



Citrus Orchard Foreman Occupational Learning

Study Guide

KM-04: Harvesting

Qualification:	110667 – Occupational Certificate: Orchard and Vineyard Foreman		
Module No.:	611202001-KM-04		
Module Title:	Harvesting		
NQF Level:	3	Credits:	4

© Citrus Academy 2026

1st edition (06/2026)

Content originator:
Citrus Academy

Occupational alignment:
Ukudla Namanzi (Pty) Ltd

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 NPC nor Citrus Research International (Pty) Ltd or the Citrus Growers' Association NPC 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 NPC, Citrus Research International (Pty) Ltd or the Citrus Growers' Association NPC. The Citrus Academy NPC, Citrus Research International (Pty) Ltd and the Citrus Growers' Association NPC, 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 NPC, Citrus Research International (Pty) Ltd and the Citrus Growers' Association NPC against any claim by any third party against the Citrus Academy NPC, Citrus Research International (Pty) Ltd or the Citrus Growers' Association NPC, 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.

Contents

Qualification Information	5
Knowledge Module	5
Knowledge Topics, Topic Elements, and IACs	6
KM-04-KT01: Preparing for Harvest (20%, 0.8 credits)	8
1. KT0101: Pre-Harvest Processes	8
IAC0101: The timing and practices of yield and fruit size estimates are described	8
IAC0102: The timing and practices of pre-harvest orchard or vineyard sanitation are described	10
IAC0103: The timing and practices of pre-harvest pest control are described	12
IAC0104: The consideration of the prescribed withholding period for specific agro-chemicals when planning the harvesting date and application of chemicals is described	13
2. KT0102: Crop Maturity Indexing Data	16
IAC0105: The specific maturity indexing procedure such as stage of growth of crop (DAFB- days of full bloom), sugar levels (TSS- total soluble solids), acid levels (TA titratable acid), fruit firmness, starch conversion, size, colour and level of ethylene production is outlined and discussed in terms of applicability to the given crop	16
KM-04-KT02: Principles and Practices of Harvesting Crop (20%, 0.8 credits)	19
1. KT0201: Climatic Factors	19
IAC0201: The impact of climatic and other environmental conditions on harvesting is explained	19
2. KT0202: Harvesting Methods, Procedures and Equipment	21
IAC0202: The correct application of crop harvesting methods is discussed	21
IAC0203: The safe handling of tools and equipment is described	22
IAC0204: The care and maintenance of harvesting tools and materials (cleaning, sanitizing, basic maintenance and repairs) is outlined	24
3. KT0203: Handling Transport of Fruit from Orchard or Vineyard to Pack Store	30
IAC0205: The handling of fruit and transport immediately postharvest to limit injury and damage to fruit during and after harvesting described	30
4. KT0204: Orchard / Vineyard Sanitation	32
IAC0206: The practices to control the development of decay and /or physiological disorders during and postharvesting are outlined	32
IAC0207: The measures to prevent fruit contamination are described	32
IAC0208: The importance of harvesting area being clean from waste material is discussed	33
IAC0209: Orchard / vineyard sanitation practices to be applied during and after harvesting are outlined	33
IAC0210: The procedure for dealing with or disposing of an infested crop is outlined	33
KM-04-KT03: Postharvest Processes (20%, 0.8 credits)	35
1. KT0301: {Postharvest Processes} In the Packhouse and Further along the Value Chain	35
IAC0301: The different postharvest processes in the packhouse are described in the correct order and how they maintain quality is explained	35
IAC0302: The cold chain processes required for this crop is described	39
2. KT0302: {Postharvest Processes} On the Farm	43
IAC0303: The procedures for cleaning, sterilising and storage of harvesting equipment is outlined	43
IAC0304: Stocktaking of harvesting equipment is delineated	43
KM-04-KT04: Logistics and Availability of Equipment (20%, 0.8 credits)	45
1. KT0401: Logistics and Equipment Needed for the Harvesting Process	45

IAC0401: The number of people and equipment needed to harvest a specific block is calculated based on a set of data supplied based on crop estimates, labour requirements of the cultivar and specific market requirements 45

KM-04-KT05: Customer Requirements and Markets (20%, 0.8 credits) 48

1. KT0501: Trends in Consumer Preferences 48

IAC0501: Customer requirements regarding eating quality, external appearance (colour), fruit size, seeded vs. seedless and easy peeling characteristics is discussed 48

2. KT0502: Market Segments 50

IAC0502: Examples of the fresh consumption market segments (export and local) is discussed and the implication on production practices is outlined 50

IAC0503: Examples of the fresh consumption market segments (export and local) are listed and the implication on production practices is discussed 50

IAC0504: Examples of the processing market segments (juicing, drying, canning, wine, other) are discussed and the implication on production practices is outlined 50

3. KT0503: Food Safety for Correct Handling of Fruit during Harvesting 53

IAC0505: The correct application of the prescribed handling protocol for the crop is ensured to meet Health, hygiene and safety in terms of the OHSA and market requirements 53

Qualification Information

The content of this study 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

Knowledge Module

The content of this learner guide is aligned to the following module 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

Knowledge Topics, Topic Elements, and IACs

The content of this study guide is aligned to the following knowledge topics, topic elements, and internal assessment criteria of the module above.

Knowledge Topics, Topic Elements, and IACs	
Code	Title
KM-04-KT01	Preparing for harvest (20%, 0.8 credits)
KT0101	Pre-harvest processes
KT0102	Crop maturity indexing data
IAC0101	The timing and practices of yield and fruit size estimates are described
IAC0102	The timing and practices of pre-harvest orchard or vineyard sanitation are described
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
IAC0105	The specific maturity indexing procedure such as stage of growth of crop (DAFB-days of full bloom), sugar levels (TSS- total soluble solids), acid levels (TA titratable acid), fruit firmness, starch conversion, size, colour and level of ethylene production is outlined and discussed in terms of applicability to the given crop
KM-04-KT02	Principles and practices of harvesting crop (20%, 0.8 credits)
KT0201	Climatic factors
KT0202	Harvesting methods, procedures and equipment
KT0203	Handling transport of fruit from orchard or vineyard to pack store
KT0204	Orchard / vineyard sanitation
IAC0201	The impact of climatic and other environmental conditions on harvesting is explained
IAC0202	The correct application of crop harvesting methods is discussed
IAC0203	The safe handling of tools and equipment is described
IAC0204	The care and maintenance of harvesting tools and materials (cleaning, sanitizing, basic maintenance and repairs) is outlined
IAC0205	The handling of fruit and transport immediately postharvest to limit injury and damage to fruit during and after harvesting described
IAC0206	The practices to control the development of decay and /or physiological disorders during and postharvesting are outlined
IAC0207	The measures to prevent fruit contamination are described
IAC0208	The importance of harvesting area being clean from waste material is discussed
IAC0209	Orchard / vineyard sanitation practices to be applied during and after harvesting are outlined
IAC0210	The procedure for dealing with or disposing of an infested crop is outlined
KM-04-KT03	Postharvest processes (20%, 0.8 credits)
KT0301	{Postharvest processes} In the packhouse and further along the value chain
KT0302	{Postharvest processes} On the farm
IAC0301	The different postharvest processes in the packhouse are described in the correct order and how they maintain quality is explained
IAC0302	The cold chain processes required for this crop is described
IAC0303	The procedures for cleaning, sterilising and storage of harvesting equipment is outlined
IAC0304	Stocktaking of harvesting equipment is delineated

KM-04-KT04	Logistics and availability of equipment (20%, 0.8 credits)
KT0401	Logistics and equipment needed for the harvesting process
IAC0401	The number of people and equipment needed to harvest a specific block is calculated based on a set of data supplied based on crop estimates, labour requirements of the cultivar and specific market requirements
KM-04-KT05	Customer requirements and markets (20%, 0.8 credits)
KT0501	Trends in consumer preferences
KT0502	Market segments
KT0503	Food safety for correct handling of fruit during harvesting
IAC0501	Customer requirements regarding eating quality, external appearance (colour), fruit size, seeded vs. seedless and easy peeling characteristics is discussed
IAC0502	Examples of the fresh consumption market segments (export and local) is discussed and the implication on production practices is outlined
IAC0503	Examples of the fresh consumption market segments (export and local) are listed and the implication on production practices is discussed
IAC0504	Examples of the processing market segments (juicing, drying, canning, wine, other) are discussed and the implication on production practices is outlined
IAC0505	The correct application of the prescribed handling protocol for the crop is ensured to meet Health, hygiene and safety in terms of the OHS and market requirements

KM-04-KT01:

Preparing for Harvest

(20%, 0.8 credits)

Topic Elements

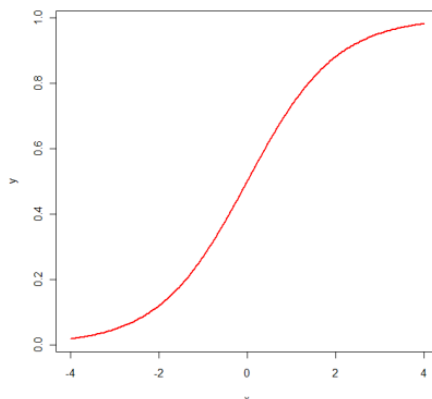
The content of this chapter covers the following topic elements:

- KT0101: Pre-harvest processes
- KT0102: Crop maturity indexing data

1. KT0101: Pre-Harvest Processes

IAC0101: The timing and practices of yield and fruit size estimates are described

- For growers to be able to predict revenue and profit, and plan accordingly, they must be able to estimate yield and fruit size.
- Yield and fruit size information is used to plan numerous practices, including harvesting, packing, logistics and transport, marketing, and resource allocation.
- Yield refers to the amount of fruit produced, and can be expressed as tree yield, orchard yield, or export yield.
- Tree yield is expressed as kilograms of fruit per tree (kg/tree).
- Orchard yield is expressed as tons of fruit per hectare of orchard (t/ha).
- Export yield is expressed as cartons per hectare of orchard (cartons/ha).
- Export yield is measured in 15kg carton equivalents for most citrus and 10kg carton equivalents for soft citrus.
- Citrus fruit growth follows a sigmoidal (S-shaped) curve.
- A sigmoidal curve is an S-shaped pattern, shown below, and refers to the fact that citrus growth, in terms of fruit size, is slow in the beginning, speeds up in the middle and slows down again at the end.



- Citrus fruit growth is divided into three phases.
- Phase 1 is mainly cell division.
- Phase 2 is mainly cell enlargement.
- Phase 3 is when ripening takes place.
- During phase 3, the fruit colour changes from green to orange, sugars increase, and acids decrease, and there is little fruit growth.
- The factors that affect fruit growth are grouped into uncontrollable and controllable growth factors.
- The difference between the two categories is the ability of farmers to influence them.
- The uncontrollable factors refer to climatic conditions, namely temperature, humidity, and rainfall.
- These climatic conditions have a profound effect on fruit growth, particularly during phases 1 and 2.
- Temperature is the most important of these climatic conditions, as fruit growth mostly takes place between 20°C and 28°C.
- Humidity and rainfall are also important considerations but are easier to manage through the use of irrigation.
- The controllable factors refer to soil type (depth and structure), and cultivar and rootstock selection.
- Different rootstocks and cultivars grow at different rates and to different sizes, and this plays a role during selection.
- A further factor which could be argued to be both controllable and uncontrollable is that of pests and diseases.
- Pests and diseases can highly impact yield and fruit size, and outbreaks of pests and diseases must be accounted for when calculating estimates.
- Final fruit size is predicted by measuring fruit size throughout growth, using one of two methods.
- The first method is taking a representative sample of fruit from a few trees and measuring the diameter of these fruits to determine an average.
- This sample usually consists of 50 to 150 fruits each from 2 to 5 representative trees.
- Representative trees refer to trees of a typical size with a typical fruit load.
- It is important to measure at least 500 fruit per unit, meaning per block or per cultivar.
- Measurements should be performed with a calliper, preferably a digital one, and size data should be recorded electronically or recorded manually and stored digitally.
- The second method of measuring fruit size is to pick all the fruit from one or two representative trees, and to measure all of this fruit to determine an average.
- These predicted averages are used to calculate the size range at picking, based on long term growth curves based on historical data and the predicted harvest time.
- Using this data, farmers can approximately forecast when picking in a particular block should begin.
- The number of fruits per tree is also measured after fruit drop and is used to determine yield.

- The number of fruits on a tree can be counted in several ways, such as placing a sticker on every fruit and counting the number of stickers used.
- Alternatively, all the fruit on a tree can be picked and counted individually, which also enables farmers to simultaneously measure size.
- Once the number of fruits on a tree have been counted, growers can use this number to calculate the percentage of fruit that falls into each size category.
- The number of fruits per size category, multiplied by the average fruit weight, gives the kilograms in every fruit size category.
- After the weights for all size categories have been calculated, these figures are added up to give the weight per tree.
- This weight per tree is multiplied by the number of trees per ha to calculate the yield per hectare in tons.
- Yield and fruit size estimates should be calculated and updated regularly, such as weekly, or monthly, to create a more accurate picture of the growth curve.

IAC0102: The timing and practices of pre-harvest orchard or vineyard sanitation are described

- Pre-harvest orchard sanitation is an essential practice for producing healthy fruit, promoting worker safety, and ensuring high productivity.
- Orchard sanitation refers to the removal of deadwood, out-of-season fruit, and fruit that has been damaged by pests or diseases from trees and, most importantly, fallen fruit from the orchard floor.
- The removal of damaged or diseased fruit from trees and fallen fruit is the most effective way of controlling populations of pests such as false codling moth and fruit fly.
- This removal also reduces the available breeding grounds for fungal diseases in the orchard environment.
- Final fruit quality is largely determined by the practices implemented before and during harvest.
- Though certain postharvest practices (such as degreening) can make superficial improvements to fruit, nothing can be done in the packhouse to repair damaged, injured, or infected fruit.
- Many different pathogens pose a risk to citrus fruit.
- A pathogen is any organism or agent that can cause a disease in a host, including viruses, bacteria, and fungi.
- Most pathogens which cause citrus diseases are fungi which spread through microscopic spores.
- Disease prevention in citrus largely involves preventing these spores from getting into citrus fruit.
- The most common method of pathogen entry into citrus fruit and resulting infection is through a wound.
- Avoiding injury or damage during picking limits wounds and thus limits the entry points for pathogens.
- Injured fruit must never be stored with non-injured fruit, as they may be carrying these pathogens.

- Latent pathogens refer to pathogens that lie dormant and wait for favourable circumstances to become active.
- Latent pathogens live on deadwood in the trees, and, when it rains, their fungal spores are washed down from the deadwood onto the fruit rind or into the button, where the spores lie dormant until the conditions are ideal for infection to start.
- Deadwood is removed from trees to prevent the spread of these latent pathogens.
- Fungal spores grow best in warm, humid conditions, out of direct sunlight, which means that the conditions in the packhouse, and especially in degreening rooms, are ideal for these pathogens to develop.
- Some pathogens are soil-borne (live in the soil) and will infect fruit upon contact (usually from fruit falling to the ground) and start to spread by producing more spores.
- Fruit fall to the ground for many different reasons, such as after being stung by a pest insect, or being dropped on the ground during picking.
- When fruit comes into contact with the soil, growers must assume that it is now infected.
- Soil-borne pathogens can also come into contact with fruit without the fruit falling off the trees.
- Fruit that hangs low and close to the ground can also get soil pathogens on them due to soil being splashed up by rain, carrying the pathogens with it.
- Flying insects can also carry spores from fallen fruit on the ground to fruit still hanging in the tree.
- This problem can be prevented by skirting trees, which is the practice of removing all the branches of a tree that hang below a certain height.
- Skirting is usually done during pruning, before the tree bears fruit, which ensures that fruit does not hang too low, and keeps the fruit away from the soil.
- Fallen fruit must never be picked up and placed with other fruit, unless that other fruit is also waste fruit.
- All fallen fruit must be removed regularly from the orchard floor to prevent pathogens from propagating and multiplying in this fruit.
- Removing fallen fruit also removes possible breeding grounds for pest insects, like false codling moth and fruit fly, which lay their eggs in fruit.
- A stick or scoop can be used to pick up fallen fruit and place it in a bag, before being removed from the orchard entirely.
- Fallen fruit should be removed at least once a week throughout the year, and at least twice a week from after colour break until picking in the orchard is finished.
- During picking, an orchard sanitation team should follow right behind the picking team to immediately pick up and remove all the fruit that might have fallen during picking.
- Fruit that ripens late in the season is not as healthy and vigorous as earlier-ripening fruit and is thus risky to export.
- This late-ripening fruit is sometimes stripped off the trees and treated as waste fruit.
- Any fruit left on the trees after picking must be removed, as if it is left on the trees, this fruit can become infected, and infect young, healthy fruit the next season.
- Out-of-season fruit should be removed throughout the year, starting just after physiological fruit drop in November.

- Out-of-season fruit is fruit that ripens at a different time from the majority of the other fruit can carry pest insects and pathogens from one season to the next.
- All the waste, late-season, and out-of-season fruit must be destroyed so that the pathogens can no longer infect any other fruit.
- In dry climates, the fruit can be finely chopped up and spread out to dry in the sun outside the orchard.
- In more humid climates, the pathogens can still develop in the chopped-up fruit, and so the best practice in these areas is to bury the waste fruit.
- The fruit should be buried at least 30cm deep, at least 400 meters away from the orchard.
- Waste fruit can also be collected and used as animal feed, for cattle, pigs or game.

IAC0103: The timing and practices of pre-harvest pest control are described

- Pest control is a vital part of citrus production, especially in the period leading up to harvest.
- Pest control programmes should be developed around the concept of Integrated Pest Management.
- Integrated Pest Management (IPM) entails the complementary integration of various pest control measures into a single system.
- This system should strive to balance maximisation of returns, long term sustainability, and minimisation of environmental impact.
- Pre-harvest pest control aims to minimise the presence and damage of citrus pests, improving yield, fruit quality, and the environment.
- The main goals of pre-harvest pest control are improved tree health, avoiding environmental damage, and regulatory compliance.
- Any pest control program implemented on the farm is useless if it is not accompanied by an accountable, well-trained staff.
- Appropriately trained workers must be appointed to monitor, scout and record pest and diseases.
- All workers involved in pest management are well aware of their roles and responsibilities, and especially the consequences of their failure to the farm as a whole.
- Pest control is a technical subject, demanding knowledge, understanding and experience, of both pests and beneficial organisms.
- The most important aspect of IPM and thus pest control is regular scouting of pests and diseases.
- Scouting refers to the monitoring for pest and disease symptoms and populations in a systemic, regular fashion.
- Scouts must be knowledgeable of the life stages and identifying of pests, as some pests and their larvae can be easily confused.
- Evidence of pests or diseases can be microscopic and requires careful observation by highly trained individuals.
- Pre-harvest pest control entails this regular scouting, as well as any treatments that may be required.

- These practices include chemical, biological, and mechanical pest control methods.
- These methods will be performed as and when needed according to the pest and disease in question.

IAC0104: The consideration of the prescribed withholding period for specific agro-chemicals when planning the harvesting date and application of chemicals is described

- Agrochemicals serve numerous functions in citrus production, but they must be used carefully, and there are numerous regulations that deal with them.
- All agrochemicals used must be approved by the government, and all are subject to strict national and international standards regulating their use, set by numerous groups and governments.
- One of the most important aspects of these regulations is that of withholding periods.
- A withholding period is the minimum length of time that must pass between the last application of a particular agrochemical and the harvest date of the crop that the agrochemical was applied to.
- This withholding period must be strictly adhered to at all times, even in unforeseen circumstances, such as a sudden pest outbreak.
- Withholding periods are determined through scientific research to ensure that any agrochemical residues left on fruit are at a level considered safe for human consumption.
- Choosing to ignore or failing to meet these requirements can put consumers at risk and have serious legal and financial ramifications for farmers.
- Withholding periods are generally found on the product label, and they are determined to ensure that fruit, particularly export fruit, complies with international standards regarding MRLs.
- Maximum residue levels (MRLs) refer to the highest amount of agrochemical residue that is legally tolerated on fruit.
- These levels are based on research and aim to ensure that any chemical residue remaining on fruit does not harm consumers' health.
- MRLs are prescribed by the food safety legislation and regulations and must be strictly adhered to.
- The prescriptions are contained in a document called Default Maximum Residue Levels for Fungicides and Pesticides for Export Citrus, which is a legally enforceable document that is available from DoA.
- MRLs are set individually for each pesticide and each crop, and different counties have different MRL requirements based on the product being used and the crop it was used on.
- Growers must research the specific MRL requirements of target markets, as they may differ significantly from other markets.
- MRL prescriptions determine how long before harvesting PPPs can be applied to plants, referred to as the pre-harvest interval.
- The best way to avoid food contamination is to adhere to the pre-harvest intervals.
- Residues are monitored by the PPECB and fruit with residues that exceed MRLs will be rejected for export, with serious legal consequences for the grower.

- In South Africa, The Citrus Growers' Association (CGA) and Citrus Research International (CRI) jointly publishes a Recommended Usage Restrictions (RUR) document regularly.
- The RUR indicates the farming practices that will ensure that MRLs are not exceeded and if growers apply the RUR, the resultant residues on fruit will be below the MRLs.

self-assessment

KT0101: Pre-Harvest Processes

Can I?	Y/N
Can I explain the role of yield and fruit size estimation in production planning?	
Can I define yield and the different ways it can be expressed?	
Can I describe the growth pattern and phases of citrus?	
Can I explain how temperature, humidity, and rainfall influence fruit growth?	
Can I distinguish between controllable and uncontrollable factors affecting fruit growth?	
Can I select appropriately representative trees for sampling?	
Can I accurately measure fruit size?	
Can I accurately count the number of fruits on a tree?	
Can I calculate predicated yield using size measurements and fruit counts?	
Can I perform proper orchard sanitation?	
Can I explain the role of orchard sanitation in pest and diseases management?	
Can I define what a pathogen is and list the main types that affect citrus fruit?	
Can I explain how fungal spores cause citrus diseases and how they infect fruit?	
Can I explain the purpose of skirting citrus trees?	
Can I explain the purpose of having a sanitation team operate separately from the picking team?	
Can I properly remove and destroy waste fruit?	
Can I define and describe the principles of IPM?	
Can I explain what scouting is and why it is critical in pest control?	
Can I properly train pest control workers?	
Can I describe the pest and disease knowledge that scouts require?	
Can I apply appropriate pest control treatments where needed?	
Can I explain withholding periods and why they are important?	
Can I explain maximum residue levels and their purpose?	
Can I explain the relationship between MRLs and food safety regulations?	
Can I explain pre-harvest intervals?	
Can I explain how failing to comply with MRL or withholding period regulations affects exports?	
Can I describe the role of PPECB, CGA, and CRI in monitoring residues and setting restrictions?	
Can I explain the purpose of the Recommended Usage Restrictions (RUR) document?	

work scenario reference

To learn about how the above information is applied in practice, please look at the following workplace scenarios:

IAC Code	IAC Title	Relevant Work Scenario(s)
IAC0101	The timing and practices of yield and fruit size estimates are described	A2, A3, A5, G1, G2,
IAC0102	The timing and practices of pre-harvest orchard or vineyard sanitation are described	F1, G1, G2, G3, H1,
IAC0103	The timing and practices of pre-harvest pest control are described	F1, F2, G1, H1, J1
IAC0104	The consideration of the prescribed withholding period for specific agro-chemicals when planning the harvesting date and application of chemicals is described	A2, A6, F1, F2, J1

2. KT0102: Crop Maturity Indexing Data

IAC0105: The specific maturity indexing procedure such as stage of growth of crop (DAFB-days of full bloom), sugar levels (TSS- total soluble solids), acid levels (TA titratable acid), fruit firmness, starch conversion, size, colour and level of ethylene production is outlined and discussed in terms of applicability to the given crop

- Maturity indexing is a process used to predict the optimum picking time for citrus fruit.
- Maturity indexing involves gathering information on fruit quality, and, together with yield and fruit size estimates, using that information to plan for harvesting.
- Maturity indexing data is collected by measuring the maturity parameters of a sample of fruit taken from a certain block or orchard.
- Maturity parameters are the factors measured during maturity indexing and are largely the same as fruit quality.
- Maturity parameters usually include fruit colour, size, firmness, juice percentage, sugar content, acidity, and sugar to acid ratio.
- Fruit colour is important for determining maturity and pleasing customers.
- Fruit colour should be measured against the fruit colour charts that can be obtained from the CRI.
- Fruit size often correlates with its maturity, and measuring fruit size can be used to gauge the readiness for harvesting.
- Fruit firmness refers to the texture and structural integrity of the fruit's flesh.
- Firmness tends to decrease as fruit matures, and cell walls soften as the fruit ripens.
- Juice percentage is the amount of the physical fruit that is juice, and is determined by weighing a sample of fruit, and then extracting the juice from the fruit.
- This juice is filtered and weighed, and the juice percentage is the juice weight divided by the initial fruit weight.
- Sugar content (also known as Total Soluble Solids, or TSS) is measured with a refractometer.
- Sugar content is commonly measured in degrees Brix (°Bx).
- The refractometer is zeroed with distilled water before measuring, and the average of three readings is used to determine the sugar content, expressed as a percentage.
- Acidity (also known as levels of Titratable Acid, or TA) is measured by titration, which measures citric acid, which is 70 - 90% of the acid in the sample.
- Titration is performed by mixing juice with phenolphthalein, which is then titrated with a 0.1562 normal sodium hydroxide solution, until the mixture turns pink.
- The volume of sodium hydroxide in millilitres used in the titration is then read and divided by 20 to give the titratable acid percentage.
- Sugar to acid ratio is calculated by dividing the sugar reading from the refractometer by the acid percentage.
- Days after full bloom (DAFB) is another important aspect of maturity indexing and is the number of days since the tree's flowers reached full bloom.
- DAFB is used to estimate when fruit will reach harvest maturity.

- Starch conversion is a process where starch stored in the fruit is broken down into sugars, increasing the sweetness of the fruit.
- Ethylene is a natural plant hormone that regulates ripening and is produced by the trees.
- Ethylene production increases can be used to indicate the onset of maturity and colour change.
- The standards for these maturity parameters and the ideal values vary based on the consumer tastes of the market that the fruit is destined for.
- Maturity indexing is performed through sampling, which is the process of taking a representative portion of a whole for analysis.
- Sampling for maturity indexing should begin two months before the estimated harvest date.
- Any fruit sampled earlier than this will (in most cultivars) not have sufficient juice for analysis, or the results of analysis may be so far out of specification that it will be of little use.
- Ideally, fruit should be sampled and analysed weekly, especially if the information is being used to adjust production practices to manipulate the internal quality of the fruit.
- Sampling is only effective if the sample is representative of the whole that the sample is taken from.
- Although a fruit sample must be taken randomly, it is important to focus on fruit that will most likely be exported.
- The procedure of sampling is as follows:
 1. Before sampling, divide the orchard(s) into sample blocks, according to cultivar and rootstock combination, tree age and condition, soil type and aspect.
 2. Select ten representative trees per block and mark them as index trees. These trees should be used for sampling throughout the season.
 3. Select two fruit per index tree which are representative of fruit on the tree.
 4. If there will be more than one picking period, due to, for instance, colour differentiation, subdivide the sample accordingly.
 5. In certain orange cultivars there is a great deviation in internal quality between large and small fruit, and in these situations, take two separate samples for large and small fruit.
 6. Place the fruit sample in a bag and write the orchard details and the date of sample on the bag or on a slip that is placed in the bag.
 7. Send the bag to a laboratory, either on- or off-site, where the sampling takes place.
 8. In the laboratory, note the details of each sample, including the producer, orchard number, and fruit size and colour.
 9. Weight the fruit, cut it, extract its juice, calculate the juice percentage, TSS, and acidity, and sugar to acid ratio.
 10. Record the results of these laboratory tests in a table and plot them on a graph along with other information, such as fruit colour.
 11. Take notes on the general fruit condition, referring to factors that may have a bearing on fruit maturity such as size, firmness, and splitting.
 12. Adjust orchard practices if the results reveal a need for manipulation practices.

self-assessment

KT0102: Crop Maturity Indexing Data

Can I?	Y/N
Can I explain what maturity parameters are and how they relate to fruit quality?	
Can I accurately perform maturity indexing?	
Can I describe how maturity indexing data is used to plan harvesting?	
Can I compare fruit colour?	
Can I measure fruit size?	
Can I judge fruit firmness?	
Can I calculate juice percentage?	
Can I measure sugar content?	
Can I perform titration to measure acidity?	
Can I calculate sugar-to-acid ratio?	
Can I calculate days after full bloom?	
Can I explain the role of starch conversion in fruit sweetness and maturity?	
Can I describe how ethylene production affects fruit ripening and colour change?	
Can I calculate when sampling for maturity indexing should begin relative to the estimated harvest date?	
Can I sample fruit effectively and accurately?	

work scenario reference

To learn about how the above information is applied in practice, please look at the following workplace scenarios:

IAC Code	IAC Title	Relevant Work Scenario(s)
IAC0105	The specific maturity indexing procedure such as stage of growth of crop (DAFB-days of full bloom), sugar levels (TSS- total soluble solids), acid levels (TA titratable acid), fruit firmness, starch conversion, size, colour and level of ethylene production is outlined and discussed in terms of applicability to the given crop	A5, D1, D3, D4, G1

KM-04-KT02:

Principles and Practices of Harvesting Crop (20%, 0.8 credits)

Topic Elements

The content of this chapter covers the following topic elements:

- KT0201: Climatic factors
- KT0202: Harvesting methods, procedures and equipment
- KT0203: Handling transport of fruit from orchard or vineyard to pack store
- KT0204: Orchard / vineyard sanitation

1. KT0201: Climatic Factors

IAC0201: The impact of climatic and other environmental conditions on harvesting is explained

- During harvest planning, an important consideration is that of the surrounding climatic or environmental conditions during the harvest.
- Pre-harvest, warmer temperatures speed up the ripening process, making fruit mature faster.
- While this may seem advantageous, as it allows for an earlier harvest, warmer temperatures create the risk of fruit becoming over-ripe if they are not monitored closely.
- If temperatures are warmer than usual in the period leading up to harvest, growers may need to consider beginning harvest earlier.
- Rain, especially when unexpected, can have both a positive and negative effect on harvest.
- While rainfall is necessary for fruit growth, excessive rain close to harvest after a drought can cause the fruit to split.
- Split fruits are more susceptible to disease and may require extra disease control practices before and after harvest.
- Split fruits also have a shorter shelf life, and this may complicate logistics and transports, as well as negatively affecting market prices.
- High humidity levels can pose a risk during picking, as humid conditions are more favourable for the growth of diseases, especially fungal ones.
- In highly humid conditions, fruit must be promptly moved to a storage area after picking, and not left in the hot, humid environment of the orchard.

- Outside of effects on the fruit, climatic and environmental conditions can also affect harvesting practices.
- If the temperature is excessively high during harvest, workers may not be able to work for as long without risk of sunstroke or other heat-related issues, and this must be considered when managing harvest.
- Heavy rain or storm conditions can also put workers and fruit at risk during harvest, and in severe cases, may require delaying harvest entirely.
- All of these factors mean that it is vital for producers to closely monitor weather reports and forecasts in the weeks leading up to harvest and adjust harvesting practices accordingly.

self-assessment

KT0201: Climatic Factors

Can I?	Y/N
Can I describe how warmer temperatures before harvest affect fruit ripening and maturity?	
Can I explain the positive and negative effects of rainfall close to harvest can have both positive and negative effects?	
Can I describe the risks of fruit splitting?	
Can I explain how high humidity during harvest increases the risk of fungal diseases?	
Can I explain how extreme temperatures during harvest can affect worker safety and productivity?	
Can I explain why harvest may need to be delayed during severe weather conditions?	
Can I effectively monitor weather forecasts leading up to harvest and adjust practices accordingly?	

work scenario reference

To learn about how the above information is applied in practice, please look at the following workplace scenarios:

IAC Code	IAC Title	Relevant Work Scenario(s)
IAC0201	The impact of climatic and other environmental conditions on harvesting is explained	G1, G2, G3, G4

2. KT0202: Harvesting Methods, Procedures and Equipment

IAC0202: The correct application of crop harvesting methods is discussed

- Citrus fruit is usually picked for export from March to October, depending on the type and cultivar.
- On most citrus farms, pickers are hired seasonally, and it is important that these pickers know what to do and what not to do while picking fruit, especially if it is their first time.
- While picking citrus, workers must always remember that fruit is a perishable product.
- As a perishable, fresh product, fruit can spoil quickly or get injured easily if not properly handled and stored.
- Most fruit injuries occur during picking, and, once fruit is injured, it is unfit for export, which leads to losses for the grower.
- Exporting is the most important market segment for citrus, and therefore export fruit must be handled with the most care while picking.
- Export citrus is harvested using clippers, whereas fruit destined for other markets (such as processing fruit) may be picked by hand, referred to as snap picking. Export fruit is never snap picked.
- Sometimes, especially early in the season, citrus is harvested selectively, meaning that only certain fruit is picked, leaving the rest of the fruit on the tree to be picked later.
- Before harvest begins, pickers need to make sure that their hands are clean and their nails are short, because long nails can injure the fruit.
- If workers have any open injuries or sores, these must be properly dressed (with a plaster or bandage) before they handle any fruit.
- Workers must also ensure that their equipment, especially their gloves, are clean, dry, and in good condition at all times, especially at the start of harvest.
- The procedure of clipping is as follows:
 1. Start with the fruit at the bottom of the tree and pick upwards to avoid leaning a ladder against the tree and damaging unpicked fruit.
 2. Hold the fruit in the gloved, non-dominant hand,
 3. Cut the stem, as close as possible to the fruit, leaving only a short piece of stem.
 4. Cut the stem at a right angle to the fruit, as if the stem is cut skew, it may leave a sharp point that can damage other fruit.
 5. Place the clipped fruit in the picking bag with the gloved hand without throwing or dropping it in.
 6. Once the bag is full, walk, do not run, to the trailer to deposit the fruit. Running will make the fruit bounce against each other and cause injuries.
 7. Empty the fruit into the picking trailer or bin by opening it at the bottom or tipping it over without letting the fruit land hard or fall far.
- When picking higher in the tree, a ladder may be needed and should be securely placed or leant against the tree.
- Pickers must take care not to bump their picking bags against the ladder if the bag already has fruit in it.

- Any fruit that falls to the ground must never be picked up during harvest and must be left there to be collected during orchard sanitation.
- Fruit that hangs excessively low on the tree or could have come into contact with the soil in any way must also not be picked, because they may be infected.
- Picking equipment should be sanitised between trees, and before and after picking.
- After picking is finished for the day, all picking equipment must be checked for wear or damage, sanitised, and safely stored.

IAC0203: The safe handling of tools and equipment is described

- The most commonly used tools and equipment when harvesting citrus are clippers, ladders, picking bags, bulk bins, picking trailers, and tractors.
- To ensure that tools and equipment are used efficiently and that the equipment lasts, the procedures for their proper handling and use must be strictly adhered to and followed.
- All equipment and tools (and especially mechanical equipment such as tractors) used during harvest must always be operated by experienced, trained staff.
- When using harvesting tools and equipment, all workers and managers must remember that almost all the tools and equipment used can pose dangers to workers and fruit.
- All workers must be well-trained and made aware of these risks and how to use tools and equipment in the proper method to ensure their and the fruit's safety.
- All activities on the farm, including harvesting, must adhere to legislation concerning workers safety, particularly the Occupational Health and Safety Act.
- Other international accreditation systems can also specify specific guidelines concerning fruit and worker safety.
- In most cases overseas markets requires accreditation to one or more of these systems before a producer is allowed to send fruit to a certain market.
- All equipment should always be used according to manufacturer instructions, and workers who use them must be aware of these recommendations and requirements.
- The table below lists various tools and equipment used for harvest and how to safely use them:

Tool / Equipment	Safe Use
Clippers	➤ Only clippers intended for harvesting citrus should be used. ➤ Clippers should be used to cut the stem of the fruit as close to the button, or calyx, as possible without injuring the shoulder of the fruit. ➤ Clipper blades are sharp and must be handled carefully by workers to avoid cutting themselves. ➤ Clippers must be closed and secure (some types have a latch or a cover to keep the blades closed) when not being used. ➤ Clippers should never be used for anything other than what they were designed for, i.e., for cutting fruit. ➤ Workers should regularly inspect their clippers to check that blades are sharp and not overlapping. ➤ Any issues discovered by workers should be immediately reported to their supervisor(s) and these workers should be issued with another pair of clippers.
Ladders	➤ Ladders are either securely placed alongside trees or rested against the canopy in the case of larger trees or ladders without a stand.

Tool / Equipment	Safe Use
	➤ When using ladders, workers must ensure that they are securely placed, especially if being leant against a tree. It is often a good idea to have another worker hold the ladder if possible. ➤ Workers should check ladders regularly for damage, particularly for instability or protruding parts that can damage fruit or injure the worker. ➤ Any issues discovered by workers should be immediately reported to their supervisor(s) and these workers should be issued with another ladder.
Picking Bags	➤ Picking bags should be securely carried over the shoulder of the picker. ➤ Pickers should carefully place fruit in the bag as they pick until it is full, without overfilling it. ➤ The full bag should be taken to a general collection point without running or bouncing them around. ➤ Pickers should carefully empty the bags into bulk bins or picking trailers without letting the fruit drop too far or land heavily. ➤ Some picking bags have closed bottoms, in which case the bags must be upended when being emptied into the picking trailer or bulk bin. ➤ Other types are open at the bottom with a flap that seals while fruit is being picked, and pickers must check that this flap is secure when picking. ➤ While picking, pickers must check that their picking bags have no holes or tears in them. ➤ Any issues discovered by workers should be immediately reported to their supervisor(s) and these workers should be issued with another picking bag.
Bulk Bins	➤ Workers must ensure that the bulk bins are securely placed on the trailer, and that the trailer is securely connected to the tractor. ➤ Bulk bins are mostly placed on the trailer and removed from the trailer by a forklift, but to improve productivity and turn-around, adaptations are sometimes made to allow bins to roll off and on the trailer on roller channels. ➤ If forklifts are used, they should be driven by trained drivers, and all workers should be aware of how to safely operate around forklifts. ➤ If the bins roll, workers must avoid being caught under the rolling bins and should be careful while loading or unloading the bins from the trailer. ➤ Some trailers use pneumatic lifts to move bins, and these should also be operated by trained workers and workers should be aware of how to operate safely around these trailers. ➤ Workers must check bins for sharp corners, splinters, or other possible risks on the bins, trailers, or machinery involved, and must be careful to not injure themselves or others while transporting these bins. ➤ Bulk bins are normally inspected by the supplier but should be checked by the picking team supervisor before use to ensure that they are in a usable condition. ➤ Any issues discovered by workers should be immediately reported to their supervisor(s) and these workers should be issued with another bin.
Picking Trailers	➤ Picking trailers vary in design and operation, and workers should be aware of how they are safely operated. ➤ Workers should inspect trailers for any broken or rusted parts, and check that they are securely connected to tractors. ➤ Workers must be careful of any sharp corners, splinters, or other possible risks on the trailers, or machinery involved, and must be careful to not injure themselves or others while transporting these trailers. ➤ Tractor drivers and picking team supervisor must inspect trailers before use. ➤ Any issues discovered by workers should be immediately reported to their supervisor(s) and these workers should be issued with another trailer.

Tool / Equipment	Safe Use
Tractors	➤ Tractor drivers must be careful of other workers as they drive around to ensure that nobody is injured. ➤ Drivers must ensure that a tractor is in good working order and that the correct tyre pressure is maintained. ➤ Any issues discovered by workers should be immediately reported to their supervisor(s) and these workers should be issued with another tractor.
<i>Table 1: The Safe Use of Harvesting Tools and Equipment</i>	

- An important part of safely using tools or equipment is the implementation of a system whereby any equipment malfunctions can be reported immediately.
- This system should allow any workers to report issues as soon as they occur and should be accompanied by a recordkeeping system that records any and all issues in detail.
- The table below lists various tools and equipment used for harvest, who is responsible for monitoring them, who is responsible for corrective measures, and what the corrective measure should be:

Tool / Equipment	Responsible for Monitoring	Responsible for Corrective Measures	Corrective Measures
Clippers	Pickers	Picking Team Supervisor	Issue picker with a clipper that is not damaged and have damaged clipper fixed.
Picking Bags	Pickers	Picking Team Supervisor	Issue picker with a picking bag that is not torn and have damaged bag fixed.
Ladders	Pickers	Picking Team Supervisor	Issue picker with another ladder and have broken ladder fixed.
Bulk Bins	Picking Team Supervisor	Farm Manager	Report to bin supplier and have damaged bins replaced.
Picking Trailers	Picking Team Supervisor, Tractor Driver	Farm Manager	Have the trailer repaired.
Tractors	Tractor Driver	Farm Manager, Mechanic	Have the tractor repaired.
<i>Table 2: The Corrective Measures of Harvesting Tools and Equipment</i>			

IAC0204: The care and maintenance of harvesting tools and materials (cleaning, sanitizing, basic maintenance and repairs) is outlined

- Harvesting equipment is expensive, and a lot of equipment is needed to carry out the harvesting process successfully and cost effectively.
- To ensure that the tools and equipment used during harvest stay in good condition and have as long a lifespan as possible, regular and effective maintenance is needed.

- To ensure this maintenance is performed properly and at the right time, a maintenance plan must be developed.
- A well-designed, properly implemented maintenance plan ensures equipment longevity, saves money, keeps workers safe, and ensures a smooth and efficient harvest.
- Citrus harvesting tools and equipment are normally divided into two different categories, namely mechanical and non-mechanical equipment.
- Mechanical harvesting equipment includes tractors and picking trailers.
- There are more advanced pieces of mechanical equipment, such as picking machines, but these are much less widely used.
- All mechanical equipment must be serviced on a regular basis, according to the guidelines given by the equipment manufacturer.
- This servicing is a specialised process that must be handled by professional mechanics.
- Smaller farms may not have these mechanics on farm and can hire outside mechanics to service when needed.
- Non-mechanical equipment includes all other equipment used daily by the picking teams.
- Non-mechanical equipment includes clippers, picking bags, gloves, and ladders.
- The maintenance tasks that need to be performed on non-mechanical equipment and tools are usually simpler than those required by mechanical equipment.
- For certain pieces of non-mechanical equipment, such as bulk bins, maintenance is handled by the suppliers.
- Any citrus producer targeting an overseas market is required to get accreditation from one or more international accreditation schemes.
- The most common of these schemes are GAP (Good Agricultural Practices) schemes.
- GAP schemes specify practices and rules that must be implemented to ensure that good agricultural practices take place on the farm.
- Included in these GAP systems are recommendations on what the best and most effective way to structure maintenance is.
- When developing a maintenance plan, growers must ensure that they adhere to these guidelines.
- The greatest risk involved with improper maintenance is injuries to workers or fruit, which can occur for several reasons.
- There are always pathogens present in any orchard, particularly during the harvest period, and lack of attention to hygiene and sanitation increases the possibility of fruit contamination and postharvest waste.
- Every worker is responsible for maintaining and sanitising the equipment that they use during the harvesting process.
- The guidelines for maintenance and sanitation are laid down by management, and every worker must be aware of the requirements.
- Faulty tools and equipment must not be used under any circumstances, as this can compromise food safety and worker health.
- Faulty equipment must be reported to the supervisor or manager immediately and the equipment repaired or replaced.

- The table below lists various tools and equipment used for harvest and how to maintain them:

Tool / Equipment	Maintenance Practices
Clippers	➤ Clippers must be checked before and during harvesting to ensure that the spring action is working well, and that the blades are sharp and closely aligned. ➤ Clippers must also be cleaned and sterilised prior to harvesting and regularly during picking, in between every tree. ➤ Clippers should be oiled before use or storage if they are not opening and closing smoothly. ➤ Clipper blades should be sharpened regularly. ➤ Any broken parts must be repaired or replaced with spares of the same make.
Picking Bags	➤ Picking bags must be cleaned before and after harvesting. ➤ Picking bags must be checked before and during harvesting to whether the straps, clips, and seams have any wear or tearing. ➤ Any broken parts must be repaired or replaced with spares of the same make.
Ladders	➤ Ladders must be cleaned before and after harvesting. ➤ Ladders must be checked before and during harvesting for stability, sharp edges, splinters, and loose components. ➤ Any broken parts must be repaired or replaced with spares of the same make.
Bulk Bins	➤ Bulk bins must be cleaned and sterilised before and after harvesting. ➤ Bulk bins must be checked before and during harvesting for cracks, sharp edges and splinters. ➤ Any broken bins must be sent to the supplier to be repaired or replaced.
Picking Trailers	➤ Picking trailers must be cleaned and serviced before and after harvesting. ➤ Picking trailers must be checked before and during harvesting for stability, sharp edges, splinters, and loose components. ➤ The tyre pressure must also be checked and pumped up if needed. ➤ The moving parts of the trailer should be oiled before use or storage if they are not moving smoothly. ➤ Any broken parts must be repaired or replaced with spares of the same make.
Tractors	➤ Tractors must be cleaned and serviced by properly trained and qualified mechanics before and after harvesting. ➤ The tyre pressure must also be checked and pumped up if needed. ➤ Tractor maintenance includes oil changes, filter replacements, and inspection of hydraulic systems, among many other practices. ➤ Any broken parts must be repaired or replaced with spares of the same make.
Table 3: The Maintenance of Harvesting Tools and Equipment	

- When not being used, tools and equipment must always be stored in a properly designed and managed storeroom.
- The tools and equipment should be issued to the workers every morning and locked up again after the day's work.
- The storeroom must be secure to ensure that unauthorised persons cannot gain access.
- The storeroom must be dry and clean to prevent contamination and rust.

- Tools and equipment must be stored separately from agrochemicals to prevent chemical contamination, and to ensure that the equipment is safe should a spillage occur.
- Unfortunately, no matter how well-trained and careful workers are, accidents can still occur, and most tools will eventually require replacement, either from damage or wear and tear.
- To handle these replacements and repairs as quickly and cost effectively as possible, there must be a replacement plan in place.
- In most instances, growers should be able to negotiate a discounted price from suppliers at the start of the harvesting period if they make a bulk purchase of equipment and tools.
- Growers may be able to reach an agreement where this price carries over the harvesting period, which can save money when replacements are needed.
- A system must be in place where workers can easily check any broken tools or equipment against possible replacement warranties that might be in place.
- Depending on the warranty, it may be possible to have the equipment replaced for free.
- Relying entirely on ordering replacements is not advisable, as this may lead to downtime while waiting for replacements.
- Therefore, it is best practice to order spares of all tools and equipment at the start of the season.
- Spares ensures that any breakages during the season don't cause undue stoppages in work, and that growers are not forced to pay exorbitant prices for replacement tools.
- Any equipment replacements must be documented, including the costs involved, the cause of the issue, the workers involved, and the downtime (if there was any).
- Maintenance plans are only successful if implemented and managed well, and all workers involved must be trained.
- Maintenance training can be divided into three different stages, namely management training, supervisor training, and picker training.
- Farm and store managers must be made aware of the importance of performing maintenance tasks.
- Management is required to accept the responsibility of ensuring the effectiveness of the maintenance plan through recordkeeping and the monitoring of maintenance equipment.
- Without training managers, the management of the maintenance plan will be inadequate and the plan not effective.
- Supervisors are responsible for monitoring the actual harvesting process where tools and equipment are used.
- Supervisors also inspect tools and equipment before use to ascertain that those tools are in a good condition before use.
- Supervisor training must include recordkeeping procedures as supervisors take responsibility for equipment and tools during harvesting.
- Supervisors collect tools and equipment from stores at the start of a day and must return the equipment again after harvesting.
- Supervisor reports will indicate when maintenance needs to be performed to keep tools and equipment in a workable condition.

- Pickers must be taught how to use tools correctly to ensure that tools and equipment are not damaged unnecessarily.
- Pickers also need to know how to report any equipment and tool faults.
- When training workers, trainers must clearly define areas of responsibility, and workers must be made aware of the role they have to play to ensure effective maintenance.
- Supervisors and team leaders who are mostly responsible for equipment and tools must be taught how and when to apply maintenance procedure.
- The only way to effectively monitor the implementation and ongoing effectiveness of the maintenance plan is through recordkeeping.
- Records of how and when maintenance tasks are performed must be kept, including why they were performed and if the maintenance was effective.
- Records are also important to minimise the loss of equipment by tracking where tools and equipment are, and which workers have them.

self-assessment

KT0202: Harvesting Methods, Procedures and Equipment

Can I?	Y/N
Can I describe when citrus fruit is typically harvested for export?	
Can I explain train pickers before harvesting?	
Can I describe the difference between clipping and snap picking?	
Can I describe what selective harvesting means and when it might be used?	
Can I ensure that workers are hygienic during picking?	
Can I pick citrus and instruct others how to pick citrus?	
Can I identify and select the appropriate tools and equipment used for citrus harvesting?	
Can I safely and carefully handle fruit?	
Can I ensure that only trained and experienced staff operate mechanical equipment such as tractors?	
Can I explain how improper use of harvesting tools and equipment can endanger workers and damage fruit?	
Can I train workers in safety and correct equipment use?	
Can I explain which legislation governs worker safety during harvesting activities?	
Can I safely use each type of harvest equipment (clippers, ladders, picking bags, bins, trailers, and tractors)?	
Can I implement systems to report equipment malfunctions?	
Can I keep proper records of equipment malfunctions?	
Can I describe the monitoring and corrective measures for each type of harvest equipment (clippers, ladders, picking bags, bins, trailers, and tractors)?	
Can I describe why regular maintenance of tools and equipment is essential?	
Can I create a maintenance plan?	
Can I distinguish between mechanical and non-mechanical harvesting equipment?	

Can I hire professionals to service mechanical equipment?	
Can I describe how maintenance requirements differ between mechanical and non-mechanical equipment?	
Can I describe what GAP schemes are and what their purpose is?	
Can I describe how poor sanitation increases the risk of fruit contamination and postharvest losses?	
Can I set guidelines for maintenance and sanitation on the farm?	
Can I explain the correct procedure for reporting damaged or unsafe equipment?	
Can I maintain each type of harvest equipment (clippers, ladders, picking bags, bins, trailers, and tractors)?	
Can I describe the appropriate storeroom for tools and equipment?	
Can I describe the daily procedure for issuing and locking away tools and equipment?	
Can I create a replacement plan is necessary for tools and equipment?	
Can I record the appropriate information when equipment replacements occur?	
Can I list and implement the three levels of maintenance training?	
Can I keep accurate records to monitor maintenance plan effectiveness?	

work scenario reference

To learn about how the above information is applied in practice, please look at the following workplace scenarios:

IAC Code	IAC Title	Relevant Work Scenario(s)
IAC0202	The correct application of crop harvesting methods is discussed	G1, G2, G3, G4
IAC0203	The safe handling of tools and equipment is described	G3, G4, I6, J2, K1
IAC0204	The care and maintenance of harvesting tools and materials (cleaning, sanitizing, basic maintenance and repairs) is outlined	I3, I4, I5, I6, J2

3. KT0203: Handling Transport of Fruit from Orchard or Vineyard to Pack Store

IAC0205: The handling of fruit and transport immediately postharvest to limit injury and damage to fruit during and after harvesting described

- Proper handling and transport of fruit immediately is critical for maintaining fruit quality and minimizing postharvest losses.
- Once fruit has been picked, it can no longer heal from injuries or stress, meaning that any injuries or decay caused now are irreversible.
- Handling fruit improperly after harvest can lead to injuries which serve as entryways for pathogens into the fruit.
- Injuring and infecting fruit at this point renders all the effort, cost, and time invested so far in production pointless.
- After being picked, fruit is placed into bulk bins or picking trailers and transported from the orchard to the packhouse or a storage area.
- The time between harvesting and transport should be minimised to prevent sun damage, heating and decay.
- Bins or trailers should be kept in shaded areas while waiting for collection, and fruit should be transported to the packhouse or storage as quickly as possible.
- When loading fruit for transport, bins must be stacked evenly and secured to prevent shifting during movement.
- Overloading trailers or trucks can lead to the fruit being compressed and damaged in the lower layers.
- Drivers must drive smoothly, avoiding sudden stops, excessive vibration, or rough terrain that can cause fruit injuries.
- This journey must be as direct and quick as possible, and the road should be free of speed bumps, potholes, or other obstructions.
- Any bumps caused by these obstacles can make fruit bounce around, leading to injuries.
- All equipment, vehicles, and containers must be regularly cleaned and sanitised to reduce the risk of contamination.

self-assessment

KT0203: Handling Transport of Fruit from Orchard or Vineyard to Pack Store

Can I?	Y/N
Can I properly handle fruit postharvest to maintain fruit quality?	
Can I describe how harvested fruit is typically transported?	
Can I safely load and transport fruit postharvest?	
Can I instruct workers on proper handling and transport procedures?	
Can I examine transport routes to ensure that they are quick and safe for fruit?	
Can I properly clean and sanitise all equipment, vehicles, and containers before and after transport?	

work scenario reference

To learn about how the above information is applied in practice, please look at the following workplace scenarios:

IAC Code	IAC Title	Relevant Work Scenario(s)
IAC0205	The handling of fruit and transport immediately postharvest to limit injury and damage to fruit during and after harvesting described	A5, A6, A8, G3, G4

4. **KT0204: Orchard / Vineyard Sanitation**

IAC0206: The practices to control the development of decay and /or physiological disorders during and postharvesting are outlined

- Preventing the development of decay and disease during and postharvesting is vital for producing profitable, high quality fruit.
- Sanitation is the most important aspect of managing decay and disease.
- Sanitation refers to two sets of practices, firstly orchard sanitation, and the sanitation of harvesting tools and equipment.
- Workers should also be well trained in personal hygiene, especially washing their hands, and should know not to handle damaged or fallen fruit while handling healthy fruit.
- There are numerous postharvest practices performed in the packhouse that fight disease and decay, and those are discussed in detail in later parts of this material.
- Fruits are continuously under threat from disease, and once picked, become even more vulnerable to infection by pathogens.
- Controlling decay and disease begins by avoiding injuries through proper picking and handling and safe transport.
- Temperature management is a critical part of mitigating decay and disease.
- Fruit should be moved to shaded areas immediately after harvest and transported to the packhouse without delay.
- Pre-cooling helps to stabilise internal fruit temperatures and mitigate the harm of field heat from the orchard.
- In storage, citrus fruit should be kept at optimal temperatures and humidity levels specific to the cultivar.
- All harvesting tools, bins, and packhouse equipment must be cleaned and sanitised regularly.
- Regular monitoring of fruit condition throughout storage and transport allows for early detection of decay or disorders.
- Quality control checks such as visual inspections and temperature and humidity monitoring help identify and correct any deviations immediately.

IAC0207: The measures to prevent fruit contamination are described

- Preventing contamination of fruit during production is a vital part of ensuring food safety and compliance with market requirements and accreditation.
- Contamination can occur through contact with soil, dirty water, unclean equipment, or unhygienic workers.
- Implementing strict hygiene and sanitation practices ensures that fruit remains safe for consumers and compliant with quality standards.
- Workers in the orchard must maintain high personal hygiene standards, including washing their hands before handling fruit and after breaks, eating, or using the toilet.
- No workers should be allowed to eat, drink, or smoke in the orchard near the fruit.
- Any workers displaying symptoms of illness should not handle the fruit at all.

- All harvesting tools, equipment, and vehicles must be cleaned and sanitised before use.
- Any fruit that falls and comes into contact with the soil should never be picked up by pickers and should be left in the orchard for the sanitation team.
- Any of this fallen fruit must be collected and stored with other waste fruit for proper disposal.
- All water used in washing, rinsing, and treatment processes must be clean, and water sources should be tested regularly for contamination.
- Chlorine or other approved sanitising agents can be added to maintain hygienic wash systems, but concentrations must be carefully controlled to ensure efficacy without damaging the fruit or leaving harmful residues.
- Only registered and approved agrochemicals should be used in production, and withholding periods must be observed.
- Equipment used for agrochemical applications must be calibrated and maintained to prevent over-application and resultant contamination.
- In storage and transport areas, pest control programs should be implemented to prevent contamination by rodents, insects, or birds.
- Packhouse facilities should be kept clean, and any area fruit comes into contact with should be sanitised before the day's work begins.
- Waste materials and fruit should be removed from the orchard or packhouse and disposed of.
- Employees in the packhouse should wear clean protective clothing and follow good hygiene practices at all times.

IAC0208: The importance of harvesting area being clean from waste material is discussed

IAC0209: Orchard / vineyard sanitation practices to be applied during and after harvesting are outlined

IAC0210: The procedure for dealing with or disposing of an infested crop is outlined

Refer to IAC0102: The timing and practices of pre-harvest orchard or vineyard sanitation are described.

self-assessment

KT0204: Orchard / Vineyard Sanitation

Can I?	Y/N
Can I implement proper sanitation procedure to manage decay and disease?	
Can I describe the difference between orchard and equipment sanitation?	
Can I instruct workers on proper hygiene procedures?	
Can I describe how fruit injuries affect decay and disease spread?	
Can I explain how temperature affects the development of decay?	

Can I describe why regular monitoring of fruit condition during storage and transport is necessary?	
Can I explain why preventing fruit contamination is essential for food safety and market compliance?	
Can I collect and properly dispose of waste fruit?	
Can I regularly test water sources for contamination?	
Can I safely use chlorine or other sanitising agents in wash systems?	
Can I ensure that only registered and approved agrochemicals are used in production?	
Can I describe what withholding periods are and why they must be followed?	
Can I explain why packhouse employees must wear clean protective clothing?	

work scenario reference

To learn about how the above information is applied in practice, please look at the following workplace scenarios:

IAC Code	IAC Title	Relevant Work Scenario(s)
IAC0206	The practices to control the development of decay and /or physiological disorders during and postharvesting are outlined	A5, A6, G3, G4, H1
IAC0207	The measures to prevent fruit contamination are described	A6, D3, G3, G4, H1
IAC0208	The importance of harvesting area being clean from waste material is discussed	A6, F1, G1, G2, H1
IAC0209	Orchard / vineyard sanitation practices to be applied during and after harvesting are outlined	A6, F1, G1, G2, H1
IAC0210	The procedure for dealing with or disposing of an infested crop is outlined	A6, F1, G2, G3, H1

KM-04-KT03:

Postharvest Processes

(20%, 0.8 credits)

Topic Elements

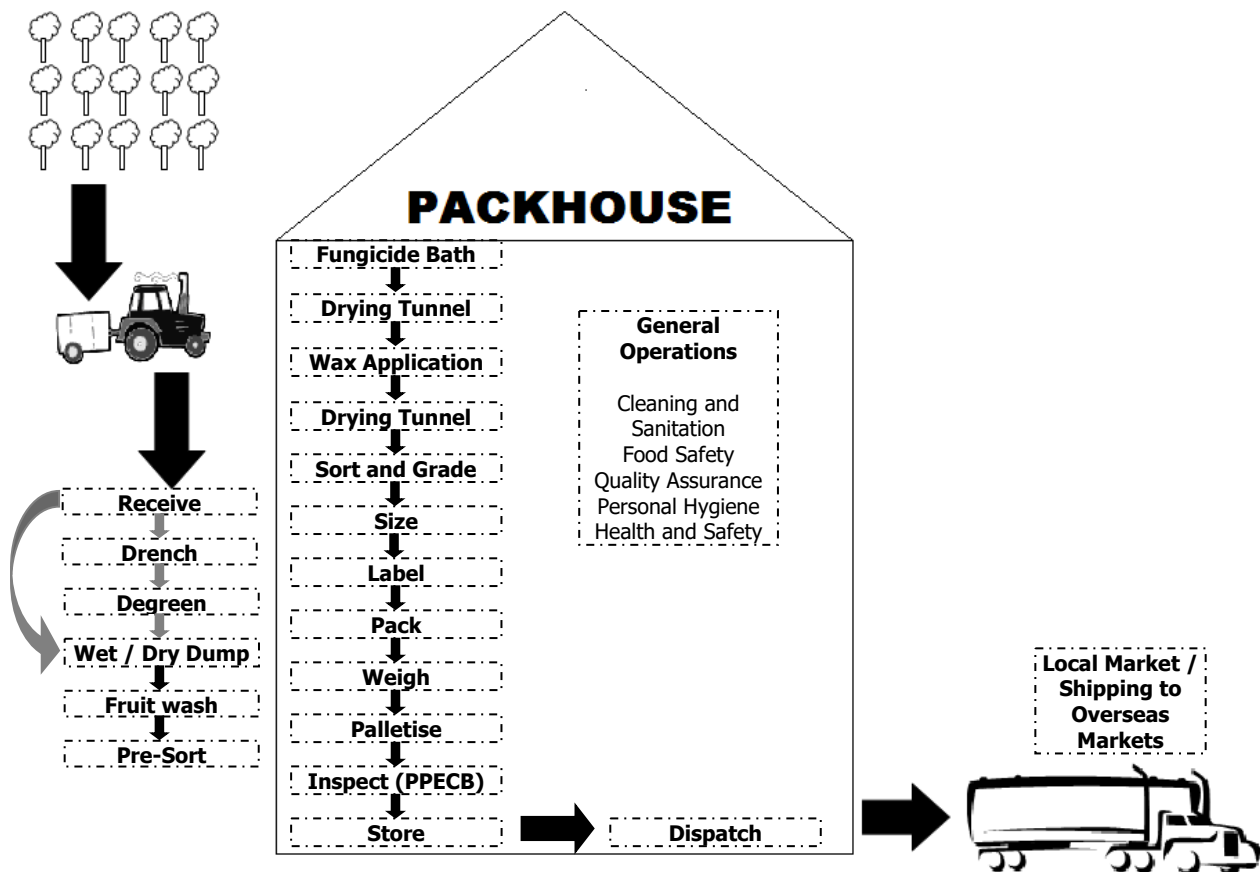
The content of this chapter covers the following topic elements:

- KT0301: {Postharvest processes} In the packhouse and further along the value chain
- KT0302: {Postharvest processes} On the farm

1. **KT0301: {Postharvest Processes} In the Packhouse and Further along the Value Chain**

IAC0301: The different postharvest processes in the packhouse are described in the correct order and how they maintain quality is explained

- Citrus packhouses are central to ensuring that growers get the best possible returns for their fruit.
- Before deregulation, most citrus packhouses were cooperative, meaning that the fruit of all the growers in an area were packed at one packhouse.
- Since then, many growers have built their own packhouses, and these packhouses vary widely in size, complexity and amount of fruit packed.
- Every citrus packhouse is differently designed, depending on the volume and type of fruit packed, grower requirements, and target markets.
- Packhouses perform several functions, including separating fruit into markets, applying treatments, inspecting fruit quality, packing, maintaining fruit quality and safety, and keeping records.
- These processes and practices vary between packhouse, but there are some practices that are common among most or all packhouses, shown below in a flow model:



- The first step in the packhouse is to receive fruit from the orchard, delivered either in picking trailers, or wooden and plastic bins.
- During receipt, the packhouse identify who and where the fruit came from, especially in communal packhouses sourcing multiple farms.
- The receivers should note both the production unit code, or PUC, and the orchard number.
- In communal packhouses, the fruit is weighed, and this weight is recorded next to the growers' name.
- If the bins are going into degreening, they must be marked with these details and with the fruit colour on arrival.
- Next, if (and only if) the fruit is going into degreening, it is drenched to remove field heat, kill fungal spores, and leave fungicide residues on the fruit to protect it during degreening.
- If fruit is being degreened, it is taken to degreening rooms and exposed to ethylene gas at a specific concentration and for a certain period of time until they have coloured up to a certain point.
- Not all fruit is degreened, and not all fruit can be degreened.
- Only mature fruit can be degreened, as degreening does not ripen the fruit, and instead merely changes the rind colour.
- At the wet or dry dump, the fruit is brought into the packhouse process, either after it has been degreened or directly from the orchard.
- At some packhouses, fruit is dumped into water, referred to as a wet dump, which is the gentlest way of handling the fruit.

- In other cases, the fruit is dumped onto a conveyor belt, referred to as dry dumping.
- The cleaner fruit is when it enters the fungicide bath, the better, so the fruit is washed in water in the wet dump.
- In a dry dump, the fruit moves over a set of brushes under nozzles that spray water on them.
- After washing, fruit is pre-sorted to remove fruit destined for processing and fruit that is badly infected and that will infect other fruit in the packhouse.
- Fruit that cannot be exported should not be treated with fungicides and waxed, as this is a waste of money.
- A mechanical sizer, usually a pony sizer, is used to remove fruit that is too large or too small.
- Sorters remove the fruit that cannot be sold on the fresh fruit market due to scarring, damage or infection.
- Fruit destined for processing is directed to special bins and then transported to factories where they are processed into juice and oils.
- After this pre-sorting, the fruit is put into a bath or through a flooder to apply fungicides on the fruit.
- The water in the bath (or the flooder reservoir) is kept at a particular temperature and concentration of fungicides and is regularly tested to ensure that the concentration and temperature remain constant.
- Sponges collect excess chemicals and water from the fruit post bathing, but the fruit should not be completely dry, merely without excess liquid on the skin.
- Fruit is dried after bathing, before waxing, as if wet fruit goes into the wax application system, this can cause the wax to break down, resulting in uneven wax coverage on the fruit.
- Drying is usually performed using drying ovens that use either diesel, gas, or electric heaters, and are kept at approximately 40°C.
- Drying ovens often incorporate fans that blow warm air onto the fruit to dry it.
- Drying usually takes no more than a few minutes for drying pre- and post-waxing.
- The temperature of drying ovens is monitored via a computer on the oven, which gives the exact temperature inside.
- It is vital to ensure the temperature is not too hot, or the fruit will cook and burn; and not too cold, or the fruit will not dry properly.
- Wax is applied to give the fruit a shiny appearance, to prevent moisture loss, and to maintain the fruit quality during export.
- Adding some fungicides is also a standard recommendation in the wax application.
- The fruit is dried again after waxing to properly dry the wax on the fruit.
- After the second drying, fruit is separated into different sizes and grades, or classes.
- Local market fruit is taken out and sent on a different packline for different packaging, and export fruit is further graded into a number of different classes.
- Most packhouses use optical sizers to size and grade fruit, which are large cameras that are programmed to grade for colour, shape and blemishes.
- The sizer also separates fruit into classes and weights.

- Manual grading (performed by workers instead of sizers) is still occasionally used in smaller packhouses.
- Where manual grading is used, the best graders are put in place to finally grade the export fruit.
- Certain markets require that fruit is labelled.
- In most packhouses, mechanical fruit labelling is used, but in some cases the packers stick the labels on by hand.
- After labelling, export fruit is packed into cartons in the packing pattern that the market requires.
- The fruit may also be wrapped, if the market requires it.
- Fruit is usually packed and wrapped by hand, but in some packhouses, automatic packing machines are used, though these are expensive to install.
- Cartons are then labelled, indicating the variety, grade, size, packing date, packline number, production unit code, and packhouse code.
- Cartons are weighed before they are stacked on pallets to make sure that they conform to the minimum weight requirements.
- This weight information is also used to make sure that trucks are not overloaded.
- The packed cartons are stacked neatly on pallets, with the stacking pattern depending on the type of carton.
- Corner pieces are put in place and strapping is used to stabilise and secure the pallets, and for open-top display cartons, securing sheets and pallet caps are also used.
- The PPECB inspectors will then inspect the packed and palletised fruit to make sure that it complies with the minimum requirements for export.
- After being palletised and inspected, the fruit is stored either in a cold room, or in separate area in the packhouse.
- At some packhouses, the pallets of fruit are loaded directly into shipping containers to save harbour handling costs.
- From there, pallets are loaded onto trucks for dispatch to the harbour, or into containers, which are either transported on trucks or by rail.
- There are other functions that are part of the packhouse process which are applied throughout the process, namely packhouse sanitation, quality control, critical control points (CCPs), and personal hygiene.
- Packhouse sanitation involves daily cleaning and sanitisation of all areas of the packhouse to protect fruit from infection.
- Packhouse sanitation forms part of food safety and quality requirements and must be strictly enforced.
- Quality control involves performing sample checks throughout the packing process to ensure that packhouse practices are being properly performed.
- These include checking that grading and sizing are being done correctly, that fruit is not injured during the packing process, and that the right fruit is ending up in the right place.
- Critical Control Points (CCPs) are points throughout the packhouse that must be monitored constantly.

- At these CCPs, quality control personnel constantly test the fruit using a checklist to ensure that internal and external quality parameters are met, and to ensure that every practice is being properly done.
- CCPs enable a system of traceability that allows managers to track issues down to specific parts of the process.
- If one CCP reports a problem and the one preceding it (i.e. the one the fruit passed through before it) does not report the problem, it can be safely assumed that the problem lies in between those two CCP's, making resolution a lot simpler.
- Personal hygiene is very important in a packhouse, and every worker that works in the packhouse must be aware of the hygiene requirements for working with a perishable product.
- Every worker must wear protective clothing, and specifically a hair covering, overalls and, in some cases, gloves.
- Worker must keep their protective clothing clean and neat at all times and ensure that it is whole and in a good condition.
- Workers must wash their hands regularly, and their nails must be kept short so that they will not injure the fruit.
- Workers must treat any open injuries or sores and cover them with plaster or bandages.
- No eating, drinking or smoking is allowed inside a packhouse.
- Workers must also be aware of all the possible dangers that the machinery, equipment and chemicals used in the packhouse pose to their own health and safety.
- A few weeks before the start of the harvest the packhouse manager needs to ensure that the required personnel needed in the packhouse are employed and trained.
- The number of people needed in each section varies greatly from packhouse to packhouse, depending on the size and the automated equipment used in the packhouse.
- It is critical to get the right people into the right positions, such as hiring sorters and graders with good eyesight.
- Once the correct individuals have been identified for each position that needs to be filled; these workers may need to be trained, not only in the jobs they are expected to perform but also in the general flow of the packhouse.
- Workers with an overview and clear understanding of where their place is in the entire process are much better able to perform their duties.
- Well-trained, informed workers understand the importance of their role within the bigger plan.

IAC0302: The cold chain processes required for this crop is described

- After harvest, treatment, and packing, citrus fruit needs to be transported, often long distances across the world, to reach their final destination of sale.
- To maintain the quality of the fruit throughout this often long journey, citrus needs to be kept cool.
- Cooling citrus maintains the quality of the fruit, by slowing down the ripening process and respiration, and preventing or mitigating the development of postharvest diseases.
- Once citrus is cooled, it must not be allowed to warm up again.

- This process of keeping fruit continuously cold is referred to as the 'cold chain', and letting the fruit warm is referred to as 'breaking the cold chain'.
- Breaking this cold chain is the quickest way of losing fruit value.
- The cold chain involves a series of logistical and storage practices aimed at maintaining these low temperatures.
- Citrus is usually first cooled at pre-cooling facilities at the packhouse or when it reaches the harbour.
- Proper cold chain management starts the moment the fruit is harvested.
- Fruit, particularly in the orchard, is susceptible to heat and, if not cooled quickly, can quickly deteriorate and become more susceptible to diseases.
- Fruit should be pre-cooled as soon as possible after harvest to mitigate the effects of heat in the orchard, which maintains quality.
- Once pre-cooled, fruit must be transported in refrigerated trucks (often called 'reefer' trucks), and then in special containers on ships.
- These trucks and containers are designed to maintain a consistent temperature that can be monitored and adjusted as needed, keeping temperature fluctuations to a minimal.
- When fruit arrive at the harbour, transport depots, or other distribution centres, they must be kept in cold storage facilities.
- These facilities keep the fruit at a constant, low temperature, while controlling humidity levels.
- The temperature of the shipments must be continuously monitored wherever possible.
- There are modern systems that allow growers to continuously monitor the temperature of shipments with sensors throughout their journey, even in the middle of the ocean.
- If these systems are not available or cost-effective, growers should still request temperature records from the transportation companies.
- This temperature data should be recorded in case there is an issue with fruit quality when the fruit reaches its final destination, as it can be examined to look for possible breaks in the cold chain.
- Temperature records may also be required as part of quality assurance and may be necessary for compliance with food safety standards or market requirements.
- If a transport company allows the cold chain to break, they should be contacted for a refund or some other form of compensation and should not be used again.

self-assessment

KT0301: {Postharvest Processes} In the Packhouse and Further along the Value Chain

Can I?	Y/N
Can I describe how packhouses differ in type, size, complexity, and volume of fruit packed?	
Can I describe the factors that affect packhouse design?	
Can I list the main functions performed by a citrus packhouse?	
Can I explain why fruit is separated and graded?	

Can I describe how packhouses maintain fruit quality and safety?	
Can I explain why recordkeeping is essential in packhouse operations?	
Can I explain the purpose and process of degreening?	
Can I describe which types of fruit are suitable for degreening?	
Can I explain the purpose of drenching fruit?	
Can I distinguish between a wet dump and a dry dump?	
Can I describe the treatments performed in a packhouse?	
Can I explain why fruit is pre-sorted?	
Can I explain why and how fruit is dried?	
Can I describe the purpose of waxing citrus fruit?	
Can I explain how fruit is separated into sizes and grades after waxing?	
Can I describe how optical sizers work and what qualities they grade for?	
Can I describe the purpose of labelling fruit?	
Can I describe the packing and palletisation process?	
Can I explain the role of PPECB inspectors in export compliance?	
Can I explain the role of sanitation in a packhouse?	
Can I explain what quality control involves?	
Can I describe what Critical Control Points (CCPs) are and their purpose?	
Can I ensure that packhouse workers practice personal hygiene?	
Can I describe the protective clothing required for workers?	
Can I prevent eating, drinking, or smoking inside a packhouse?	
Can I describe how workers can protect themselves in a packhouse?	
Can I hire and train packhouse workers?	
Can I explain what the cold chain is and why it is vital for citrus quality?	
Can I describe what is meant by "breaking the cold chain" and why it reduces fruit value?	
Can I manage the cold chain to prevent breakages?	
Can I track the temperature of fruit throughout its journey using monitoring systems?	
Can I describe how temperature records support quality assurance and traceability?	

work scenario reference

To learn about how the above information is applied in practice, please look at the following workplace scenarios:

IAC Code	IAC Title	Relevant Work Scenario(s)
IAC0301	The different postharvest processes in the packhouse are described in the correct order and how they maintain quality is explained	A4, A5, A6, A7, A8

IAC0302	The cold chain processes required for this crop is described	A5, A6, A7, A8, D3
---------	--	--------------------

2. KT0302: {Postharvest Processes} On the Farm

IAC0303: The procedures for cleaning, sterilising and storage of harvesting equipment is outlined

Refer to IAC0204: The care and maintenance of harvesting tools and materials (cleaning, sanitizing, basic maintenance and repairs) is outlined.

IAC0304: Stocktaking of harvesting equipment is delineated

- Stocktaking is a vital part of harvesting tools and equipment management, as it ensures that the necessary tools and equipment are always available.
- The stocktaking process begins with a comprehensive inventory of all harvesting tools and equipment.
- This inventory should list every item, including its condition, location, how many of the item there are, and any other specific details that are relevant.
- All harvesting tools and equipment should be included, including (but not limited to) clippers, ladders, picking bags, PPE, tractors, bulk bins and picking trailers.
- This inventory creates a record that workers and management can refer to, ensuring that no tools or equipment are overlooked or misplaced.
- In terms of condition, any issues with tools or equipment (such as being worn out, rusted, damaged, etc.) should be noted for repair or replacement.
- Stocktaking ties into maintenance and other management practices as they inform decisions on maintenance planning and financial decisions regarding replacement or repair.
- In terms of equipment availability, the inventory must account for the number of workers and the scale of the harvest to ensure that sufficient equipment is available.
- Stocktaking, as with most production and management practices, relies on a solid base of recordkeeping.
- Accurate, up-to-date records of the inventory are necessary for the healthy function of a citrus harvest.
- These records assist in predicting the equipment needs for future harvests, while also providing valuable data for budgeting.
- The harvesting equipment should be regularly, randomly, audited, to judge whether the actual state and amount of equipment available on the farm matches the records.
- This audit also allows management to identify and deal with any discrepancies immediately, before they become bigger issues.

self-assessment

KT0302: {Postharvest Processes} On the Farm

Can I?	Y/N
Can I explain the importance of stocktaking for harvesting tool and equipment management?	
Can I describe and perform the stocktaking process?	

Can I design a harvesting equipment inventory with all necessary information included?	
Can I accurately record the condition of tools and equipment?	
Can I use an inventory to inform maintenance decisions?	
Can I explain the role of recordkeeping in the stocktaking process?	
Can I perform regular random audits of harvesting equipment?	

work scenario reference

To learn about how the above information is applied in practice, please look at the following workplace scenarios:

IAC Code	IAC Title	Relevant Work Scenario(s)
IAC0303	The procedures for cleaning, sterilising and storage of harvesting equipment is outlined	I1, I2, I8, J2, K1
IAC0304	Stocktaking of harvesting equipment is delineated	I1, I2, I6, I8, J2

KM-04-KT04:

Logistics and Availability of Equipment

(20%, 0.8 credits)

Topic Elements

The content of this chapter covers the following topic elements:

- KT0401: Logistics and equipment needed for the harvesting process

1. KT0401: Logistics and Equipment Needed for the Harvesting Process

IAC0401: The number of people and equipment needed to harvest a specific block is calculated based on a set of data supplied based on crop estimates, labour requirements of the cultivar and specific market requirements

- Calculating the number of workers and equipment needed for harvesting a specific block or orchard is vital for profitably and successfully planning and managing harvest.
- Accurate calculations ensure that resources are being used efficiently, and that as little time, manpower, and money is being wasted as possible.
- Worker and equipment requirements are calculated based on yield and fruit size estimates, the labour requirements of the specific cultivar, and market requirements.
- Yield and fruit size estimates inform growers how much fruit will be harvested, and how much volume and weight the fruit will be.
- Different cultivars require different levels of labour to harvest, as some cultivars might have fruits that are physically easier to harvest, making the harvesting process quicker.
- Other cultivars might have fruit that is more densely packed and harder to access, meaning that more time will be required for harvest.
- The predicted effects of particular cultivars on harvesting time can be determined from historical experience of growers or industry experts.
- If growers harvest multiple cultivars, it is advisable to develop a standard method for comparing the cultivars' picking time, such as an average "picking time per tree" figure.
- Market requirements also impact labour and equipment requirements.
- Export markets require more careful handling and selective picking compared to fruit destined for processing.
- This extra care will slow down harvesting, meaning that more workers will be needed, and thus more equipment.
- From this information, growers can calculate how many workers will be needed to pick the fruit based on historical and predicted picking rates.

- Once the worker requirements are known, equipment needs can be calculated based on how much of each piece of equipment is needed per worker.
- Larger equipment and vehicle requirements can be calculated based on how much fruit will need to be transported from the orchard.
- Once the labour and equipment requirements have been calculated, the farm should order the equipment and hire the workers as early as possible to avoid issues with delays.
- Equipment and tools should be ordered from reputable suppliers who ideally have a good reputation among other growers in the area.
- Depending on the size and location of the operation, it may make more financial sense to rent certain pieces of large mechanical equipment, such as tractors and trailers, for the harvest.
- If equipment is being rented, growers must ensure that the equipment will arrive well before harvest begins.
- Growers should ideally contact multiple rental companies to have backup options available in case a certain rental company fails to deliver the equipment.
- It is prudent to keep spare workers on call and to keep spares of all necessary equipment to be able to deal with unforeseen circumstances such as workers getting sick or equipment breakdown.
- A general rule of thumb is to keep an additional 5-10% of the total workforce or equipment stock available as spares or backup.

self-assessment

KT0401: Logistics and Equipment Needed for the Harvesting Process

Can I?	Y/N
Can I use yield and fruit size estimates to calculate the total fruit volume and weight to be harvested?	
Can I accurately calculate the number of workers and equipment needed for harvest?	
Can I describe how different citrus cultivars affect the labour requirements of harvesting?	
Can I explain how market requirements influence harvesting speed and equipment requirements?	
Can I calculate large equipment and vehicle requirements for harvest?	
Can I order equipment and hire workers early to avoid delays?	
Can I source equipment from reputable suppliers with good grower feedback?	
Can I determine whether renting or buying large mechanical equipment would be more cost-effective?	
Can I ensure there are sufficient spare workers and equipment available?	
Can I calculate the required number of spare workers and equipment?	

work scenario reference

To learn about how the above information is applied in practice, please look at the following workplace scenarios:

IAC Code	IAC Title	Relevant Work Scenario(s)
IAC0401	The number of people and equipment needed to harvest a specific block is calculated based on a set of data supplied based on crop estimates, labour requirements of the cultivar and specific market requirements	A2, A3, G1, G2, G3

KM-04-KT05:

Customer Requirements and Markets

(20%, 0.8 credits)

Topic Elements

The content of this chapter covers the following topic elements:

- KT0501: Trends in consumer preferences
- KT0502: Market segments
- KT0503: Food safety for correct handling of fruit during harvesting

1. KT0501: Trends in Consumer Preferences

IAC0501: Customer requirements regarding eating quality, external appearance (colour), fruit size, seeded vs. seedless and easy peeling characteristics is discussed

- Understanding and meeting the requirements and preferences of customers is vital to run a productive, profitable farm.
- Customer requirements include preferences for qualities including flavour, appearance, size, seed content, and ease of peeling.
- Flavour is arguably the most important, characteristic customers consider.
- Customers generally prefer fruit that is juicy, with a good balance between sweetness and acidity.
- The sugar content and acidity and the ratio between them are largely responsible for the flavour, and consistency of flavour is the goal for producers.
- Ideally, every fruit a grower produces should be as tasty as any other fruit produced, thus keeping customers coming back.
- In terms of production practices, consistent flavour is achieved through proper orchard management, and by ensuring that fruit ripens evenly and is harvested at the right time.
- The external appearance of fruit is often the first thing customers judge and highly influences their purchasing decisions.
- Ideally, fruit should be evenly and brightly coloured, and free of blemishes.
- In terms of production practices, factors such as adequate sunlight, proper nutrition, and well-managed irrigation all play a role in developing and maintaining the ideal external appearance.
- Size preference can vary depending on the market and the customer, although generally, consumers prefer their fruit to be medium-sized (relative to the normal size of the

particular variety or cultivar), which makes them convenient to transport, handle and consume.

- Fruit size is influenced by the tree's genetics, the spacing of fruits on the tree, and overall tree health.
- The preference for seeded or seedless fruits largely depends on the variety of citrus in question, and market trends.
- Although seedless varieties have become more popular due to their convenience, some more traditional customers may want a more "natural" fruit that still has seeds.
- Seed content (or lack thereof) is determined by cultivar selection.
- Fruit that is easy to peel tends to be more desirable to customers, especially for varieties like mandarins and tangerines, which are often eaten as snacks on the go.
- Peeling characteristics are determined by genetics, maturity, and postharvest handling.

self-assessment

KT0501: Trends in Consumer Preferences

Can I?	Y/N
Can I explain the importance of understanding and meeting customer requirements?	
Can I identify the main customer preferences for citrus fruit?	
Can I describe the qualities and production practices that affect flavour?	
Can I describe the qualities and production practices that affect fruit appearance?	
Can I describe the qualities and production practices that affect fruit size?	
Can I describe how cultivar selection determines seed content in citrus?	
Can I describe the qualities and production practices that affect peeling characteristics?	

work scenario reference

To learn about how the above information is applied in practice, please look at the following workplace scenarios:

IAC Code	IAC Title	Relevant Work Scenario(s)
IAC0501	Customer requirements regarding eating quality, external appearance (colour), fruit size, seeded vs. seedless and easy peeling characteristics is discussed	A1, A2, A5, A6, A7

2. KT0502: Market Segments

IAC0502: Examples of the fresh consumption market segments (export and local) is discussed and the implication on production practices is outlined

IAC0503: Examples of the fresh consumption market segments (export and local) are listed and the implication on production practices is discussed

- There are numerous segments in the citrus fruit market in which growers can sell their fruit, and each have their own advantages and disadvantages.
- The three major market segments are export, domestic, and processing:
- South Africa is a major citrus exporter, that exports to more than 60 countries around the world.
- The export market is by far the most profitable, with more than 90% of the income in the industry being generated there.
- The export market has the advantage of being highly profitable but having higher costs, standards, and risks than other market segments.
- Oranges are mainly exported to Northern Europe and the Middle East.
- Soft citrus is mainly exported to the United Kingdom and Northern Europe.
- Grapefruit is mainly exported to Northern Europe and the Far East.
- Lemons and limes are mainly exported to the Middle East and Russia.
- Citrus that does not achieve the quality standards set for export fruit can be sold on the domestic markets.
- The domestic markets include the fresh produce markets, the bakkie trade, other informal markets, government feeding schemes, and local supermarket programmes.
- Marketing fresh citrus locally is less risky and less expensive (both in terms of pre- and postharvest costs) than exporting, but the returns are also considerably lower.
- There are however examples of successful local marketing initiatives, such as ClemenGold sold by Woolworths, and there is a belief that the local marketed can be developed further.

IAC0504: Examples of the processing market segments (juicing, drying, canning, wine, other) are discussed and the implication on production practices is outlined

- Citrus fruit is used to manufacture a variety of products, in the so-called processing market.
- Citrus fruit and its derivatives (such as juices, concentrates, oils, etc.) are used in products ranging from food, drinks, cosmetics, medicine, and more.
- Citrus oils are extracted from the peel of citrus fruit, and used, amongst other things, to flavour various soda drinks and in the cosmetics industry.
- The processing market for citrus can be divided into several segments, including juicing, drying, canning, winemaking, oil extraction and others.
- Each of these segments has specific requirements for fruit in terms of quality, size, and maturity depending on what they plan to use the fruit for.

- The different requirements of the various market segments affect production practices including cultivar selection, fertilisation, irrigation, pruning, and harvest timing.
- Juicing requires fruit with high juice content, a good sugar-to-acid ratio, and good flavour, with external quality being less important.
- Juicing fruit may be left longer on the tree to increase sugar levels, and harvesting may be less selective due to less concern for external quality.
- Drying requires fruit with firm texture, uniform size, and high soluble solids to ensure efficient dehydration.
- Canning requires fruit with good shape, firmness, and peel integrity to withstand heat processing.
- Canning and drying fruit may be harvested earlier to maintain firmness.
- Wine or other forms of fermentation require high sugar content, acidity, and specific flavour characteristics.
- Although most growers send only fruit that is unsuitable for being marketed as fresh fruit for processing, there are some growers that produce purely for the processing market.
- If a grower produces fruit for processing, it is important that they familiarise themselves with the specific requirements of their target market segment.

self-assessment

KT0502: Market Segments

Can I?	Y/N
Can I describe the various market segments in the citrus industry?	
Can I describe the various advantages and disadvantages of the various markets?	
Can I select the appropriate market segment for a certain farm?	
Can I identify examples of products made from processed citrus?	
Can I list and describe the major segments of the citrus processing market?	
Can I describe the various requirements of each processing segment?	
Can I describe how the requirements of each market segment influence production practices?	

work scenario reference

To learn about how the above information is applied in practice, please look at the following workplace scenarios:

IAC Code	IAC Title	Relevant Work Scenario(s)
IAC0502	Examples of the fresh consumption market segments (export and local) is discussed and the implication on production practices is outlined	A1, A5, A6, A7, A8
IAC0503	Examples of the fresh consumption market segments (export and local) are listed and the implication on production practices is discussed	A1, A5, A6, A7, A8

IAC0504	Examples of the processing market segments (juicing, drying, canning, wine, other) are discussed and the implication on production practices is outlined	A1, A5, A6, A7, A8
---------	--	--------------------

3. **KT0503: Food Safety for Correct Handling of Fruit during Harvesting**

IAC0505: The correct application of the prescribed handling protocol for the crop is ensured to meet Health, hygiene and safety in terms of the OHSA and market requirements

- Adhering to health, hygiene, and safety rules is essential for the safety and health of workers, and for complying with the accreditation systems, regulatory requirements, and market requirements growers may be subject to.
- The most important piece of regulation to be adhered to by all businesses is that of the Occupational Health and Safety Act (OHSA).
- OHSA is a legal requirement to meet health and safety standards and carries serious consequences for infractions.
- All employees, from the pickers in the orchard, to senior management, must be thoroughly trained in OHSA guidelines.
- This includes understanding the risks associated with orchard work, the correct use of personal protective equipment (PPE), and the importance of adhering to safety rules.
- Growers should conduct regular training sessions on the practices and requirements of these standards.
- Growers should also put up signs and charts around the farm reminding workers of the importance of these rules, as well as the rules themselves.
- OHSA guidelines also require that growers provide workers with the appropriate PPE.
- Depending on the worker's role, PPE may include gloves, protective eyewear, masks or respirators, headwear, and suitable clothing, and more.
- PPE should be maintained in good condition and replaced when necessary. Workers should be trained in the correct use and maintenance of their PPE.
- OHSA and other accreditation systems also affect production practices such as handling, especially in terms of food safety.
- These safety requirements, especially for export markets, are a vital consideration, and must be adhered to at all times.
- Many markets include requirements in terms of health and safety, and in particular hygiene, and not meeting these requirements can lead to growers being banned from that market entirely.
- The most important aspect of market safety requirements is that of residue levels left on your fruit, and in particular MRLs (Maximum Residue Levels).
- The second important aspect of market and regulatory requirements is that of recordkeeping and traceability.
- Many markets require that growers are able to trace a particular carton of fruit all the way from its arrival in a supermarket overseas back to the exact orchard it was grown in.
- This traceability aids in dealing with issues related to pests and diseases and can save growers a lot of money and time when there are issues in this regard.

- It is essential that growers maintain records of all activities in the orchard, including the use of pesticides and fertilizers.

self-assessment

KT0503: Food Safety for Correct Handling of Fruit during Harvesting

Can I?	Y/N
Can I explain why adhering to health, hygiene, and safety rules is essential?	
Can I describe and adhere to the OHSA?	
Can I describe the consequences of not adhering to OHSA regulations?	
Can I describe the risks associated with food safety?	
Can I identify the ensure workers have access to appropriate, high-quality PPE?	
Can I explain the concept and importance of MRLs?	
Can I describe the importance of recordkeeping in market and regulatory compliance?	
Can I explain the concept of traceability?	

work scenario reference

To learn about how the above information is applied in practice, please look at the following workplace scenarios:

IAC Code	IAC Title	Relevant Work Scenario(s)
IAC0505	The correct application of the prescribed handling protocol for the crop is ensured to meet Health, hygiene and safety in terms of the OHSA and market requirements	G2, G3, G4, K1, K3