan with reference to sustainability. Motivate your report findings and suggest improvements.

No model answer provided. Depend on the information and documents available.

Activity 10 – Worksheet

Complete the worksheet below in your own words.

Draw a diagram in which you explain the links between a nutrient management plan and soil conservation, water availability and crop requirements respectively.

Explain in your own words how you would determine if a nutrient management plan is suitable in terms of:

- Soil conservation
 - **The NMP must include ways and means to evaluate the chemical, physical and biological condition of the soil.**
 - **The NMP must then include procedures to monitor the conditions regularly. The frequency will be determined by the magnitude of the changes over a period.**
 - **The NMP must include methods to correct and maintain the optimal soil conditions.**
 - **The NMP must include ways and means to prevent pollution and must be able to evaluate the degree of pollution of water sources and soil.**
 - **The NMP must record what is applied and what the potential hazards for the soil and environment are.**
 - **Over supply must be monitored by recording applications, crop parameters and leaf and soil analyses data.**
- Water availability
 - **Managing the calcium status of the soil will avoid crusting and improve water penetration.**
 - **Maintaining root health ensures that water uptake is optimal.**
- Crop requirements
 - **Basically a good NMP will be able to provide in the needs of the trees in respect of all 14 nutrient elements and in the requirements to keep the soil in an optimal condition.**
 - **The sources of nutrients are the soil (soil analysis and recordkeeping required), irrigation water (analysis required to accommodate seasonal changes) and the fertilisation program.**
 - **The methods used to supply the required nutrients can be manual or mechanical applications to the soil fertigation and foliar sprays in any combination**

Marking Matrix and Assessor Report for Formative Assessment Activities
Formative Evidence Collection Summary for L5 Unit Standard 116371

	<i>Action Required from Learner to Develop Competence</i>	<i>Competence Assessments</i>	<i>Standard for Activity</i>	<i>Allocation of Marks</i>	<i>Feedback to Learner and Comments on Evidence</i>
<i>Specific Outcome 1: Interpret soil and leaf analysis and make appropriate nutrient application recommendations</i> <i>Range:</i> A recommendation refers to nutrient application, which includes but is not limited to agrochemical or organic nutrient material	Attend classroom lesson, participate and ask questions	Activities in learner activity book were completed correctly	Activity answers must be at least 85% correct	As per model answer sheet	
<i>Specific Outcome 2: Optimise soil utilisation plan according to crop and soil requirements</i> <i>Range:</i> Soil utilisation plan refers to but is not limited to crop establishment and can include conservation areas and infrastructure planning, taking into account soil depth, drainage, infiltration rate, pH, water holding capacity, field capacity, soil horizons, soil aeration, erosion danger, organic content, active biomass, texture, clay content, structure, biological content, compaction, CEC, CAC, nutrient content, C:N ratios	Attend classroom lesson, participate and ask questions	Activities in learner activity book were completed correctly	Activity answers must be at least 85% correct	As per model answer sheet	

Marking Matrix and Assessor Report for Formative Assessment Activities
Formative Evidence Collection Summary for L5 Unit Standard 116371

	Action Required from Learner to Develop Competence	Competence Assessments	Standard for Activity	Allocation of Marks	Feedback to Learner and Comments on Evidence
Specific Outcome 3: Keep all records regarding soil properties and use to build a database for future reference <i>Range:</i> Records refer to but not limited to leaf, soil and fruit analysis, soil maps and observations of soil properties and crop yields	Attend classroom lesson, participate and ask questions	Activities in learner activity book were completed correctly	Activity answers must be at least 85% correct	As per model answer sheet	
Specific Outcome 4: Design a soil system management strategy <i>Range:</i> Soil systems refer to but are not limited to soil maps, field histories, slope / contours, mulching, application of nutrients, soil preparation techniques, rehabilitation, erosion control measures, compaction control measures, controlled traffic, and crust formation control measures, chemical, physical and biological properties	Attend classroom lesson, participate and ask questions	Activities in learner activity book were completed correctly	Activity answers must be at least 85% correct	As per model answer sheet	
Specific Outcome 5: Create and implement a database for soil management	Attend classroom lesson, participate and ask questions	Activities in learner activity book were completed correctly	Activity answers must be at least 85% correct	As per model answer sheet	
Embedded Knowledge: The learner is able to demonstrate a basic knowledge of: 1. Sampling procedures	Attend classroom lesson, participate and ask questions	Activities in learner activity book were completed correctly	Activity answers must be at least 85% correct	As per model answer sheet	

Marking Matrix and Assessor Report for Formative Assessment Activities
Formative Evidence Collection Summary for L5 Unit Standard 116371

	<i>Action Required from Learner to Develop Competence</i>	<i>Competence Assessments</i>	<i>Standard for Activity</i>	<i>Allocation of Marks</i>	<i>Feedback to Learner and Comments on Evidence</i>
1. Chemical, properties of soil – pH, nutrient status and degradation, C:N relation in soil, Cation Exchangeable Capacity, Cation Absorptive Capacity, Buffering capacity, etc. 2. Physical properties of soil – texture, structure, soil profiles, crust formation, erosion types, compaction, and degradation 3. Biological properties and processes of soil 4. Soil ecology – soil organisms, food webs, role of water and oxygen in soil 5. Soil health and conservation 6. Role of living organisms 7. Conservation practices – runoff control, contours, etc. 8. Tillage operations – mechanical, non-mechanical, organic, minimum and zero tillage 9. Application of nutrients – liquid and solid 10. Soil preparation – primary and secondary soil preparation methods, mulching 11. Soil preparation and fertiliser application equipment 12. Nutrients – mixtures, limes, calcitic and dolomitic lime, single nutrients					

Marking Matrix and Assessor Report for Formative Assessment Activities
Formative Evidence Collection Summary for L5 Unit Standard 116371

	<i>Action Required from Learner to Develop Competence</i>	<i>Competence Assessments</i>	<i>Standard for Activity</i>	<i>Allocation of Marks</i>	<i>Feedback to Learner and Comments on Evidence</i>
and compost, liquids, etc. 13. Calibration of equipment 14. Characteristics of the nutrients 15. Role of nutrients in the plant 16. Rules and regulations for transport, storage and handling of agro-chemicals					
US CCFO: Identifying	Attend classroom lesson, participate and ask questions	Activities in learner activity book were completed correctly	Activity answers must be at least 85% correct	As per model answer sheet	
US CCFO: Working					
US CCFO: Organising					
US CCFO: Communicating					
US CCFO: Science					
US CCFO: Demonstrating					
US CCFO: Contributing					
US CCFO: Collecting					

Assessment Feedback Form – Activity Workbook			
		Comments / Remarks	
Feedback to learner on assessment			
Feedback from learner to assessor			
Learner's Signature		Date:	
Assessor's Signature		Date:	



Step 6

Strategy Design

Before the project is undertaken, the learner must be reminded of what is expected from him / her in terms of summative and reflexive competence. Read and explain to the learner, the **Preparation for Your Final Assessment** section in the learner assessment guide. Learners and assessor should sign off this section to acknowledge that this step was completed.

- Use the planning and questioning format below to help you collect evidence for foundational and embedded knowledge as prescribed by the outcomes of the unit standards.
- Provide the questions as listed to the learners as a guide.
- Ensure that you apply the exact same methodology for each learner in order to ensure that VACS principles are adhered to.
- The benchmark for learner competence is an 85% overall questionnaire score.
- Only a suitably qualified and registered assessor who is ALSO a subject matter expert in this specific field can mark this assessment tool for learner assessment.
- If no such a person can be found to assess the learner, then it is advised that a qualified assessor consults with the appropriate subject matter expert prior to the assessment in order to establish key points for competence and / or uses model answers as supplied by a subject matter expert to allocate marks. The subject matter expert should be consulted for any answers that the assessor might have queries on.
- Use a header in the following format for each questionnaire paper:

Unit Standard:	116371	NQF Level:	5
Learner Name			

- The assessor should copy and paste as required and hand out questionnaire to learners.
- Marks and scores should be allocated as follows:

What does soil management mean?	10%
Why is soil management a priority?	10%
What does soil management address?	10%
What does soil management achieve?	10%
Whose responsibility is a soil management strategy?	5%
How can soil management strategies be implemented viably, sustainably and profitably?	10%
What are the main components of a soil management plan?	5%
How do the components of the soil management plan link logically?	10%
How long does a soil management plan run?	5%
What has to be kept on record for a soil management plan to be successful?	10%

What information is gained from the records/data kept during a soil management plan?	10%
Does the information gained from the records/data kept during a soil management plan allow you to make any adjustments to your plan?	5%



Step 7

Integrated Summative Assessment Tool

One assessment tool is provided in this step, being:

1. Attitudes and Attributes Assessment Tool

This assessment tool has been drafted in its entirety and follows below. It must be copied and completed for every learner in the same manner and according to the same procedure.

Learners must not be given these tools in preparation for summative assessment. This corresponding step in the Learner Assessment Guide is a direct reflection of these tools and is drafted in a format that is appropriate to the learner's level of language competence.

1. Attitudes and Attributes Assessment Tool

- Use this rating scale to judge the learner's CCFO competence according to the unit standard.
- The learner's entire performance and all the stages of learning, as well as all gathered evidence must be considered for this section.
- It is advised that the assessor consult with facilitators, mentors, coaches and supervisors in order to ensure that an objective rating is allocated.
- A rating between 1 and 5 should be given, as follows:

Rating	Description
1	No evidence can be found
2	The evidence found is weak and this is still a major development area for the learner
3	The evidence found meets the average expectation for a learner on this level
4	The evidence found is of a high quality and exceeds the average standard expected
5	The evidence found is outstanding and the learner attitudes and traits are very well developed

- Learner must be given constructive feedback on each rating.
- Ensure that you apply the exact same methodology for each learner in order to ensure that VACS principles are adhered to.
- The benchmark for learner competence in this tool is 3:5 in EVERY CCFO.

At the end of this step, an assessment feedback form is provided which must be completed and signed by the assessor, learner and moderator, where applicable.

Attitudes and Attributes Assessment Tool

Use the following rating table in this assessment:

Rating	Description
1	No evidence can be found
2	The evidence found is weak and this is still a major development area for the learner
3	The evidence found meets the average expectation for a learner on this level
4	The evidence found is of a high quality and exceeds the average standard expected
5	The evidence found is outstanding and the learner attitudes and traits are very well developed

CCFO Criteria	Rating
Identifying – The learner can identify problems and deficiencies correctly.	
Working in a Team – The learner is able to work well as member of a team.	
Organising – The learner works in an organised and systematic way whilst performing all tasks and tests.	
Communicating – The learner is able to communicate his or her knowledge orally and in writing, in a way that shows what knowledge he or she has gained.	
Demonstrating – The learner is able to show and perform the tasks required correctly.	
Contributing – The learner is able to link the knowledge, skills and attitudes that he or she has acquired in this module of learning to specific duties in their job or in the community where he or she lives.	
Science – Learner is able to utilise and use science and technology effectively	
Collecting – Learner can effectively gather information	



Assessment Feedback Form			
		Comments / Remarks	
Feedback to learner on assessment and / or overall recommendations and action plan for competence			
Feedback from learner to assessor			
Assessment Judgement	You have been found: ☐ Competent ☐ Not yet competent in this unit standard		Actions to follow: ☐ Assessor report to ETQA ☐ Learner results and attendance certification issued
Learner's Signature		Date:	
Assessor's Signature		Date:	
Moderator's Signature		Date:	

Step 8

Re-Assessment Procedures

- Note that only outcomes on which the learner was found not yet competent must be re-assessed.
- The same procedures in steps 6 and 7 are repeated.
- The tool must be adapted at discretion of the assessor. Best practice is not to present the exact same format and questions if possible.
- Use your expertise and judgement to ensure that the method of re-assessment remains integrated and relevant to the expected outcomes.



Step 9

Documentation

The following documentation is addressed in this step:

1. Learner and assessor information reports;
2. Assessor report and summative evidence collection summary;
3. Learner assessment re-actionnaire;
4. Assessor's assessment review and improvement document;
5. Assessment appeal form

1. Learner and Assessor Information Forms

The learner information form is in the assessment guide for learners. The assessor information form follows. These forms must be completed for each individual learner and placed in the learner's portfolio of evidence.

2. Assessor Report and Summative Evidence Collection Summary

This report follows after the information report. Use it to summarise the findings during assessment. Please complete the copy of this report that is in the learner assessment guide.

3. Learner Assessment Re-Actionnaire

A pro-forma for the learner assessment re-actionnaire is included in the learner assessment guide. Ask the learner to complete this form and sign it.

4. Assessor's Assessment Review and Improvement Document

The assessor is expected to complete the assessor review of the assessment process, using the pro-forma document of which an example follows. Please complete the copy of the document in the learner assessment guide. This document must be discussed with the learner and any learner commentary should be recorded.

5. Assessment Appeal Form

The assessment appeal form is also provided in the learner assessment guide. Assist the learner to complete the document if necessary.

The learner must be requested to sign-off all reports and documents before they are placed in the portfolio of evidence.

Assessor Information Form			
Unit Standard			
Program Date(s)			
Surname			
First Name			
Company Name			
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			

Assessor Report and Formative and Summative Evidence Collection Summary for Unit Standard 116371 – Level 5					
Description	Evidence Gathered		Benchmark	Competent / Not yet Competent	Feedback and Comments
	Foundational and Embedded Knowledge	Practical Skills, Underpinning Knowledge and Reflexive Competence			
Specific Outcome 1: Interpret soil and leaf analysis and make appropriate nutrient application recommendations <i>Range:</i> A recommendation refers to nutrient application, which includes but is not limited to agrochemical or organic nutrient material	Attend classroom lesson, participate and ask questions	Activities in learner activity book were completed correctly	Activity answers must be at least 85% correct		
Specific Outcome 2: Optimise soil utilisation plan according to crop and soil requirements <i>Range:</i> Soil utilisation plan refers to but is not limited to crop establishment and can include conservation areas and infrastructure planning, taking into account soil depth, drainage, infiltration rate, pH, water holding capacity, field capacity, soil horizons, soil aeration, erosion danger, organic content, active biomass, texture, clay content, structure, biological content, compaction, CEC, CAC, nutrient content, C:N ratios	Attend classroom lesson, participate and ask questions	Activities in learner activity book were completed correctly	Activity answers must be at least 85% correct		

Assessor Report and Formative and Summative Evidence Collection Summary for Unit Standard 116371 – Level 5					
Description	Evidence Gathered		Benchmark	Competent / Not yet Competent	Feedback and Comments
	Foundational and Embedded Knowledge	Practical Skills, Underpinning Knowledge and Reflexive Competence			
Specific Outcome 3: Keep all records regarding soil properties and use to build a database for future reference <i>Range:</i> Records refer to but not limited to leaf, soil and fruit analysis, soil maps and observations of soil properties and crop yields	Attend classroom lesson, participate and ask questions	Activities in learner activity book were completed correctly	Activity answers must be at least 85% correct		
Specific Outcome 4: Design a soil system management strategy <i>Range:</i> Soil systems refer to but are not limited to soil maps, field histories, slope / contours, mulching, application of nutrients, soil preparation techniques, rehabilitation, erosion control measures, compaction control measures, controlled traffic, and crust formation control measures, chemical, physical and biological properties	Attend classroom lesson, participate and ask questions	Activities in learner activity book were completed correctly	Activity answers must be at least 85% correct		
Specific Outcome 5: Create and implement a database for soil management	Attend classroom lesson, participate and ask questions	Activities in learner activity book were completed correctly	Activity answers must be at least 85% correct		

Assessor Report and Formative and Summative Evidence Collection Summary for Unit Standard 116371 – Level 5					
Description	Evidence Gathered		Benchmark	Competent / Not yet Competent	Feedback and Comments
	Foundational and Embedded Knowledge	Practical Skills, Underpinning Knowledge and Reflexive Competence			
Unit Standard CCFOs: • Identifying • Working in a Team • Organising • Collecting • Communication • Science • Demonstrating • Contributing	N/a	Rating Scale	Minimum rating of 3:5 in each criteria or overall average of 3:5		

Assessor's Assessment Review and Improvement Document	
<i>Issues</i>	<i>Comments</i>
Did the assessment go according to plan?	
Did anything unexpected happen?	
Were you pleased with the assessment decision; i.e. was it what you expected?	
How could the process have been carried out more efficiently?	
How could the process of assessing the knowledge be improved?	
How could the Performance Observation checklist be improved?	
Was the evidence you gathered sufficient to make a judgment of competence?	
Was the way you obtained feedback from the learner effective?	
Were you pleased with the way you communicated your decision to the learner? If not, how could this have been improved?	
How would you improve the assessment process?	

Any learner has the right of appeal against any not-yet-competent decision by the assessor. If the learner wishes to appeal, please assist him / her to complete the form below.

Appeal Form			
I hereby appeal against the outcome of my assessment.			
Date:			
Learner's Name:			
Assessors Name:			
Organisation:			
Assessment Details: Criteria, role, standards Used, etc.			
Issue to be Reviewed:			
Learner's Signature		Date:	
Assessor's Signature		Date:	

Step 10

Administration and Completion of Portfolio of Evidence

All the documents or copies thereof, as prescribed previously, must be kept on file as part of the learner portfolio of evidence.

Learner's portfolio of evidence must be readily available for internal and external moderation and verification by the appropriate practitioners, until after the verification process has taken place. The portfolio of evidence may then be kept or returned to the learner according to the service provider's policy.

The prescribed learner results form should be submitted to the ETQA or the National Learner Database as per the SETA procedure.

