Citrus Orchard Foreman Occupational Learning

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Work Scenario Guide

F2:
PPP Application

Qualification:	110667 – Occupational Certificate: Orchard and Vineyard Foreman
Work Scenario:	**F2: PPP Application**
Learning Area:	F: Implement plant protection activities
Scenario Description:	You need to carefully oversee the application of agrochemical and biological plant protection products by your workers to ensure that they are being applied safely, efficiently, effectively, and in line with accreditation systems and market requirements.

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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

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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-04-KT01	**Preparing for harvest**
IAC0103	The timing and practices of pre-harvest pest control are described
IAC0104	The consideration of the prescribed withholding period for specific agro-chemicals when planning the harvesting date and application of chemicals is described
KM-05-KT08	
IAC0801	The procedures for monitoring and reporting on chemical applications are outlined
IAC0802	The OHS and GAP for safe handling of chemicals is described
IAC0803	GAP for record-keeping of chemical applications is delineated and motivated
IAC0804	IPM reporting requirements and traceability is explained
Practical Skills	
PM-01-PS02	**Determine agricultural input to support the production activities of the orchard related to the production stages of the crop**
IAC0201	Correct agricultural calculations was applied
IAC0202	Costs within budgetary constraints or cost ratios
IAC0203	Standard agricultural norms are identified and applied
IAC0204	List of inputs and factors related to the activity are identified
IAC0205	Ratios and variances are correctly calculated
PA0201	Determine the agricultural input required for maintained orchard and crop quality.
PA0202	Determine the machinery, tools and equipment which will be needed to maintain orchard and crop quality throughout the different seasons of the year.
PA0203	Determine how different scenarios will influence the input.
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-2a-PS04	**Determine personnel requirements to meet production schedules**
IAC0401	The estimations and utilisation plans are correct
IAC0403	The sectional labour plan is correct

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PA0401	Develop sectional (orchard) labour plans
PA0402	Estimate requirements
PA0403	Identify human resources shortages
PA0405	Determine labour requirements to achieve production objectives
PA0406	Plan utilisation and allocate human resources in order to achieve consistent production to meet production targets

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Chapter 1
Pre-Application Planning

learning outcomes

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

- Plan for a PPP application.

1. Introduction to Pre-Application Planning

When you decide that chemical control is necessary, it is very important that you properly plan for the application of plant protection products. Poor planning could result in financial losses due to a reduced crop or a poor-quality crop, and possible damage to the health of the trees. Time and money will also be lost if incorrect or unnecessary applications are made.

Planning entails two steps: Firstly, a crop protection program is compiled to control the pests and diseases commonly found in the area where the farm is located. The crop protection manager decides which chemicals to use, in what concentration to apply the chemicals, and the schedule of application.

This information is incorporated in a crop protection program, which is normally compiled before the start of the season at blossom time and must be followed strictly as the season progresses. Minor changes may be made during the season if circumstances in the field change.

The second step in the planning is the pre-application plan. Pre-application planning is done before each application stipulated on the crop protection program and may be best accomplished by using a simple checklist. We will look at the checklist at the end of this chapter, after considering the various components of this planning process.

2. Plant Protection Products

The first step in the pre-application planning is to identify the product listed in the crop protection program. Plant protection products are generally classified as insecticides, fungicides, or herbicides.

definition

Insecticides

Insecticides are plant protection products (PPPs) that are used to control insects.

Fungicides

Fungicides are plant protection products (PPPs) that are used to control fungi.

Herbicides

Herbicides are plant protection products (PPPs) that are used to control weeds.

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2.1. Plant Protection Product Registration

Only chemicals that have been registered with the Department of Agriculture in accordance with Act 36 of 1947 are permitted for use in South Africa. These products are listed in the following Government publications, which are updated from time to time:

- Guide for the Control of Plant Pests
- Guide for the Control of Plant Diseases

In these publications, there is a section covering citrus pests and diseases where remedies for specific problems are listed. If these books are not available, the crop protection manager may need to consult a representative of one of the agrochemical companies.

2.2. Plant Protection Product Identification

The first step in identifying a product is to consult the chemical label. All chemicals must, by law, have a label on the container describing the chemical inside. The following information appears on the product label:

- Full instructions on how to use the chemical, together with detailed information on the uses for which the product is registered. The instructions must be read carefully and adhered to strictly.
- A physical description of the product, including its colour and whether it is in fluid, powder, or granular form. The crop protection manager should inspect the chemical in the container to ensure that it answers to this physical description.
- The chemical composition of the product.
- The toxicity of the product, along with instructions for its safe handling.
- The pre-harvest interval (PHI) of the product. The PHI, also known as the Withholding Period, refers to the period after application of a chemical treatment during which time the fruit may not be harvested. PHIs vary considerably from chemical to chemical.
- The product expiry date, being the date on or before which the chemical should be used. Chemicals should be used before the expiry date to make sure that the chemical is still effective.

information

Residues and PHIs

All chemicals leave a residue on the fruit, and there are very specific regulations regarding the chemical residues levels that are allowed, especially if they are exported. Minimum residue levels (MRLs) are prescribed for all plant protection products registered with the Department of Agriculture.

The PHI indicates the period of time during which the chemical residue will be too high and outside the regulatory limits. During this time, the fruit must not be harvested. It is also important to note that the PHI that appears on the label is only for the local national requirement. If the fruit being sprayed is to be exported, the crop protection manager needs to be aware of restrictions in that particular country.

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2.3. Plant Protection Product Availability

The crop protection program indicates the concentration at which the product must be used, and the amount required per tree or hectare. It may also indicate the total quantity of chemical required for the application, but if not, the crop protection manager can calculate this by using the information provided.

The crop protection manager must ensure that a sufficient quantity of the chemical is available before application commences. In this regard, he needs to consult with the person in charge of procurement (buying) and the inventory manager.

3. Application Methods

Plant protection products can be applied in various ways. The manner of application should be stated on the crop protection program. Application methods include:

- Foliar spray application
- Trunk application
- Soil drench

There are many variations of application methods and the decision on which method to use depends on the specific requirements and purpose.

4. Foliar Spray Application

The most common method of applying insecticides and fungicides to trees in orchard farming is by way of applying a foliar spray. This means that the spray material is applied to the leaves of the trees. There are four main types of foliar spray applications, being:

- Outside cover spray
- Medium cover spray
- Full cover spray
- Bait spray

4.1. Outside Cover Spray

As the name suggests, these sprays are applied at low volume and with a light covering of the tree canopy. Droplet size is small, and the tree is sprayed with a fine mist of spray material that only covers the outer canopy of the tree.

Outside cover sprays are often used for the application of chemical bait sprays, in which case they can also be applied by aerial spraying. The volume of spray material applied per tree with an outside cover spray varies depending on tree size and shape but ranges from a half litre to ten litres per tree.

4.2. Medium Cover Spray

Medium cover sprays are the most commonly applied sprays, and wet the foliage of the tree to the point of run-off, meaning that all leaves of the tree are wet, but very little spray material drops off the leaves.

The tree canopy is not necessarily penetrated, but some of the branches may be slightly wet, especially the green branches that bear the leaves. The volume of spray material applied per tree during a medium cover spray varies depending on tree size and shape but ranges from 10 to 20 litres per tree.

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4.3. Full Cover Spray

Full cover sprays are designed to thoroughly wet the tree canopy and to penetrate the inside of the canopy, drenching the branches and framework of the tree as well. The volume of spray material applied per tree during a full cover spray varies depending on the tree size and shape but ranges from 20 to 50 litres per tree.

4.4. Bait Sprays

Bait sprays are commonly used for the control of fruit fly. These applications require a spray with coarse or large droplet size. Sprays are often applied to only a third of the orchard, depending on the intensity of the pest threat. The volume of spray material applied per tree varies from 100ml to 800ml per tree, depending on tree size.

5. Trunk Application

Some chemicals can be applied directly to the trunk of the citrus tree. These chemicals are systemic, meaning that they are absorbed through the bark and translocated within the tree to the area where they are required.

6. Soil Drench

This method involves diluting the chemical in water and then pouring it onto the soil around the trunk of the tree where it is absorbed by the roots and translocated within the tree. These chemicals are also systemic. Certain chemicals can also be applied through a drip irrigation system, which also allows their uptake by the roots.

7. Application Equipment

Once the method of application has been determined, the equipment required for the application is identified and checked. Application equipment and measuring equipment is required during most applications. The crop protection manager determines the equipment requirements by considering:

- The area or number of trees to which the chemical must be applied
- The time period in which the application must be completed
- The number of farm workers available

Once the equipment requirements have been determined, the crop protection manager must consult with the person responsible for mechanical equipment to ensure that sufficient equipment, such as tractors and spray machines, will be available, and with the person responsible for the stores to ensure that sufficient measuring equipment is available.

The crop protection manager must also ensure that all equipment is in a good working order, as breakdowns during application can cause delays that may result in ineffective pest and disease control. Spray machines and tractors are normally serviced before the start of a season and must be checked regularly. The crop protection manager must consult with the person responsible for mechanical maintenance in this regard. The application equipment that is required is specific to the application method.

8. Foliar Application Equipment

Foliar applications can be applied in a number of ways using a number of different pieces of equipment, namely:

- Knapsacks
- Handguns

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- Mistblowers
- Crop sprayer aircraft

8.1. Knapsacks

Newly planted trees up to the age of one year may be sprayed with a knapsack as they require very little spray volume. You must however take care that the knapsacks used to spray trees are not used for herbicide application due to possible contamination and damage to trees.

8.2. Handguns

Depending on variety planted and the area they are located in, trees between the ages of two and four years old are too big to be sprayed with knapsacks and are often sprayed with handguns. If mistblowers are not available, handguns can also be used for trees of any age. A handgun consists of a spray gun which is attached to a spray cart with a pump. With handguns, as opposed to knapsacks, a much higher volume of spray material can be applied at speed with little wastage.

8.3. Mistblowers

The most popular automatic spray machines are called mistblowers. These machines work on the principle of air displacement, in which air within the tree is "blown out" by the high-speed fan on the spray machine. This displaced air is replaced with air laden with spray material that wets the tree.

There are many different types of mistblowers. They can be broadly classified into low, medium, and high-profile machines. The choice of machine depends on the type of spray required. For example, low- and medium profile machines would not be suitable to apply a full cover spray to large mature trees.

Low Profile Machines are double-sided mistblowers without any tower or deflector. Medium Profile Machines are raised, double-sided machines with or without a single-sided deflector or a raised machine with a short tower. High Profile Machines are single or double-sided mistblowers that have tall towers and cover the tree canopy from top to bottom, depending on tree size.

Tractors are used to pull spray machines. Power from the tractor is transferred to the spray machine for operating the pump, fan, and spray tank agitator. This transfer takes place via the power take-off (PTO) of the tractor.

The PTO is a short, splined shaft at the back of the tractor. A PTO shaft is connected to the PTO of the tractor and to the spray machine, through which power is transferred enabling the spray machine to operate. Other machines that require power to operate, such as grass slashers, also make use of power through the tractor PTO.

8.4. Crop Sprayer Aircraft

Where large areas have to be covered in a short period of time, aerial applications, using a crop sprayer aircraft, are often used. Aerial applications can, however, only deliver light cover sprays, and are therefore generally only used for bait sprays.

9. Trunk Applications

The amount of chemical applied in a trunk application must be measured very accurately. Specialised equipment, which is calibrated very accurately, is used for this purpose. The most common applicator is called a Calibra. Some farmers use a paint brush for trunk applications. The quantity of product required is calculated according to the diameter of the

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tree trunk. There are tables available that indicate how much chemical to apply to trees of different sizes.

10. Soil Drench

The chemical solution is applied by using measuring cups or jugs that ensure with relative accuracy that the correct quantity is applied.

11. Health and Safety

All chemicals should be considered hazardous until indicated otherwise. Plant protection products can be hazardous to humans, animals and to the environment. When PPPs are being applied, health and safety regulations must be strictly observed.

In terms of planning for PPP applications, the requirements for protective gear and safety equipment for the particular chemical must be known to all who will take part in the application. The contact numbers for emergency services must be displayed prominently and, in a place where all workers have access to the information.

12. Pre-Application Checklist

A pre-application checklist can now be compiled from the above information. The format of the pre-application checklist is not standard, and different farms may use different methods or formats for this purpose.

It is, however, essential that this type of information is recorded in a format that is easy to use for the persons responsible for the application. The checklist must contain all the necessary information to avoid confusion and the need to consult various records.

A pre-application is prepared for every application that has to be done according to the crop protection program. The pre-application checklists can then be used during the application to verify that the application is done correctly.

After the application has been completed, the pre-application checklist is filed with the application reports as part of the records kept for the farm. Below is an example of a pre-application checklist.

example

Pre-Application Checklist

Pre-Application Checklist						
Crop Protection Program Instructions:						
Orchard Number			Size and No of Trees			
Application Date	From:		To:			
Target Pest(s)/Disease(s)						
Chemicals						
PHIs						
Chemical Concentration	*Chemical*		*Concentration*		*Per*	
Application Method	Trunk Application		Soil Drench		Spray	

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Spray Type	Light Cover		Medium Cover		Full Cover	
Other Instructions						

Chemical Requirements:

Chemical	*Quantity Required*	*Unit*	*Units Required*	*Check*	
				Available	*Expiry*

Equipment Requirements:

Description	*Quantity*	*Check*	
		Available	*Condition*

Worker Requirements:

Description	*Number*	*From*	*To*

Other Requirements:

Notes:

Signed:		**Date:**	

summary

Chapter 1 – Pre-Application Planning

- The two steps in planning for the protection of citrus crops against pests and diseases are the compilation of a crop protection program and pre-application planning.
- Plant protection products are classified as insecticides, fungicides, and herbicides.
- Plant protection products must be registered with the Department of Agriculture (DoA) for specific uses and may only be used for the purpose for which they are registered.
- The information displayed on the product label is full usage instructions, a physical description, the chemical composition, the toxicity, the pre-harvest interval, and the expiry date of the product.
- The crop protection manager must ensure that the required products are available in sufficient quantities.

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- Application methods that are mostly used are foliar sprays, trunk applications and soil drenches.
- The four main types of foliar applications are outside cover sprays, medium cover sprays, full cover sprays, and bait sprays.
- The equipment requirements are calculated based on the area of application, the period available for the application and the number of workers available.
- Knapsacks, handguns, mistblowers (spray machines) and crop sprayer aircraft are commonly used for foliar applications, depending on the size of the trees and the spray requirements.
- Calibra applicators or paint brushes are mostly used for trunk applications.
- Measuring cups and jugs are used for soil drenches.
- The health and safety requirements include the use of protective gear and safety equipment and posting emergency contact details in an accessible place.
- The protective gear and safety equipment that are required is indicated on the label of each product with pictograms.
- The pre-application checklist must include all the information required to complete the application.

assessment activities

✓ **Activity P1**: Complete this activity to test your knowledge of pre-application planning.

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Chapter 2
Mixing

learning outcomes

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

- Mix PPP at correct dosage rates.

1. Introduction

Some plant protection products require manual mixing before use, usually with water, specifically those used in foliar spray application. The PPPs that are used in trunk applications and soil drenching methods are usually bought ready-for-use and therefore do not need mixing. However, you should never assume this to be the case, and you should ALWAYS read the label whenever you use any PPP, even if it is one you have used before.

It is essential that you mix chemicals for foliar applications correctly and accurately. If the concentration is too low, the crop protection measures will not be effective. On the other hand, if the concentration is too high, this can result in overdosing and damage to trees, as well as financial loss due to the waste of expensive chemicals.

Mixing chemicals is not only a matter of measuring correct quantities and combining the ingredients. The person responsible for the mixing must be aware of the nature of the chemicals being handled, the safety requirements for working with such chemicals, the appropriate equipment that is required, and the correct mixing procedure.

Remember that you are mixing chemicals, and mixing the wrong chemicals may result in unintended results like accidentally producing a poisonous gas or even an explosion. This means that improper mixing can lead to serious injury. Always observe the safe handling procedures and manufacturer's instructions.

Spray material is normally mixed immediately before application and will generally not be stored in mixed form. It is therefore essential that the person responsible for mixing the chemicals has all the required chemicals, equipment, and information to complete the task without delay.

2. Calculating the Amount of Chemicals Required

Normal practice in the citrus industry is for recommendations for the concentration of crop protection chemicals to be made in millilitres (ml) or grams (g) per 100ℓ of clean water. This is also the manner in which it is shown on the crop protection program. The person responsible for mixing the spray material must have a thorough understanding of this notation. Below are a few examples of notations:

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example

Notation Examples

Target Pest(s) / Disease(s)	*Chemical*	*Notation*	*Explanation*
Red scale	Methomyl	100g / 100ℓ + Bladbuff @150ml/100ℓ	100g Methomyl plus 150ml of Bladbuff per 100ℓ clean water
Thrips, bollworm, aphids, and mealybug	Tokuthion	50ml / 100ℓ	50ml Tokuthion per 100ℓ clean water
Thrips, blackspot	Agrimec	15ml / 100ℓ	15ml Agrimec plus 150g Dithane plus 300ml mineral oil per 100ℓ clean water

To mix the spray materials in the example table above, one has to calculate the quantities of the various ingredients depending on the total quantity of spray material required. The amount of water is normally used as a basis, meaning that if 500ℓ of spray material is required, 500ℓ of clean water will form the basis of the calculation, as follows, using the examples above:

example

Spray Material Calculations

Notation	Spray Material Required	Calculation	Requirements
100g / 100ℓ + mineral oil @ 1.75ℓ / 100ℓ	500ℓ	(100g/100ℓ + mineral oil @ 1.75ℓ/100ℓ) x 5 = 500g/500ℓ + 8.75ℓ mineral oil	500g Methomyl 500ℓ clean water 8.75ℓ mineral oil
50ml / 100ℓ + wetter/buffer @ 50ml / 100ℓ	2,000ℓ	(50ml/100ℓ + wetter/buffer @ 50ml/100ℓ) x 20 = 1,000ml(1ℓ)/2,000ℓ + 1,000ml(1ℓ) wetter/buffer	1ℓ Tokuthion 2,000ℓ clean water 1ℓ wetter/buffer
15ml / 100ℓ + 150g / 100ℓ + mineral oil @ 300ml / 100ℓ	1,000ℓ	((15ml + 200g)/100ℓ + mineral oil @ 300ml) x 10 = (150ml + 2,000g(2kg))/1,000ℓ + 3,000ml (3ℓ) mineral oil	150ml Agrimec 2kg Dithane 1,000ℓ clean water 3ℓ mineral oil

information

Buffering

Many PPPs are pH sensitive, meaning that how well they work is affected by the pH of the water used in the spray solution or suspension. For example, borehole water often has a high pH (over

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pH 7) and if Cypermethrin is mixed with this high pH water, the chemical will be less effective as the pH increases. Ultimately, the chemical will not work at all.

To avoid this negative reaction buffering agents are used. These chemicals change the pH of the mixing water, usually reducing it. The degree of buffering depends on which product is used and on how much buffering solution is added.

The crop protection manager determines whether buffering is needed. Ideally, a pH meter should be used to firstly determine if the pH of the water is too high and therefore needs to be buffered for the particular product being used, and secondly to determine whether the pH of the water is acceptable after buffering. It is possible to lower the pH excessively, resulting in phytotoxicity for example when sing phosphorous acid such as Aliette.

Oils

Spray oils are often used in citrus production either to improve the efficacy of other chemicals or as an insecticide. Oil smothers certain insects and kills them.

Spray oils are mineral-based and come in various grades from ultra-light to extra-heavy. All oils recommended for use on citrus are narrow distillation range oils. Oil does not mix readily with water, and it is therefore very important that the spray material is constantly agitated (stirred) while the spray tank is being filled and while the spray machine is spraying.

3. Mixing Procedure

The person responsible for mixing must have either the crop protection program or the pre-application checklist readily available during mixing so that the chemicals, mixture, and concentration can be checked. The correct mixing equipment must also be on hand, checked, calibrated, and sterilised as prescribed.

The plant protection products that are indicated on the pre-application plan or crop protection program are taken from the storeroom. The person responsible for mixing must again at this time properly identify the chemicals, check their expiry dates, and ensure that he / she is aware of the toxicity and safety requirements for handling the chemicals.

Clean water and a bar of soap must be readily available so that the individual may immediately wash if the chemical comes into contact with skin, and so that the person can wash after handling the chemicals.

After the required quantities for the various ingredients are determined, the following steps are taken:

- Accurately measure the chemical ingredients, meaning all ingredients except water, using the appropriate equipment.
- If premixing is necessary (check label) then add the chemical ingredients to a 10ℓ bucket of clean water.
- Mix thoroughly.
- Add the 10ℓ mixture to the spray tank on the mistblower containing half the amount of water to be used.
- If premixing is not necessary, then add the chemical ingredients directly to the spray tank containing half the amount of water to be used.
- Add the remainder of the water to the spray tank, agitating (stirring) the mixture continuously. It is important that the water is run into the spray tank through a coarse filter. This is an orifice filter, which is part of the spray machine.

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summary

Chapter 2 – Mixing

- PPP used for foliar applications must be mixed correctly and accurately immediately before application.
- The person responsible for mixing the chemicals must take note of the safety requirements for handling the chemicals by checking the colour codes, symbols and pictograms that are used on the product labels.
- Colour codes are used to indicate the hazard classification of the chemical.
- Internationally recognised symbols are used to indicate the toxicity of chemicals that are extremely, highly, and moderately hazardous.
- Pictograms are used to indicate other information about the product, including the required protective gear and clothing.
- Apart from the chemicals themselves, protective clothing, measuring equipment and mixing equipment is required during the mixing process.
- The amount of chemicals that are required is calculated from the crop protection program. The same volume of water as the volume of spray material that is required is used as a basis.
- Buffers are used to adjust the pH of water.
- Spray oils often form part of spray materials because they assist in controlling pest and diseases.
- The mixing procedure involves measuring the correct amounts of chemicals, mixing these in a bucket if required on the label, adding the mixed chemicals to half the volume of water in the spray tank, and adding the remainder of the water while agitating the mixture.
- Plant protection products must be stored in a safe, secure room that complies with GAP requirements.
- Empty chemical containers must not be reused for any purpose. They must be rinsed, punctured, and disposed of, either by being buried or by being incinerated.
- All protective clothing and equipment must be washed after use.

assessment activities

✓ **Activity P2**: Complete this activity to test your knowledge of mixing.

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Chapter 3
PPP Application

learning outcomes

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

- Apply plant protection products.
- Apply post-application processes.

1. PPP Applications

Now, let's discuss the actual process of applying PPPs after the pre-application planning has been done and the chemicals have been mixed for application.

2. Influence of Climatic Conditions

Climatic conditions play an important role in spray application of PPPs. The climatic conditions that you must consider are:

- Wind
- Rain and dew
- Temperature and Humidity

You should take look at weather forecasts and the weather on the day when planning PPP applications. Let's talk about these climatic conditions in more detail.

2.1. Wind

Foliar sprays should not be applied when wind speed exceeds 12km/h. High wind speeds will negatively affect spray coverage of the tree, which could result in poor control of the target pest or disease. Excessive wind will also result in spray drift that could damage other crops, pollute water supplies, and harm the environment. Workers in other orchards may also be affected by spray drift.

2.2. Rain and Dew

Trees must be dry before foliar sprays are applied. If trees are wet, spray material is diluted and less effective. One cannot spray at all while it is raining. As a general rule, six hours of dry weather are required after a spray has been applied. If more than 10mm of rain falls before this time, the application should be repeated.

2.3. Temperature and Humidity

Most PPPs are applied during the summer months. Oil sprays must not be applied if temperatures are expected to exceed 30°C and or relative humidity (RH) is expected to be lower than 30%. It is for this reason that oil sprays are often applied at night in hotter citrus producing areas. If oil is applied under very hot conditions, there is a high risk that fruit burn will occur. Some products are also sensitive to ultraviolet light (UV) and should also be applied after nightfall.

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3. Equipment Calibration

When you are using equipment to apply a PPP, such as a sprayer, it is very important that you properly calibrate the equipment. Incorrect calibration could result in the chemical application being ineffective if not enough of the product is applied to the crop, and damage to the crop if too many chemicals are applied. Over application may also poison people or animals and is obviously a waste of money.

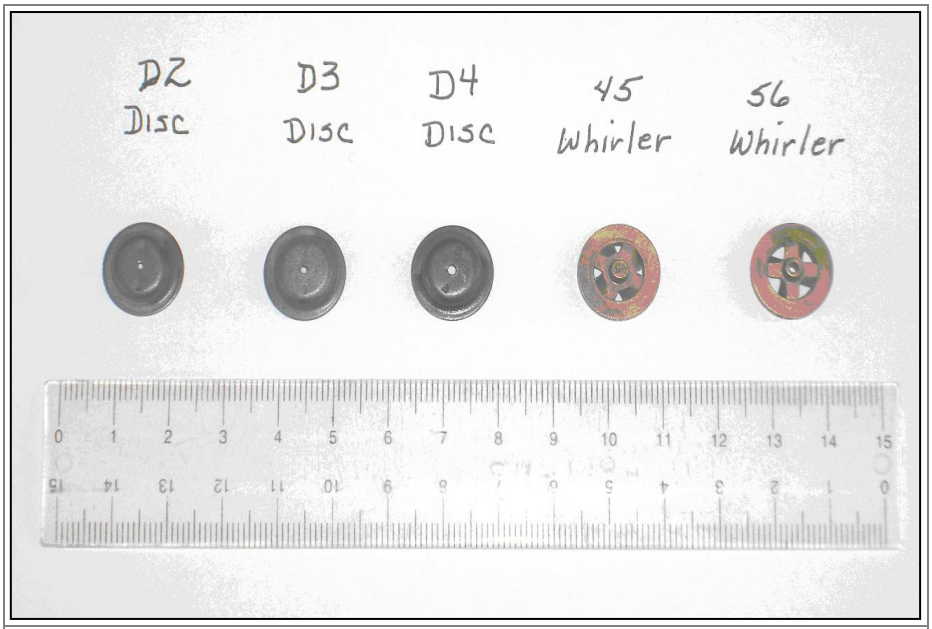
For trunk applications and soil drenches, plant protection products are measured, and equipment calibration is therefore not required, with the exception for trunk applications when a Calibra applicator is used. In this case the Calibra must be calibrated or set at the correct volume required for the trunk size, according to the formula given on the label.

When foliar applications are used, the spray equipment must, however, be calibrated to ensure that the correct volume of spray material is delivered.

3.1. Mistblower Calibration

In order to ensure that the target pest is effectively controlled, it is essential that that enough of the spray material is applied to adequately cover the tree, and that the coverage of the tree is even. It is extremely important that spray equipment must be calibrated correctly before it is used to apply spray material, as the calibration of the equipment will determine the amount of spray material that will be applied to each tree.

The pump of the spray machine pumps liquid from the spray tank through nozzles. The nozzles consist of whirlers and discs. The whirler determines droplet size, the angle of the spray, and a hollow or full cone. Discs have different sized holes which determine the amount of spray material delivered per unit time.



Different Sized Discs and Whirlers

In the figure above, note that the orifice size of a D2 disc is smaller than the D4 disc. The D2 will therefore allow less spray material to pass through than the larger disc per unit time.

Second from the right in the figure above is a 45 whirler which does not have a hole in the middle like the 56 whirler on the far right. The spray pattern of the 45 whirler is therefore a hollow cone, meaning that no spray material comes out of the middle, while the 56 whirler delivers a full cone, meaning that a solid jet of spray material

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comes out. The openings of the 56 whirler are also bigger than those of the 45 whirler, which allows more spray material to pass through and gives a bigger droplet size.

The amount of spray material delivered also depends on the pressure of the pump. The pump pressure is expressed in kPa (kilo Pascal). The crop protection manager will be able to provide this information.

The following information is required to complete the calibration:

- Litres required per tree
- Tree spacing in row
- Tractor speed
- Number of nozzles on the spray cart
- Pump pressure

The key is to calculate how many litres per minute each nozzle on the spray machine must deliver if it travels at a fixed speed. To do this, one first needs to calculate how many trees are passed per minute at this speed, from which the total volume that must be delivered can be calculated. If the total volume is then divided by the number of nozzles, the volume that has to be delivered by each nozzle is the result.

example

Nozzle Delivery

Litres required per tree = 25ℓ

Tree spacing = 3.0m

Tractor speed = 33.3 metres per minute (2.0 km/hour)

Trees sprayed = 33.3 m/min divided by 3.0m tree spacing = 11.1 trees sprayed per minute

Total litres required per minute = 11.1 trees x 25ℓ/tree = 277.5 ℓ/min

(This applies to a spray machine that sprays on both sides. For a machine that sprays on one side only, divide by 2: 277.5 / 2 = 139 ℓ/min)

Number of nozzles on both sides of spray cart = 72

Litres required per nozzle = 277.5 ÷ 72 nozzles = 3.85 litres/nozzle/minute

The delivery in litres per minute per nozzle of the various combinations for whirlers and discs at various pump pressures are set out in the table below. The volume closest to the required volume per nozzle is looked up in the column corresponding to the pump pressure. This combination of whirlers and discs are then used.

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information

Delivery in ℓ/min/nozzle for Combinations of Whirlers and Discs

Whirler	*Discs*	*700 kPa (100 psi)*	*1000 kPa (150 psi)*	*1400 kPa (200 psi)*	*2000 kPa (300psi)*	*2700 kPa (400psi)*
23 Whirler	D1	0.405	0.470	0.526	0.620	0.697
	D1.5	0.492	0.586	0.660	0.790	0.900
	D2	0.606	0.720	0.800	0.950	1.060
	D3	0.680	0.790	0.910	1.060	1.210
	D4	0.870	1.060	1.210	1.440	1.660
	D5	1.060	1.290	1.440	1.740	2.000
	D6	1.210	1.480	1.700	2.050	2.340
25 Whirler	D1	0.590	0.700	0.795	0.966	1.100
	D1.5	0.780	0.930	1.060	1.250	1.440
	D2	0.950	1.100	1.290	1.550	1.740
	D3	1.100	1.330	1.520	1.820	2.080
	D4	1.710	2.050	2.350	2.840	3.250
	D5	2.050	2.460	2.840	3.410	3.940
	D6	2.065	3.220	3.680	4.500	5.190
45 Whirler	D1	0.720	0.850	0.970	1.170	1.320
	D1.5	0.950	1.170	1.320	1.630	1.850
	D2	1.210	1.440	1.660	2.010	2.310
	D3	1.360	1.667	1.930	2.350	2.690
	D4	2.120	2.570	2.950	3.600	4.200
	D5	2.690	3.250	3.750	4.620	5.300
	D6	3.520	4.350	5.090	6.210	7.200
56 Whirler	D1	0.870	1.060	1.250	1.510	1.740
	D1.5	1.250	1.550	1.780	2.150	2.460
	D2	1.480	1.780	2.080	2.540	2.910
	D3	2.010	2.460	2.840	3.480	4.050
	D4	3.300	4.010	4.660	5.720	6.580
	D5	4.550	5.570	6.410	7.880	9.080
	D6	6.600	7.720	9.320	11.450	13.170

example

Whirler and Disc Combination

Using the example above:

Pump pressure = 20 bar (2,000 kPa)

In the table, look under the 2,000 kPa column and select a combination of whirlers and discs to give as close to 3.85 litres per minute per nozzle as possible. In this case, the closest is 3.6 litres per minute per nozzle, which is a combination of D4 disc and 45 whirler.

It is important to select a combination that gives the most efficient coverage. A popular combination for a good medium cover spray when using machines with only average wind output is to alternate 45 and 56 whirlers with D3 discs to give good outside canopy coverage (45 whirlers) and some degree of penetration (56 whirlers).

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Before sending the spray machine out to begin spraying, it is especially important that the coverage is checked to see if any fine tuning is required. It may for instance be necessary to close a few nozzles to avoid wastage, or maybe the nozzle size towards the top of the spray machine should be changed to get better coverage.

It is important to remember that the speed of the PTO should be 540 rpm. This aspect is often ignored and can lead to incorrect pressure being delivered by the pump and thus lower volumes of spray material being applied.

Knapsacks and herbicide sprayers may also have to be calibrated, depending on the type of application that is required. The calibration of this equipment varies and must be done according to the manufacturers' instructions.

4. Protective Gear

Before application commences, the person applying the PPPs must be adequately supplied with protective clothing and safety equipment. The degree of protection that is required depends on the type of chemicals that are being applied. If a group 1 chemical is for example applied with a mistblower, full protection for the tractor driver is required, while minimum protection is required for a group 4 chemical applied via the soil drench method.

Minimum protection means:

- Cotton overall
- Gum boots
- Rubber gloves

Maximum protection means:

- Cotton overalls
- Rain hat
- Raincoat and trousers
- Gum boots
- Goggles
- Respirator, with appropriate cartridge
- Rubber gloves

5. Equipment Cleaning

Once the application has been completed, all machinery must be washed with clean water and stored for future use. If spray equipment is not cleaned properly after use, the danger of contamination remains, and people, animals and the environment may be placed at risk. In addition, certain chemicals are corrosive, and spray equipment that is not properly washed may be damaged.

6. Personal Hygiene

On completing the spray task, all persons involved should bathe and dress in clean clothing. Do not dress again in clothes that were used for the spray operation unless they have been laundered properly.

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summary

Chapter 3 – PPP Application

- The climatic conditions that must be considered for foliar applications are wind, rain and dew, temperature, and humidity.
- If the wind is too strong during spraying, it will result in spray drift that may harm the environment and water sources and may be harmful to other people in the vicinity.
- Trees must not be wet when they are sprayed, as this will dilute the spray material and make the chemicals less effective.
- If the spray material contains oil, it must not be applied when it is too hot, as this can burn the fruit. Certain chemicals are also sensitive to ultraviolet light.
- Spray equipment must be calibrated before being used to ensure that the spray material will be applied at the correct rate.
- The most important step in the calibration of mistblowers is selecting the correct combination of whirlers and discs to deliver the correct volume of spray material per tree.
- The tractor driver, or any person that applies spray material, must wear the appropriate protective gear and clothing for the chemicals that are being applied.
- Post-application, all equipment must be cleaned and stored properly, and all empty containers must be disposed of.

assessment activities

- ✓ **Activity P3**: Complete this activity to test your knowledge of PPP application.
- ✓ **Activity F1**: Complete this activity to test your knowledge of the entire module.

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