



Citrus Orchard Foreman Occupational Learning

Work Scenario Guide

D2: Plant Health Management

Qualification:	110667 – Occupational Certificate: Orchard and Vineyard Foreman
Work Scenario:	D2: Plant Health Management
Learning Area:	D: Oversee the monitoring of plant health
Scenario Description:	You find that your trees are unhealthy, and need to work with other managers to create a plan to maintain and improve plant health through irrigation, nutrition programmes, IPM and disease management.

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Alignment Information

Qualification

The content of this learner guide is aligned to the following occupational qualification:

SAQA QUAL ID	Qualification Title			
110667	Occupational Certificate: Orchard and Vineyard Foreman			
Originator				
Development Quality Partner – AgriSETA				
Primary Or Delegated Quality Assurance Functionary			NQF Sub-Framework	
-			OQSF - Occupational Qualifications Sub-Framework	
QUALIFICATION TYPE		FIELD		SUBFIELD
Occupational Certificate		Field 01 - Agriculture and Nature Conservation		Primary Agriculture
Abet Band	Minimum Credits	Pre-2009 NQF Level	NQF Level	Qual Class
Undefined	147	Not Applicable	NQF Level 04	Regular-ELOAC

Modules

The content of this learner guide is aligned to the following modules of the occupational qualification above.

Module Code	Module Title	Level	Credits
Knowledge Modules			
611202-001-00-KM-01	Plant Structure and Physiology	4	5
611202-001-00-KM-02	Vineyard or Orchard Establishment	3	2
611202-001-00-KM-03	Vineyard or Orchard Manipulation Processes	3	8
611202-001-00-KM-04	Harvesting	3	4
611202-001-00-KM-05	Basic Principles of Plant Nutrition	4	4
611202-001-00-KM-06	Crop Protection	3	3
611202-001-00-KM-07	Assets in Horticultural Production	3	2
611202-001-00-KM-08	Farm Business Management and Farming Process Management	4	8
611202-001-00-KM-09	Human Resource Management and Processes	4	8
611202-001-00-KM-10	Overseeing Farming Resource Utilisation	4	8
Practical Skill Modules			
611202-001-00-PM-01	Organise, Allocate and Monitor Availability and Productive Use of Resources	4	5
611202-001-00-PM-2a	Set Team and Individual Performance Goals to Enhancing Team Performance	4	10
611202-001-00-PM-2b	Control Vineyard or Orchard Practices	4	10

611202-001-00-PM-03	Supply Accurate Daily Orchard or Vineyard and Production Information	4	10
Work Experience Modules			
611202-001-00-WM-01	Vineyard or Orchard Resource Optimisation	4	20
611202-001-00-WM-02	Skilled and Motivated Work Team Output	4	20
611202-001-00-WM-03	Daily Orchard or Vineyard and Production Information Availability	4	20

Learning Outcomes

The content of this learner guide is aligned to the following learning outcomes of the modules above.

Knowledge Topics	
Outcome Code	Module Title
KM-01-KT01	Plant structure and physiology
IAC0104	The growth requirements of plants including air, nutrients and water are listed
IAC0105	The principles of good plant nutrition practices (Good Agricultural Practices) are outlined and discussed in terms of their impact on production
IAC0106	Plant nutritional requirements during the various stages of fruit production are delineated
IAC0107	The implications of nutritional conditions on market readiness is described
KM-03-KT05	Chemical manipulation
IAC0501	The reason, process and timing of dormancy management are explained
IAC0502	The reason, process and timing of thinning are explained
IAC0503	The reason, process and timing of fruit size improvement are explained
IAC0504	The reason, process and timing of quality improvement are explained
KM-05-KT01	Crop Nutrition
IAC0101	The role of essential nutrient elements in plant growth is explained
IAC0102	Plant growth requirements through various stages of production is outlined
IAC0103	Nutrient deficiencies are explained in terms of symptoms, causes and corrective actions
IAC0104	Nutrient sources (organic, compost, etc.) are listed and described
IAC0105	Commercial fertilisers and mixtures are listed and described
IAC0106	Nutrient application methods are described
KM-05-KT02	Soil properties
IAC0201	The texture, structure, water holding capacity and drainage capacity is discussed in terms of its effect on crop growth
IAC0202	The effects of pH, EC, CEC, etc. on crop growth is described
IAC0203	The role of micro-organisms and organic matter on crop growth is explained
IAC0204	The physical and chemical soil requirements of different crops are outlined
KM-05-KT05	Irrigation
IAC0506	Irrigation scheduling in different climatic and weather conditions and stages of fruit production is outlined and motivated
IAC0507	The impact of soil properties and conditions on irrigation scheduling are discussed
Practical Skills	
PM-01-PS03	Organise and allocate equipment and agri-chemicals to the work team to perform Vineyard or orchard practices

IAC0301	The equipment identified is correct according to the different production processes
IAC0302	The number of tools/equipment is correct according to the output norms of the Vineyard or orchard
IAC0304	Activities are correctly assigned to team members according to the size of the team and capabilities of the team members
PM-03-PS03	Scout to ascertain crop health
IAC0302	The recommended adjustments to the production plan are relevant and based on information obtained by scouting
PA0301	Read and interpret the scouting plan

Chapter 1

Plant Health Management

learning outcomes

The content of this chapter is aimed at helping you to:

- Manage plant health using nutrient applications.

1. Plant Health Management

When nutrient deficiencies are detected, they are usually rectified with fertilisation. Citrus, as with all other crops, has a specific timetable for the application of these nutrients. For certain nutrients, timing applications is especially important, while others have a longer and less specific application period.

To be able to provide the appropriate nutrition at the right time, you need to develop a fertilisation program. This program is usually developed in advance for a year and contains the details of all applications that are to be made during that time. Based on the fertilisation program, an application program is developed.

2. Fertilisation Programs

Fortunately, many institutions supply pre-made fertilisation programs, varying from basic, general programs to very specific programs. General programs are unfortunately not very useful for citrus production, so the best programs are those that have been developed for a specific orchard, based on specific data from the orchard.

Such specific programs utilise leaf and soil analyses data for the current year, as well as historic analytical data. This information is combined with information about the previous applications, including what, how much and when, and information on the previous and current crop, including yields and fruit quality.

All these factors are taken into consideration to formulate the best fertilisation program for the farm and for specific orchards. The best fertilisation program is one that will result in the best possible fruit volumes and quality, and therefore give the highest economic profit, without sacrificing sustainability.

A good fertilisation program contains the following details for each orchard:

- Orchard number or reference
- Cultivar and variety
- Details for soil applications, including fertiliser used, rate of application, and time of application
- Details for foliar applications, including fertiliser used, rate of application, and time of application
- Any additional information or special instructions

Below is an example of a fertilisation program. From this program, the fertiliser manager develops application programs for soil applications and foliar sprays.

example

Fertilisation Program

FERTILISATION PROGRAM – CITRUS			
Orchard:	Orchard 10	Size:	3.0ha
Cultivar/Variety:	Delta Valencias	Trees per ha:	316
<i>Fertiliser</i>		<i>Quantity</i>	<i>Application Time</i>
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: Manganese and Solubor are compatible. Spread the lime over the entire area allocated per tree.			

3. Fertilisation Application Programs

The best practice is to develop a fertilisation application program for every month for the whole farm, in which the applications of all the orchards are summarised on one working document for each month. Soil applications and foliar applications are planned separately, resulting in two application programs for each month.

Using the information from the fertilisation program, other information is added, such as the size of each orchard and the number of trees per hectare. The fertilisation program usually prescribes the rate of application as volume or mass per tree or per ha. By adding the orchard size and tree numbers, the total volume of fertiliser required per orchard can be calculated.

When developing the fertilisation application program, specifically for foliar sprays, you should always consider any other production practices currently being performed, such as crop protection applications. The fertilisation application program must be coordinated with other production practices to ensure that the right fertiliser is applied at the right time.

4. Soil Application Program

The soil application program for the farm is a summary of all the planned soil applications for every orchard for a specific month. Using the fertilisation program in the example above as a starting point, the following Soil Application Program can be developed:

example

Soil Application Program

SOIL APPLICATION PROGRAM							
Month:	July 2006						
Product:	Limestone Ammonium Nitrate (LAN)						
<i>Orchard</i>	<i>Size (ha)</i>	<i>Trees per ha</i>	<i>*Total Trees</i>	<i>Recommend (g per tree)</i>	<i>**Total Recommend per Orchard (kg)</i>	<i>Applied (g per tree)</i>	<i>Total Applied per Orchard</i>
A	3.5	316	1,106	650g	719kg		
B	2.0	316	632	500g	316kg		
C	4.1	556	2,279	250g	570kg		
D	3.2	416	1,331	500g	666kg		
Total					2,271kg		

*Total Trees = size (ha) x trees per ha

** Total Recommended per Orchard (kg) = total trees x recommended g per tree / 1,000

i.e. * 3.5 ha x 316 trees per ha = 1,106 trees

** 1,106 trees x 650g per tree = 718,900g / 1000 = 719kg

When applying fertilisers, you may create too high a concentration of the nutrient, which might be damaging to the plant. This means that it is often better for the fertiliser to be applied in a few smaller doses rather than one dosage during the month. However, you need more information about the specific conditions and nutrients to be able to determine how the fertilisers should be applied.

For example, when 500g LAN per tree is applied at one time, the high concentration of ammonium nitrate, the active ingredient in LAN, may result in temporary soil salinity, which may affect the roots and lead to reduced absorption. The high concentration of ammonium nitrate can also not be absorbed within a short period of time and subsequent irrigation might leach the nitrogen beyond the reach of the roots.

The solubility and salt index of the fertilisers, the clay content of the soil, and the rooting depth of the plants will all affect the efficiency of an application. Leaching is less of a problem in clayey than sandy soils. The buffer capacity of clayey soils is also much better than that of sandy soils and the increase in temporary salinity due to the application of ammonium nitrate will therefore be less.

The salt index of fertilisers will also determine whether you should split up the doses or not. Fertilisers with a high salt index, such as potassium chloride, are better suited to be split into multiple applications than calcium nitrate, which has a low salt index. To prevent such problems and improve the absorption of nitrogen, the application of 500g can be split into two applications during the month of 250g each. Note that this is not always practical on

large farming estates, as the man-hours required for the application is doubled when the application is split.

However, it is not always better to split up the doses. Under certain conditions it may be far better to apply the fertilisers in one application. For example, soils can fix phosphorus and potassium, rendering them unavailable to the plant. In this situation, it is better to do one heavy application to overcome the fixing capacity of the soil, rather than a number of small applications.

definition

Fixation

Fixation is the process where the water-soluble, plant-available form of a nutrient is converted to a water insoluble form. The fixed nutrient cannot readily be converted back to a water-soluble form and will remain unavailable for a considerable period. This means that the fixed nutrient is no longer able to be used by the plant.

After the Soil Application Program has been compiled, planning is done for application scheduling during the month. This will include determining which orchard will receive its application during what time of the month, taking into consideration available manpower and equipment. Please note that if a number of applications are done in the same orchard in consecutive months, you should take care to ensure that the applications are done on more or less the same day of each consecutive month.

In practice, it is quite difficult to apply exactly the recommended quantity per tree to all of the trees in orchard. This means that it is often necessary to calculate the actual average rate of application after the application has been done. This is done by dividing the total quantity applied by the number of trees, calculating the average application per tree.

The actual average quantity per tree may vary somewhat from the recommended quantity per tree, but it is important to ensure that this variation is not larger than 10%. In terms of the example above, the variation should therefore be between 618g and 683g per tree in the case of orchard A. Soil application programs are developed for August, September and October as well, with two separate programs for the application of LAN and potassium chloride in August and September.

5. Foliar Application Program

A foliar application program is developed in a similar manner, although the calculations are different. The recommended dosage for foliar applications is generally stated in g or ml per 100l water. The size of the trees plays an important role in the total amount of spray material that will be required. On average, between 2,000 and 2,500 litres of material are sprayed per hectare on mature citrus trees in a medium-cover spray, which is required for foliar feeding.

The average actual application per hectare is calculated once the application has been done as with a soil application. Once again, you must ensure that the variance between the recommended quantity and the actual applied quantity does not vary by more than 10%. A foliar application program is developed for October as well. Note that it was stated in the fertilisation program that the Manganese Sulphate and Solubor® sprays are compatible and can be used.

example

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	3.5	2,500	8,750	1,000g	88kg		
B	2.0	2,250	4,500	0	0		
C	4.1	1,250	5,125	0	0		
D	3.2	1,750	5,600	1,000g	56kg		
Total					144kg		

*Total Litres = size (ha) x litres per ha

** Total Recommended per Orchard (kg) = recommended g per 100l / 100 x total litres / 1,000

i.e. * 3.5 ha x 2,500 litres per ha = 8,750 litres

** 1,000 g per 100l / 100 = 10g per litre x 8,750 litres = 87,500g / 1000 = 88kg

Please Note: The volume applied per ha varies due to a variation in trees size and, to some extent, the inter-row spacing. While 2,500 litres per ha is an indication of the requirement, the real parameter is "to the point just before runoff".

6. Recommended Fertilisers

In the table below is a list of the fertilisers commonly available in Southern Africa, showing the nutrient element that each fertiliser provides to the plant.

information

Commercially Available Fertilisers

<i>Fertiliser</i>	<i>Nutrient Elements</i>	<i>Nutrient Content</i>
Potassium Chloride	K and Cl	50% K*, 50% Cl*
Potassium Sulphate	K and S	% K*, % S*
Potassium Nitrate	K and N	38% K, 13% N
Mono Potassium Phosphate (MKP)	K and P	29% K, 24% P
Calcitic Lime	Ca	minimum 35% Ca

Dolomitic Lime	Mg	maximum 10% Ca and minimum 4,3% Mg
Gypsum	Ca and S	23% Ca, 19% S
Calcium Nitrate	Ca and N	17% Ca, 12% N
Magnesium Nitrate	Mg and N	10% Mg 10% N
Magnesium Sulphate	Mg and S	10% Mg, 13% S
Limestone Ammonium Nitrate (LAN)	N	28% N
Urea	N	46% N
Ammonium Sulphate	N	21% N, 23% S
Ammonium Nitrate	N	19-34% N
Ammonium Sulphate Nitrate	N	27% N, 12% S
Single Super Phosphate	P, Ca and S	10% P, 22% S, % Ca
Mono Ammonium Phosphate (MAP)	N and P	11-12% N and 22-26% P

Recommended fertilisers and chemicals for foliar sprays can be substituted with other fertilisers with the same elements or active ingredients, so long as the chemistry of the replacement chemical and its reaction in the soil and on the leaf will not create unwanted side-effects, and the recommended mass or volume is adjusted to compensate for variations in concentration of the active ingredient(s).

The person responsible for the formulation of the fertilisation program should be consulted before substitutions are made. Fertiliser manufacturers may also be able to assist in this regard. The rate of application for the replacement fertiliser is calculated as follows:

Rate of application for recommended product x % active ingredient in recommended product
/ % active ingredient in replacement product = rate of application for replacement product

7. Specific Nutrient Deficiencies

In the material about plant health monitoring, we discussed the most common nutrient deficiencies. Below, these same nutrient deficiencies are discussed in terms of how they should be rectified.

As stated in that material, deficiency symptoms should never be the basis for formulating fertilisation programs. If you wait to see symptoms before fertilising, this exposes the plants for at least six weeks to insufficient nutrient supply. In a commercial citrus farm, this can be catastrophic.

7.1. Nitrogen

Nitrogen deficiencies are rectified by soil applications and / or foliar sprays depending on the time of the year and severity of the deficiency. When a hidden nitrogen deficiency is detected in an orchard, it should be reported and rectified as part of the overall nitrogen application schedule.

Note that nitrogen cannot be applied to citrus at all times during the year. Applying nitrogen at a time too close to harvesting will have an adverse effect on fruit colour development. Any nitrogen supplementation should therefore not be done during this

period. If a serious deficiency is detected during January to June, one must consider the effects on the current and next crop before deciding on a nitrogen application.

7.2. Magnesium

Magnesium deficiencies are rectified by soil applications and/or foliar sprays depending on the time of the year and severity of the deficiency. A magnesium deficiency can be corrected at any time of the year, as long as the correct carrier is used. Do not apply magnesium nitrate during August to 100% blossom or during March to June. Other sources of magnesium have fewer constrictions unless they contain plant-available nitrogen.

7.3. Copper

Copper deficiencies are rectified by foliar sprays. When applied to small fruit, the sap from damaged cells reacts, causing a darker blemish. This accentuated blemish grows with the fruit and this fruit cannot be exported and will be culled at picking. Copper products, especially copper suspensions, should therefore not be applied on trees carrying small and green fruit.

7.4. Iron

Iron deficiency is best rectified by an application of an appropriate chelate to the soil, preferably during August. Iron chelates are expensive and an application is only economically justifiable when more than 20% of the canopy shows iron deficiency symptoms. Where drip irrigation systems are used, much less chelate is applied and the cost can usually be justified even as a maintenance application.

definition

Chelate

A chelate is a chemical compound in which metallic and organic atoms are combined.

When the irrigation water or nutrient solution is not acidified, use a chelate that is stable in an alkaline environment. On alkaline soils, the preferred chelate is EDDHA (ethylene di-amine, di-hydroxy tetra acetic acid), which is applied at a rate of 30g per m² at not more than 300g per tree.

summary

Chapter 1 – Plant Health Management

- A fertilisation program is developed on an annual basis and contains information on all the applications that have to be made during the year.
- The best fertilisation programs are specifically developed for the orchard or farm and make use of the soil and leaf analyses data and data from the orchard, such as yield data and previous applications.
- A proper fertilisation program contains details for each orchard, including the orchard number, the cultivar and variety, special instructions, and details of soil applications and foliar applications, including the name of the fertiliser, the rate of application and the time of application.

- From the fertilisation program, application programs for soil applications and foliar applications are developed for each month for the whole farm.
- The solubility and salt index of the fertilisers, the clay content of the soil, and the rooting depth of the plants are the major factors regulating the efficiency of an application and must therefore be considered when a decision is made on whether to split applications.
- The total per orchard that is calculated on the application program is used to monitor the effectiveness of the application, by comparing this volume with the volume that is actually applied.
- Foliar applications programs are developed in the same way, but the total amount of spray material required is also calculated.
- Based on the application programs, the types and amounts of fertiliser that must be ordered every month is calculated.
- Fertilisers that have been recommended on the fertilisation program can be substituted by other fertilisers that have a similar nutrient content as long as the chemistry will not create unwanted side-effects.

assessment activities

- ✓ **Activity P1:** Complete this activity to test your knowledge of plant health management.
- ✓ **Activity F1:** Complete this activity to test your knowledge of the entire module.