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# Citrus Orchard Foreman Occupational Learning

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## Study Guide

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### KM-02: Vineyard or Orchard Establishment

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|-----------------------|-----------------------------------------------------------------|-----------------|---|
| <b>Qualification:</b> | 110667 – Occupational Certificate: Orchard and Vineyard Foreman |                 |   |
| <b>Module No.:</b>    | 611202001-KM-02                                                 |                 |   |
| <b>Module Title:</b>  | Vineyard or orchard establishment                               |                 |   |
| <b>NQF Level:</b>     | 3                                                               | <b>Credits:</b> | 2 |

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**Occupational alignment:**  
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# 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 |
|--------------------------------|-----------------------------------------------------------------------------|-------|---------|
| <b>Knowledge Modules</b>       |                                                                             |       |         |
| 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       |
| <b>Practical Skill Modules</b> |                                                                             |       |         |
| 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                                                                                                                                                                                                                                          |
| <b>KM-02-KT01</b>                          | <b>Crop and cultivar selection (25%, 0.5 credits)</b>                                                                                                                                                                                          |
| KT0101                                     | Crop and cultivar/s requirements                                                                                                                                                                                                               |
| KT0102                                     | Market trends and requirements for the fruit type                                                                                                                                                                                              |
| KT0103                                     | Integration with existing enterprises on the farm                                                                                                                                                                                              |
| IAC0101                                    | The critical climatic and other requirements for the commercial production of the crop and cultivar/s are described                                                                                                                            |
| IAC0102                                    | Reasons for suitable root stocks and cultivar combinations for specific situations are understood and explained                                                                                                                                |
| IAC0103                                    | The infrastructure requirements for producing this crop is given in terms of the on-farm infrastructure and the infrastructure further down the value chain                                                                                    |
| IAC0104                                    | Major market trends and requirements for the specific crop is described taking into account long-term future outcomes                                                                                                                          |
| IAC0105                                    | The integration of the new enterprise with existing enterprises is outlined and explained with regards to labour requirement, production practices and risk distribution                                                                       |
| <b>KM-02-KT02</b>                          | <b>Farm Lay-Out (25%, 0.5 credits)</b>                                                                                                                                                                                                         |
| KT0201                                     | Principles                                                                                                                                                                                                                                     |
| KT0202                                     | Factors to consider                                                                                                                                                                                                                            |
| KT0203                                     | Basic ecological principles                                                                                                                                                                                                                    |
| IAC0201                                    | Farm lay-out is described in terms of resource requirements and optimisation thereof                                                                                                                                                           |
| IAC0202                                    | The effect of farm lay-out on natural resources is described in terms of the impact on the protection thereof                                                                                                                                  |
| IAC0203                                    | Agricultural infrastructure planning and layout principles are explained                                                                                                                                                                       |
| IAC0204                                    | The effect of topography on block lay-out and row direction is outlined                                                                                                                                                                        |
| IAC0205                                    | The impact of wind condition and direction on row direction and the need for protection of crop is described                                                                                                                                   |
| IAC0206                                    | The effect of physical soil limitations on block and row lay-out are reported                                                                                                                                                                  |
| IAC0207                                    | Free standing systems are compared to trellised systems in order to determine the impact on farm lay-out                                                                                                                                       |
| IAC0208                                    | Specific requirements regarding production under protection (i.e. hail netting) is discussed                                                                                                                                                   |
| IAC0209                                    | Provision for sufficient cross pollination by the correct lay-out of the orchard is explained                                                                                                                                                  |
| IAC0210                                    | The importance of minimising the impact of farming on the natural environment is discussed in terms of the positive and negative long- and short term effects on both the farm and the natural environment                                     |
| IAC0211                                    | The importance of waste management is explained in terms of its impact on the surrounding environment as well as the farm                                                                                                                      |
| IAC0212                                    | The principles of water management is outlined and discussed to isolate factors that impact water quality and availability taking care to consider both downstream impacts and the long term effects of correct and incorrect water management |
| IAC0213                                    | The impact of production practices on natural resources are outlined to illustrate methods for minimising the negative impact                                                                                                                  |
| <b>KM-02-KT03</b>                          | <b>Block establishment (25%, 0.5 credits)</b>                                                                                                                                                                                                  |

|                   |                                                                                                                                                                                                                                                                                                       |
|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| KT0301            | Soil preparation                                                                                                                                                                                                                                                                                      |
| KT0302            | Crop system installation                                                                                                                                                                                                                                                                              |
| IAC0301           | The difference between a chemical and physical soil survey as well as the need for both is explained                                                                                                                                                                                                  |
| IAC0302           | The need for and timing of a soil survey (chemical and physical) is described                                                                                                                                                                                                                         |
| IAC0303           | The process of making a profile hole is outlined and the data which can be obtained is listed                                                                                                                                                                                                         |
| IAC0304           | The practical application of physical and chemical corrective measures such as mechanical soil preparation, pre-planting soil amelioration to improve fertility and soil conditions and methods of pre-planting fertiliser application during soil preparation based on analysis results is discussed |
| IAC0305           | The importance of soil conservation is explained                                                                                                                                                                                                                                                      |
| IAC0306           | The basic principles of soil conservation and the application thereof are discussed                                                                                                                                                                                                                   |
| IAC0307           | The purpose of vine plant or fruit tree development systems applicable to a given crop is explained                                                                                                                                                                                                   |
| IAC0308           | The correct installation of vine plant or fruit tree systems described                                                                                                                                                                                                                                |
| IAC0309           | An irrigation plan and diagram is interpreted                                                                                                                                                                                                                                                         |
| IAC0310           | The importance of correct installation of an irrigation system for planting area is explained                                                                                                                                                                                                         |
| <b>KM-02-KT04</b> | <b>Crop establishment (25%, 0.5 credits)</b>                                                                                                                                                                                                                                                          |
| KT0401            | Handling and storage of plant material before planting                                                                                                                                                                                                                                                |
| KT0402            | Planting of the tree/vine                                                                                                                                                                                                                                                                             |
| KT0403            | Young plant care                                                                                                                                                                                                                                                                                      |
| IAC0401           | The handling of plant material from the nursery to the farm is described in terms of the impact it has on eventual young plant survival                                                                                                                                                               |
| IAC0402           | The pre-planting storage and preparation of plant material is outlined in order to optimise for a maximum yield of young plants                                                                                                                                                                       |
| IAC0403           | The process of making planting holes is briefly described in terms of the specifications for a given crop                                                                                                                                                                                             |
| IAC0404           | Pre-planting soil improvement such as the correction of pH and nutrient status to improve fertility and soil conditions is explained in terms of the outcome of young plant growth                                                                                                                    |
| IAC0405           | The methods of pre-planting fertiliser application is discussed in terms of efficacy in a given situation                                                                                                                                                                                             |
| IAC0406           | The correct application of mechanical soil preparation methods is described                                                                                                                                                                                                                           |
| IAC0407           | The correct application of crop establishment methods during the planting process is explained                                                                                                                                                                                                        |
| IAC0408           | The aftercare required by a particular crop is outlined and the effect of insufficient aftercare on plant growth is discussed                                                                                                                                                                         |
| IAC0409           | The requirements of plants immediately after planting is outlined and explained                                                                                                                                                                                                                       |
| IAC0410           | Production practices for young plants such as irrigation, weed control, pest and disease control are discussed                                                                                                                                                                                        |

# KM-02-KT01:

## Crop and Cultivar Selection

### (25%, 0.5 credits)

#### topic elements

The content of this chapter covers the following topic elements:

1. KT0101: Crop and cultivar/s requirements
2. KT0102: Market trends and requirements for the fruit type
3. KT0103: Integration with existing enterprises on the farm

### 1. KT0101: Crop and Cultivar/s Requirements

**IAC0101: The critical climatic and other requirements for the commercial production of the crop and cultivar/s are described**

- The climatic requirements of citrus production include temperature, sunlight, and rainfall.
- The environmental requirements of citrus production include soil and topography.
- Temperature plays a pivotal role in determining the suitability of a certain climate or area for citrus production.
- Citrus trees are particularly sensitive to frost, and not all citrus varieties are equally able to tolerate cold.
- Citrus trees have high sunlight requirements and generally thrive when they receive a lot of direct sunlight each day.
- The layout of the orchard must be well planned to ensure that trees receive the right amount of sunlight.
- Citrus trees require consistent and well-distributed rainfall and/or irrigation to thrive and produce high-quality fruit.
- South Africa's climate is generally characterized by distinct wet and dry seasons, which can vary depending on the region.
- Rainfall patterns vary across South Africa, as coastal regions may receive more consistent rainfall, while inland areas experience drier conditions.
- During the drier seasons in South Africa, reduced rainfall means that additional production practices are required, particularly increased irrigation.
- South Africa's soil types and textures vary widely, and the type and texture of the soil available must be considered during the selection of suitable citrus varieties for specific regions.
- Soil has several characteristics that must be assessed through regular soil testing or a more comprehensive soil survey, including drainage, nutrient levels, pH, structure, and moisture level, among others.

- Citrus trees generally prefer soils that are well-draining, as poor draining soil can easily become waterlogged, which can lead to root rot and other diseases.
- In terms of soil pH, citrus trees generally thrive in slightly acidic to neutral soils with a pH range of 6 to 7.
- Topography refers to the physical features of a piece of land, such as its shape, slope, and elevation, which can affect the suitability of the land for agricultural activities.
- The environmental topography of an orchard site impacts other factors such as water drainage, wind and rainfall patterns, and temperature fluctuations.
- Citrus orchards are best situated on gently sloping terrain, rather than steep slopes, as gentle slopes allow for water to drain naturally, but not too quickly.
- Gentle slopes reduce the risk of water runoff and soil erosion, both of which can be very harmful to a citrus enterprise and the longevity of an orchard.
- Orientation refers to the direction of the orchard rows and plays a role in optimising sunlight exposure for citrus trees.

**IAC0102: Reasons for suitable root stocks and cultivar combinations for specific situations are understood and explained**

- The rootstock is the lower portion of a grafted citrus tree, consisting of the root system and the lower stem.
- The rootstock serves as the foundation and support for the entire tree.
- Different rootstocks can impart specific characteristics to the tree, such as drought resistance, cold tolerance, and resistance to diseases.
- Rootstock selection is critical as it determines the tree's growth rate, size, and adaptability to soil conditions and pests.
- Growers must evaluate the soil type, climate, and potential pest and disease pressures in the proposed orchard location to choose the most appropriate rootstock.
- The cultivar, short for "cultivated variety," represents the upper portion of the grafted citrus tree, including the branches, leaves, and the fruit-bearing scion or budwood.
- Cultivars are selected based on the desired fruit characteristics, including taste, size, shape, colour, seed content, and overall quality.
- Cultivar selection is focused on considering the market demand and fruit quality desired to maximise profitability.
- As an export-focused industry, the citrus industry requires that farmers select cultivars that meet international market standards.
- The process of combining rootstock and cultivar involves attaching a scion, or budwood, from the chosen cultivar onto the selected rootstock, in a process known as "budding" or "grafting".
- Factors that influence rootstock and cultivar combination selection include disease and pest resistance, soil adaptability, climate adaptability, canopy and orchard management, market demand, and fruit production goals.
- Soil adaptability refers to the ability of a specific rootstock to adapt to soil conditions outside of its ideal range, as well as the general tolerance for adverse or imperfect soil conditions.

- Certain cultivars are better suited to different soils than others, and some are more able to adapt to different types of soil than others.
- Different citrus cultivars and rootstocks have specific climate preferences, particularly regarding ideal temperature ranges and tolerance for heat, cold, drought or waterlogging.
- Rootstock selection plays a significant role in orchard management, as citrus trees grown on various rootstocks exhibit varying growth habits, canopy sizes, and fruiting patterns.
- These variations mean that canopy and orchard management tasks may need to be applied more or less frequently on trees grown from certain rootstocks to accommodate for their larger size or faster growth.
- Growers must consider the selected combination when designing orchard layouts and spacing to maximize sunlight penetration, airflow, and ease of management.
- Market preferences for fruit size, quality, flavour, and appearance vary between markets, and thus the market being targeted will influence the selection of cultivar and rootstock.
- As citrus farming in South Africa is export-oriented, cultivar selections must align with international market preferences to ensure that they sell well.
- Market demand in the modern day extends beyond fruit preferences to include aspects like organic production, sustainability, and ethical farming practices.
- Fruit production goals encompass various aspects, including yield quantity, fruit quality, harvesting efficiency, and resource optimisation.
- Rootstock and cultivar combination selection should align with these objectives to ensure that production goals are achieved.

**IAC0103: The infrastructure requirements for producing this crop is given in terms of the on-farm infrastructure and the infrastructure further down the value chain**

- Producing citrus crops requires a well-planned and efficient infrastructure network, encompassing both on-farm infrastructure and off-farm infrastructure further down the value chain.
- On-farm infrastructure varies from farm to farm, depending on the size, location, type(s) of fruit produced, and other factors.
- Generally, on-farm infrastructure includes irrigation systems, housing, amenities, roads and vehicles, equipment and stock storage facilities, security, and environmental compliance infrastructure.
- Larger farms may also have nurseries, cold storage facilities, packhouses, laboratories, and other large pieces of infrastructure.
- Irrigation systems vary in design, size, and complexity depending on the method of irrigation and other factors.
- Irrigation systems should ideally be equipped with timers and moisture sensors to optimise water use and ensure consistent soil moisture levels for citrus trees.
- Some farms maintain on-farm nurseries for propagating rootstock and cultivars.
- These nurseries' infrastructure would include shade structures, misting systems, and well-drained soil beds to promote healthy seedling growth.

- Some farms have on-site packhouses, where others share a single packhouse with other farms in the area to split the costs if no single farm in the area could justify the expense of building its own packhouse.
- Packhouses can be very large and are equipped with lots of complex machinery and equipment, including sorting and grading lines and tables, optic sizers, washing and waxing stations, and packing equipment.
- Cold storage infrastructure is vital for preserving fruit quality and extending shelf life and serves as the beginning of the “cold chain.”
- Many farms, especially those in more remote areas, require housing for seasonal workers, such as those extra workers hired during harvest.
- If farms are housing workers, it is essential to provide suitable, comfortable accommodation and amenities to attract and retain a skilled, committed workforce.
- Worker amenities and accommodation can include boarding houses, cafeterias, bathrooms, hand- and eye-washing stations, storage areas (such as lockers), and changing rooms.
- Farms rely on a range of and vehicles, including tractors, sprayers, forklifts, and trailers, among others.
- These vehicles require infrastructure such as storage areas, maintenance areas, roads, garages, and workshops.
- Security infrastructure may include fencing, gates, and surveillance systems, and serves to protect the valuable assets, stock, and infrastructure on the farm.
- Compliance with environmental regulations may require specific infrastructure to meet these requirements, such as waste management, erosion control, and pesticide storage facilities.
- Off-farm infrastructure that lies further down the value chain are needed to efficiently process, market, transport, and finally export fruit.
- Off-farm infrastructure includes packhouses, logistics infrastructure, cold chain storage, seaports, and research infrastructure.
- Off-farm packhouses are generally communal packhouses, where multiple farms send their fruit to be packed.
- Off-farm packhouses perform the same operations as an on-farm packhouse, but at a larger scale with more complexity.
- As an export-dependent industry, South African farmers rely on logistics and transport infrastructure to transport fruit on a strict time schedule to ensure that it arrives overseas in the best condition possible.
- This logistics infrastructure includes a well-maintained network of roads, rail, and ships.
- This transport network is supported by other pieces of infrastructure such as loading docks, refrigerated trucks, cold storage, and railway hubs, among many others.
- Export citrus requires temperature-controlled storage facilities along the supply chain to maintain freshness and extend shelf life.
- Producers must ensure that the cold chain remains unbroken to preserve the quality of the fruit during transit and storage.
- High-quality export infrastructure such as seaports are essential to continued success, as they aim to provide easy, streamlined access to global markets.

- Agricultural research and development institutions, such as the CRI, are an essential part of the industry.
- These institutions research and develop the latest production techniques, pest and disease management strategies, and other innovations in the industry, and provide this information to growers.

## self-assessment

### KT0101: Crop and Cultivar/s Requirements

| Can I?                                                                                                           | Y/N |
|------------------------------------------------------------------------------------------------------------------|-----|
| Can I explain the sunlight requirements of citrus trees?                                                         |     |
| Can I explain the water requirements of citrus trees?                                                            |     |
| Can I explain the temperature requirements of citrus trees?                                                      |     |
| Can I explain the soil requirements of citrus trees?                                                             |     |
| Can I explain the topographic requirements of citrus trees?                                                      |     |
| Can I describe the general climate of South Africa and my area in particular?                                    |     |
| Can I describe the relation between climatic and environmental references and orchard layout?                    |     |
| Can I explain the concept of rootstocks and cultivars and how they affect production?                            |     |
| Can I select an appropriate rootstock and cultivar combination for my area and production system?                |     |
| Can I explain how market demand influences cultivar selection?                                                   |     |
| Can I combine a rootstock and cultivar through grafting or budding?                                              |     |
| Can I describe the importance of infrastructure for citrus production?                                           |     |
| Can I distinguish between and list various kinds of on-farm and off-farm infrastructure?                         |     |
| Can I describe the importance of cooling citrus and the cold chain?                                              |     |
| Can I explain how environmental compliance requirements shape farm infrastructure?                               |     |
| Can I describe the key elements of the logistics network (roads, rail, ships, docks, refrigerated trucks, hubs)? |     |
| Can I explain the role and value of agricultural research institutions (like CRI) in citrus production?          |     |

## 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 critical climatic and other requirements for the commercial production of the crop and cultivar/s are described | A1, B1, B2, D2, D3        |

|         |                                                                                                                                                             |                    |
|---------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| IAC0102 | Reasons for suitable root stocks and cultivar combinations for specific situations are understood and explained                                             | A1, A2, A7, B1, B7 |
| IAC0103 | The infrastructure requirements for producing this crop is given in terms of the on-farm infrastructure and the infrastructure further down the value chain | A1, A8, B1, B2, I7 |

## 2. KT0102: Market Trends and Requirements for the Fruit Type

**IAC0104: Major market trends and requirements for the specific crop is described taking into account long-term future outcomes**

- As an export-dependent industry, South African citrus production requires an understanding of major market trends and requirements, both current and anticipated for the long-term future.
- South African citrus exports have diversified beyond traditional markets like the European Union and the United Kingdom, to include emerging markets in Asia and elsewhere.
- The global demand for citrus has witnessed significant shifts in recent decades, reflecting changing consumer preferences, dietary trends, and health considerations.
- Traditionally, citrus fruits were primarily consumed for their refreshing taste and high vitamin C content, however, recently there has been a growing awareness of the health benefits associated with citrus consumption.
- The globalization of food markets and improved transportation infrastructure has facilitated and streamlined the international trade of citrus products.
- Resultingly, South Africa has become a major player in the global citrus market.
- Citrus is expected to continue its upward trajectory in the markets as consumers increasingly seek natural and healthy food options.
- Advancements in technology and agricultural practices have improved citrus yield and quality, further supporting the industry's growth.
- Sustainability and environmental concerns are increasingly important in international (especially wealthier) markets.
- South African producers should adopt sustainable practices and certifications like GlobalG.A.P. to remain competitive internationally.
- Sustainable practices include managing water responsibly, limiting agrochemical use, and otherwise reducing the environmental impact of farming.
- IPM is an essential part of sustainability, as focusing on biological control and limiting agrochemical use meets many environmental and sustainability requirements.
- International markets, such as the EU, have strict quality standards regarding size, colour, taste, safety for citrus exports.
- Compliance with Maximum Residue Levels (MRLs) for pesticides is mandatory for many international markets, as well as strict quality control regarding food safety.
- Traceability is often a requirement for certification and access to export markets.
- Fruit must be traceable all the way back to the specific orchard it was grown in.
- Proper packaging or labelling is also important, and improper packaging or labelling can lead to consignment rejection.

## self-assessment

### KT0102: Market Trends and Requirements for the Fruit Type

| Can I?                                                                                                              | Y/N |
|---------------------------------------------------------------------------------------------------------------------|-----|
| Can I relate market trends to production decisions?                                                                 |     |
| Can I describe the various markets available to South African citrus producers?                                     |     |
| Can I evaluate the various markets and determine the most suitable one for my farm?                                 |     |
| Can I describe the global demand trends for citrus and the factors influencing them?                                |     |
| Can I implement sustainable and environmentally conscious practices to remain competitive in international markets? |     |
| Can I implement GlobalG.A.P. requirements to remain accredited?                                                     |     |
| Can I describe how IPM supports sustainability goals?                                                               |     |
| Can I comply with MRLs for agrochemicals?                                                                           |     |
| Can I describe why traceability is required for certification and access to export markets?                         |     |
| Can I describe the importance of proper packaging and labelling for export consignments?                            |     |

## 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) |
|----------|-----------------------------------------------------------------------------------------------------------------------|---------------------------|
| IAC0104  | Major market trends and requirements for the specific crop is described taking into account long-term future outcomes | A1, A2, A6, A7, A8        |

### 3. KT0103: Integration with Existing Enterprises on the Farm

**IAC0105: The integration of the new enterprise with existing enterprises is outlined and explained with regards to labour requirement, production practices and risk distribution**

- The process of integrating a new citrus enterprise with an existing one is a complex process but can be very beneficial if well managed.
- There are several key considerations during integration, including labour requirements, production practices, and risk distribution.
- Labour requirements refer to the additional workers or changes to pre-existing workers' status that may be required during integration.
- Enterprise integration provides an opportunity to refine and optimise the workforce by promoting, hiring, reassigning, and letting workers go.
- The pre-existing workforce often has extensive experience, and merging teams of experienced workers with new workers can allow them to help with training the newer workers.
- Conversely, new workers may have new skills and information due to being educated or trained more recently and may be able to share newer techniques and knowledge with older workers.
- This two-way knowledge sharing can improve overall workplace productivity and efficiency.
- The workforce integration must be carefully managed to prevent friction and ensure that neither sets of workers feel disrespected or unheard.
- New and existing enterprises may use different cultivation methods, which need to be reviewed and harmonised.
- Combining and standardising production practices ensures consistent quality, reduces operational complexity, and simplifies decision-making.
- Citrus farming is subject to various risks, including weather events, pests, diseases, market fluctuations, and political or social changes.
- Well-managed integration allows for diversification of these risks.
- Risk mitigation strategies include crop insurance, diversifying citrus varieties, and geographically spreading orchards.
- Careful planning and risk assessment improve the long-term sustainability and resilience of the integrated enterprise.

## self-assessment

### KT0103: Integration with Existing Enterprises on the Farm

| Can I?                                                                                               | Y/N |
|------------------------------------------------------------------------------------------------------|-----|
| Can I determine the viability and value of integrating a new citrus enterprise with an existing one? |     |
| Can I describe the key infrastructural and procedural considerations during enterprise integration?  |     |

|                                                                                      |  |
|--------------------------------------------------------------------------------------|--|
| Can I explain how labour requirements and structure might change during integration? |  |
| Can I manage workforce integration to prevent friction and optimise the workforce?   |  |
| Can I combine and standardise production practices?                                  |  |
| Can I use integration to help diversify and mitigate risks?                          |  |

## 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 integration of the new enterprise with existing enterprises is outlined and explained with regards to labour requirement, production practices and risk distribution | A1, A2, B1, I7, K2        |

# KM-02-KT02: Farm Lay-Out (25%, 0.5 credits)

## topic elements

The content of this chapter covers the following topic elements:

1. KT0201: Principles
2. KT0202: Factors to consider
3. KT0203: Basic ecological principles

### 1. KT0201: Principles

#### **IAC0201: Farm lay-out is described in terms of resource requirements and optimisation thereof**

- The layout of a citrus farm is a critical factor in ensuring a productive and sustainable operation.
- Well-organised orchards, infrastructure, and work zones help to efficiently allocate workers and resources.
- The land itself is an important resource, and the size and shape of available land will significantly determine farm layout.
- Orchard layout must account for available space, tree spacing, and ease of access.
- Proper orchard layout ensures that growers achieve the desired number of trees per hectare while allowing workers and machinery to move freely.
- Tree rows should be oriented and spaced to maximise sunlight exposure for photosynthesis and fruit development.
- Microclimates are small-scale variations in climate conditions within the orchard, influenced by factors such as sunlight, wind, topography, water bodies, and surrounding vegetation.
- Areas with more sunlight tend to be warmer, while shaded areas remain cooler.
- Wind patterns create pockets of cooler or warmer air, depending on shelter from natural or artificial windbreaks.
- Topography, such as slopes and elevation differences, influences temperature variations, with higher areas usually being cooler than lower areas.
- Water bodies can increase humidity through evaporation and create cooler, more humid microclimates near them.
- Vegetation can create shade or natural wind protection, creating cooler or more sheltered microclimates.

- Efficient harvesting requires farm and orchard layout that allows easy access for harvesting crews and machinery.
- Orchard blocks and tree spacing should enable workers to reach the fruit without damaging trees or injuring themselves.
- Rows should be laid out to facilitate efficient movement of workers and equipment, reducing the time and effort required to harvest.
- Pest and disease management also influences layout, as the placement of pest monitoring stations, beneficial insect habitats, and traps must be considered.
- Separation of citrus varieties can also help to prevent the spread of diseases and pests, reducing the reliance on agrochemicals.
- Road layout is an important aspect of farm layout, as roads serve many vital purposes in farm operations.
- Properly designed roads are essential for smooth farm operations, enabling easy access for workers, vehicles, and machinery.
- Main roads connect the farm to public roads and should be wide enough for large vehicles like tractors and trucks.
- Smaller roads connect to these main roads and provide access to orchards, storage areas, packhouses, and other on-farm infrastructure.
- Inside orchards, there are numerous roads or paths that allow safe and easy movement for workers and machinery during production activities.

**IAC0202: The effect of farm lay-out on natural resources is described in terms of the impact on the protection thereof**

**IAC0203: Agricultural infrastructure planning and layout principles are explained**

- Farm layout design involves protecting and conserving natural resources, including soil, water, and biodiversity.
- Soil conservation should be a primary focus of farm layout design, and the layout should follow natural land contours and slopes.
- This alignment with natural topography prevents soil erosion and the loss of fertile topsoil, which ensures long-term productivity and reduces the costs of soil restoration.
- Water usage and waste should be managed through integrating irrigation systems and water management practices into farm layout design.
- These practices include including well-placed water sources, irrigation channels, and reservoirs.
- Drainage systems are also an important part of water management, as proper drainage prevents waterlogging and increased soil salinity.
- Proper water management planning can limit water usage, protect water quality, and support a healthy farm ecosystem.
- Biodiversity is a vital part of supporting pest control, soil health, and pollination, all of which are important parts of production.
- Citrus farming inherently reduces natural biodiversity, but proper layout design can assist in increasing biodiversity on the farm.

- Including natural habitats and green buffer zones, such as wetlands, grasslands, and other natural vegetation, into the layout, can positively influence biodiversity.
- These biodiversity practices support beneficial wildlife, ecosystem balance, and sustainable farming, which benefit both farm productivity and the broader ecosystem.

## self-assessment

### KT0201: Principles

| Can I?                                                                                               | Y/N |
|------------------------------------------------------------------------------------------------------|-----|
| Can I describe how the layout of a citrus farm affects productivity and sustainability?              |     |
| Can I explain how the size and shape of available land influences farm layout?                       |     |
| Can I define what microclimates are and how they form within an orchard?                             |     |
| Can I explain how environmental and climatic conditions influence microclimates?                     |     |
| Can I lay out orchards to assist with pest and disease management?                                   |     |
| Can I assist in the design of a proper road and path system for my farm?                             |     |
| Can I describe the importance of soil conservation in farm layout design?                            |     |
| Can I describe the benefits of preventing soil erosion and loss of fertile topsoil?                  |     |
| Can I explain how water usage and waste can be managed through irrigation systems and layout design? |     |
| Can I the role of water sources, irrigation channels, and reservoirs in water management?            |     |
| Can I explain why drainage systems are important to prevent waterlogging and soil salinity?          |     |
| Can I describe why biodiversity is important for pest control, soil health, and pollination?         |     |
| Can I integrate natural habitats and green buffer zones into a farm design?                          |     |

## 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  | Farm lay-out is described in terms of resource requirements and optimisation thereof                          | A1, A8, B1, B2, B3        |
| IAC0202  | The effect of farm lay-out on natural resources is described in terms of the impact on the protection thereof | A1, B1, B4, D2, L1        |
| IAC0203  | Agricultural infrastructure planning and layout principles are explained                                      | A1, A2, B1, F1, L1        |

## 2. KT0202: Factors to Consider

### IAC0204: The effect of topography on block lay-out and row direction is outlined

- Topography refers to the natural features and contours of the land.
- Topography significantly influences orchard layout and row direction.
- The topography of South African citrus farms varies widely, from flat plains to hilly terrains.
- Orchard rows should be aligned along contour lines, not up and down slopes, to prevent soil erosion, runoff, and topsoil loss.
- Aligning rows along contours also improves water drainage and assists with soil conservation.
- Orchard rows are typically planted in a north-south orientation in the Southern Hemisphere to ensure even sunlight distribution.
- This orientation helps prevent shading of trees by neighbouring rows, allowing for uniform fruit development, and ripening.
- North-facing slopes get more sun, and south-facing slopes get less sun.
- Topography influences wind patterns, and windbreaks may be needed to deal with excessive wind.
- Topography influences soil characteristics, including depth, composition, and drainage, which all affect the suitability of a particular area for planting and production.
- Trees should be laid to account for variations in soil quality and should make use of the best quality soil where possible.
- Steep slopes limit safe access for workers, vehicles and machinery and may not be suitable for roads.
- Steep slopes may require erosion control measures to prevent excessive soil erosion through production activities.
- Farm layout design should focus on balancing safety, ease of use, and soil protection.
- Topography also influences orchard microclimates, with higher elevations generally being cooler, and lower elevations generally being warmer.
- Orchard block layout should consider these microclimate variations, ensuring that frost-prone areas are protected and temperature-sensitive cultivars are planted in suitable locations.

### IAC0205: The impact of wind condition and direction on row direction and the need for protection of crop is described

- Some citrus-producing regions have strong winds, which can damage citrus crops through causing fruit drop, branch breakage, and leaf damage.
- Winds can also create microclimate variations in temperature, humidity, and evaporation rates, which can affect fruit quality and yield.
- The most common wind protection method is the use of windbreaks, which serve to intercept and diffuse the wind.
- Windbreaks in citrus orchards are generally trees planted in rows next to or in the orchard.

- These windbreak trees function to intercept and diffuse wind and create favourable orchard microclimates, thus improving tree health and productivity.
- Windbreaks should be placed to account for wind direction, tree height, and spacing.
- The tree species selected for windbreaks should be hardy, drought-tolerant, and compatible with the farm's ecosystem.
- Wind can also be managed through row direction, and it is generally recommended that rows are planted perpendicular to prevailing winds, where possible.
- This perpendicular planting reduces wind exposure to the tree canopies, reducing the pressure on trees and minimizing wind-related damage.

**IAC0206: The effect of physical soil limitations on block and row lay-out are reported**

- Physical soil characteristics such as drainage, elevation, texture, and depth affect orchard layout.
- Different soil types and their distinct properties affect citrus tree growth and health, and thus orchard design.
- Proper orchard layout helps optimise production while managing soil limitations.
- Soil drainage is a vital consideration, as poor drainage can lead to root rot, low oxygen availability to roots, and poor overall tree health.
- Aligning orchard rows to contour lines and planting blocks at higher elevations allows for better drainage away from the root zone, minimising waterlogging.
- Citrus trees prefer well-draining soils with enough depth for deep root penetration and are generally not well suited for shallow or rocky soils.
- In shallow or rocky soils, trees may be planted closer together to maximize root access to available soil.
- Alternative rootstocks with improved soil tolerance may also be able to overcome soil limitations.
- Soil improvement techniques such as ridging can also help to create a suitable root zone for citrus trees in challenging soil conditions.
- Soil testing is an integral part of orchard planning, as it allows precise assessment of soil properties and nutrient levels, which allows for informed layout design.

**IAC0207: Free standing systems are compared to trellised systems in order to determine the impact on farm lay-out**

- Free-standing tree systems refer to citrus trees that are not physically supported by trellises or structures.
- Free-standing trees grow naturally and require more space between trees for canopy growth.
- These extra space requirements lead to more spacious orchard layouts, and more land may be required for the same tree density.
- Free-standing systems can make production activities such as harvesting, pruning, and pest management more challenging due to larger canopies and irregular spacing.
- Trellised tree systems refer to citrus trees that are grown using support structures (trellises or wire frames) to guide tree growth.

- Trellised systems allow for closer tree spacing, increasing tree density, and maximising land use.
- Trellised systems also allow for more uniform and orderly orchard layout.
- The uniform layout allows for easier management due to controlled canopy growth and consistent spacing between trees.
- The uniform layout also allows for easier movement throughout the orchard for vehicles, machinery, and workers.
- The uniform layout also makes production activities such as pruning, harvesting, and pest management more straightforward.

**IAC0208: Specific requirements regarding production under protection (i.e. hail netting) is discussed**

- Hail can heavily damage trees, fruit, and equipment.
- In some areas, particularly those prone to hailstorms, it may be necessary to grow citrus under protective structures such as hail netting.
- This protection preserves crop yield, prevents equipment damage, and ensures long-term tree health.
- When planning hail netting, the netting must be spaced to cover the entire orchard.
- Netting should be designed to create proper spacing for airflow and sunlight penetration, and to avoid overcrowding or shading the trees.
- Netting requires proper support, and this support must be made of sturdy materials (e.g., steel posts or frames) to withstand hail and bad weather.
- Support structures must be securely anchored and evenly spaced to provide optimal support.
- Netting must be designed so that water from rain or melted hail does not collect on the netting, which could cause damage to the netting or the trees.
- The netting should integrate sloped surfaces or gutters to ensure water drainage.
- Netting and other protection must be regularly inspected and maintained.
- Netting should be designed with clear access points and pathways for repair personnel to access all parts of the structures easily and safely.

**IAC0209: Provision for sufficient cross pollination by the correct lay-out of the orchard is explained**

- Citrus trees have flowers that contain pollen, a powdery substance that plays a pivotal role in fruit formation.
- Citrus flowers contain both male and female parts, and for fruit formation to occur, pollen must travel from the male to the female part.
- Pollinators are animals (usually insects) that facilitate this transfer of pollen between flowers as they search for nectar, facilitating fertilization and fruit formation.
- Cross pollination refers to pollination between two flowers on different trees of the same species.

- Most citrus trees are self-pollinating, meaning that pollination can occur without animal pollinators, but pollination through animal pollinators leads to significantly higher fruit set and yield.
- Cross pollination can be encouraged through planting compatible varieties of citrus with matching bloom times and flowering habits.
- Setting up beehives or maintaining natural insect biodiversity on the farm and within the orchard can also promote cross pollination.
- Scouts should regularly monitor pollinator activity and fruit set to assess the effectiveness of cross pollination efforts.
- Orchard layout can also affect pollinator populations and activity.
- Orienting orchard rows north-south, adequately spacing trees, and planting windbreaks allow for pollinators to move easily and establish habitats.

## self-assessment

### KT0202: Factors to Consider

| Can I?                                                                                                                                                           | Y/N |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| Can I describe how topography influences orchard layout and microclimates?                                                                                       |     |
| Can I align orchard rows along contour lines?                                                                                                                    |     |
| Can I align orchard rows to increase sunlight exposure?                                                                                                          |     |
| Can I describe how poorly planned orchard layout can present challenges to production?                                                                           |     |
| Can I select and implement appropriate windbreaks in orchards to protect trees?                                                                                  |     |
| Can I explain how soil properties influence orchard layout in terms of tree spacing?                                                                             |     |
| Can I plan and perform soil improvement techniques and soil testing during orchard planning?                                                                     |     |
| Can I explain the differences between free-standing and trellised tree systems, and how they affect production planning and practices?                           |     |
| Can I explain the threat of hail to citrus trees, and implement protective structures like hail netting where needed?                                            |     |
| Can I describe the process of pollination in citrus fruit formation, including the function of male and female flower parts, pollinators, and cross-pollination? |     |
| Can I explain how orchard layout can support pollinator activity?                                                                                                |     |

## 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) |
|----------|-------------------------------------------------------------------------|---------------------------|
| IAC0204  | The effect of topography on block lay-out and row direction is outlined | A1, A8, B1, B2, B3        |

|         |                                                                                                              |                    |
|---------|--------------------------------------------------------------------------------------------------------------|--------------------|
| IAC0205 | The impact of wind condition and direction on row direction and the need for protection of crop is described | A1, B1, B2, B7     |
| IAC0206 | The effect of physical soil limitations on block and row lay-out are reported                                | A1, A8, B1, B2, B3 |
| IAC0207 | Free standing systems are compared to trellised systems in order to determine the impact on farm lay-out     | B6, B7, C1, C2, D2 |
| IAC0208 | Specific requirements regarding production under protection (i.e. hail netting) is discussed                 | B1, B7, D2         |
| IAC0209 | Provision for sufficient cross pollination by the correct lay-out of the orchard is explained                | A1, A5, B1, B2     |

### 3. KT0203: Basic Ecological Principles

**IAC0210: The importance of minimising the impact of farming on the natural environment is discussed in terms of the positive and negative long- and short term effects on both the farm and the natural environment**

- Natural resource management is a vital part of farm layout design.
- Orchard layout should align with natural land contours and slopes to reduce erosion and topsoil loss.
- These practices maintain land productivity and reduce the need for costly soil restoration practices.
- Farm layout affects water usage, requiring strategic placement of water sources, channels, and reservoirs.
- Biodiversity refers to the variety of living organisms, including plants, animals, and microorganisms within and around farms.
- Biodiversity is vital for ecosystems, as it promotes vital processes such as natural pest control, soil health improvement, and pollination support.
- Biodiversity must be conserved through including suitable habitats like wetlands, grasslands, and buffer zones in the farm layout.
- Farm layouts should integrate environmental conservation to support sustainable farming.

**IAC0211: The importance of waste management is explained in terms of its impact on the surrounding environment as well as the farm**

- Waste management is an important part of citrus production, as proper waste management protects the environment and supports sustainable farming.
- Waste materials produced during citrus production include rejected fruit, plant materials, agrochemical containers, and packaging.
- Poor waste management can harm the land, water, and air in and around the farm, negatively affecting production in the long term.
- Poor waste management can also create breeding grounds for pests and diseases in piles of leftover waste, which can lead to crop damage, reduced yield, and increased IPM costs.
- Waste management practices include composting, recycling, proper disposal, and reducing the production of waste.
- Composting is the process of collecting organic waste and allowing it to decompose naturally in a dedicated composting area.
- The result of the decomposition is compost, a nutrient-rich substance which can be used as a fertiliser to enrich soil.
- Composting reduces the need for chemical fertilisers and supports organic farming.
- Recycling is the process of taking certain waste materials (such as plastic) and re-processing them to create new products of the same type.
- Recyclable materials must be separated by type of material and sent to recycling facilities.
- Recycling reduces landfill waste, conserves resources, and minimises pollution.
- Some materials (like agrochemical containers) require special cleaning before recycling or cannot be recycled.

- If growers are unsure how to properly recycle certain waste, the manufacturer should be contacted for information.
- Disposal is necessary for some waste (such as hazardous waste) that cannot be composted, recycled, or otherwise reused.
- Hazardous waste (e.g., batteries, expired chemicals, medical waste, etc.) must be disposed of according to safety regulations and legislation.
- Some of this hazardous waste may require the services of specialised disposal or waste management companies.
- Waste prevention and reduction practices involve minimising waste production, through practices like reducing the over-purchasing of stock.
- Many production practices tie into waste reduction, such as implementing proper IPM to avoid producing waste fruit that cannot be sold due to disease issues.
- Waste reduction practices are usually the most cost-effective waste management practices, as they focus on reduce unnecessary spending, both before and after the waste is created.
- Local communities should also be involved in waste management and recycling initiatives, especially if there is already waste management infrastructure available in those areas.
- This collaboration fosters good community relations, as well as improving waste management practices overall.

**IAC0212: The principles of water management is outlined and discussed to isolate factors that impact water quality and availability taking care to consider both downstream impacts and the long term effects of correct and incorrect water management**

- Water is a vital part of citrus farming, being used for irrigation, cleaning equipment, mixing agrochemicals, and packhouse washing systems.
- Water management is crucial due to the limited availability of water, and its importance in farming.
- The quality of the water from water sources can be influenced by several factors, including source type, geological conditions, contamination, treatment and storage, and environmental factors.
- Types of water sources for citrus production include boreholes, rivers, dams, and municipal supplies.
- These types of sources vary in water quality, water availability, cost of use or maintenance, and ease of access, meaning that they each have advantages and disadvantages.
- It may be advisable, particularly in a large farm, to use a mix and match of multiple sources.
- The use of multiple water sources allows for risk management in terms of events that limit water availability at one particular source or type of source.
- If growers choose to use multiple sources, the farmer must ensure that the quality of the water remains as consistent as possible.
- If water quality varies too much, especially in terms of pH or mineral content, water management can become much more difficult and more costly.

- Inconsistent water quality can also negatively affect trees during the transition between two different sources.
- The geology of the region the source is located in can affect both water quality and availability.
- The presence of minerals in the soil or bedrock near a water source can lead to water hardness or other issues.
- Certain types of soil can introduce contaminants into surface water sources such as rivers.
- When establishing a new enterprise and selecting an appropriate water source, it may be necessary to perform a geological survey to prevent these issues.
- Water source contaminants come in many forms, including sediment, microbial contaminants, agricultural runoff, industrial pollution, or human waste.
- Contaminants in water sources can pose significant threats to citrus trees, causing disease, affecting fruit quality, and harming the environment.
- Trees should be regularly monitored for symptoms of contamination, such as leaf discoloration or fruit deformation.
- Agricultural runoff generally comes from agrochemicals leaching into water sources when not carefully applied.
- Microbial contaminants negatively affect water quality and pose health risks to crops if not properly treated.
- Surface water sources like rivers, ponds, and dams, particularly standing ones, are particularly susceptible to microbial contaminants such as bacteria and algae.
- Sediment is physical material, such as soil, that ends up in and settles on the bottom of water source.
- Erosion from improperly managed farming activities or natural processes such as wind erosion can introduce sediment into water sources.
- Sediment, when not properly treated for (usually by filtration), can reduce water clarity and quality, impacting irrigation systems and clogging filters.
- In the worst-case scenarios, a heavy sediment buildup in an irrigation system may require the dismantling and replacement of sections of the system, which can be very costly and disruptive.
- Depending on the source, water may require treatment to improve its quality.
- Water treatment processes include filtration, chlorination, and other physical or chemical purification methods to remove contaminants.
- The design and maintenance of water storage facilities, such as dams and reservoirs, directly influences water quality.
- Proper construction and management of storage facilities can help to reduce sedimentation and contamination.
- Water quality must be regularly monitored, and factors such as pH, salinity, nutrient levels, and microbial contaminants must be regularly tested.
- Implementing IPM strategies reduces the reliance on chemical pesticides, which helps to protect water quality by limiting runoff.
- Proper handling and storage of agrochemicals is vital for preventing accidental leaks or spills that could contaminate water sources.

- Environmental factors have a significant impact on water quality, as heavy rains can cause runoff and introduce contaminants into water sources, while droughts can concentrate impurities in water due to reduced flow.
- Local weather and climate patterns should be monitored to anticipate changes and adjust water management practices accordingly.
- On-farm water management has impacts further downstream, influencing neighbouring farms and nearby ecosystems such as rivers and wetlands.
- Inefficient water use or excessive runoff can reduce water availability for others and harm ecosystems.
- Runoff can be minimised to protect water bodies by designing farm layouts with buffers and vegetation strips to filter soil and chemicals, and by implementing efficient irrigation systems that reduce waste.
- Water management should be collaborative, and farmers should work with neighbouring farms and local municipalities to manage water on a regional level.
- Collaborative approaches to water management include sharing information about water usage, coordinating irrigation schedules, and participating in community initiatives to protect water sources.
- Water management on farms is subject to several regulations and pieces of legislation, particularly the National Water Act of 1998, which governs access to and use of water.
- To comply with this legislation, farmers must obtain the necessary permits and licenses, including registering their water use with the Department of Water Affairs.
- Compliance with these requirements is essential to avoid fines and legal consequences while ensuring sustainable water use.
- Beyond legal compliance, farmers are encouraged to adopt voluntary best practices such as using water-efficient irrigation systems, irrigating during off-peak hours to reduce stress on water supplies, and maintaining equipment regularly to prevent water loss.
- Keeping accurate records of water use, including volumes and irrigation schedules, is vital for demonstrating regulatory compliance and for assessing water use efficiency on the farm.
- Reporting water usage to the Department of Water Affairs is a legal requirement, and this data supports government monitoring of national water resources and informs decisions about allocation and long-term management.

**IAC0213: The impact of production practices on natural resources are outlined to illustrate methods for minimising the negative impact**

- The layout of a farm affects the farmer's ability to protect and conserve natural resources through soil conservation, water management, and biodiversity conservation.
- Soil conservation should be a primary consideration in farm layout design.
- The farm layout should follow the natural contours and slopes of the land to align planting patterns, roads, and infrastructure with these features.
- Aligning infrastructure with natural land contours helps minimise soil erosion.
- Incorporating efficient irrigation systems, strategically placed reservoirs, and well-designed irrigation channels can help to optimise water usage and minimise waste.

- Properly designed drainage systems are essential to prevent waterlogging and increased soil salinity.
- Biodiversity within and around farms supports ecological processes such as natural pest control, soil improvement, and pollination.
- Farm layouts should reintroduce biodiversity through the inclusion of buffer zones and natural habitats.
- The layout should incorporate habitats for wildlife species such as wetlands, grasslands, and natural vegetation areas.
- By supporting biodiversity through thoughtful layout design, farmers can help to maintain a balanced ecosystem, which strengthens long-term farm sustainability and resilience.

## self-assessment

### KT0203: Basic Ecological Principles

| Can I?                                                                                                                | Y/N |
|-----------------------------------------------------------------------------------------------------------------------|-----|
| Can I explain how natural resource management relates to farm layout design?                                          |     |
| Can I describe how aligning orchards with land contours and slopes aids in soil conservation?                         |     |
| Can I explain how farm layout affects water management?                                                               |     |
| Can I define and explain the importance of biodiversity?                                                              |     |
| Can I lay out a farm to conserve biodiversity?                                                                        |     |
| Can I relate environmental conservation and sustainable farming to farm layout?                                       |     |
| Can I explain the importance of proper waste management in citrus production?                                         |     |
| Can I list and manage the types of waste produced on citrus farms and their potential environmental impacts?          |     |
| Can I describe and implement waste management practices such as composting, recycling, disposal, and waste reduction? |     |
| Can I describe and manage the factors that influence water quality?                                                   |     |
| Can I evaluate various water sources for suitability for citrus production?                                           |     |
| Can I implement strategies to monitor and improve water quality?                                                      |     |
| Can I describe the legal framework for water management?                                                              |     |

## 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) |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|
| IAC0210  | The importance of minimising the impact of farming on the natural environment is discussed in terms of the positive and negative long- and short term effects on both the farm and the natural environment | A1, B1, B2, L1            |

|         |                                                                                                                                                                                                                                                |                    |
|---------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| IAC0211 | The importance of waste management is explained in terms of its impact on the surrounding environment as well as the farm                                                                                                                      | A6, H1, J1, J2, L1 |
| IAC0212 | The principles of water management is outlined and discussed to isolate factors that impact water quality and availability taking care to consider both downstream impacts and the long term effects of correct and incorrect water management | A6, D2, D3, E1, L1 |
| IAC0213 | The impact of production practices on natural resources are outlined to illustrate methods for minimising the negative impact                                                                                                                  | A1, B1, B2, L1     |

# KM-02-KT03:

## Block Establishment

### (25%, 0.5 credits)

### topic elements

The content of this chapter covers the following topic elements:

1. KT0301: Soil preparation
2. KT0302: Crop system installation

#### 1. KT0301: Soil Preparation

**IAC0301: The difference between a chemical and physical soil survey as well as the need for both is explained**

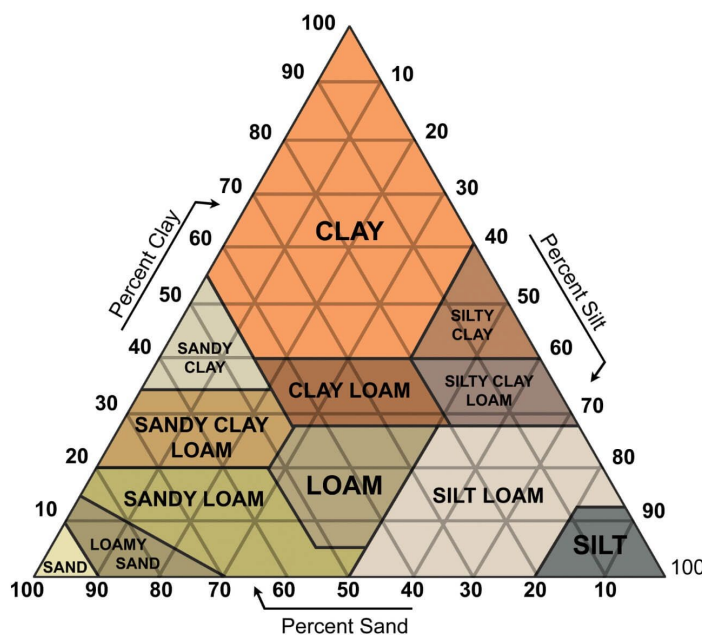
**IAC0302: The need for and timing of a soil survey (chemical and physical) is described**

- Soil surveys involve analysing the soil in a specific area to understand the soil's unique characteristics and are a vital aspect of establishing new orchard blocks.
- Soil surveys are usually conducted before planting to assess soil readiness and identify any preparation required, ensuring optimal conditions for orchard establishment.
- Soil surveys provide important information about soil composition, nutrient levels, and physical properties.
- This information informs decisions on crop selection, irrigation practices, and fertilisation methods.
- There are two main types of soil surveys, namely chemical surveys and physical surveys.
- A chemical soil survey analyses the soil's chemical composition, including essential nutrients, minerals, and any potentially harmful elements such as excessive salts or toxic compounds.
- A physical soil survey analyses the soil's physical composition, including texture, structure, and moisture-holding capacity.
- Soil texture describes whether the soil is sandy, loamy, or clayey.
- Soil texture influences drainage and nutrient retention.
- Soil structure affects aeration and root development.
- Both chemical and physical surveys are necessary because they provide different types of information, all of which is needed to fully understand the soil.
- Chemical surveys guide fertilisation practices, while physical surveys guide irrigation and planting practices.
- Soil surveys must be conducted well in advance, during orchard planning, to ensure that any necessary land preparation is completed as early as possible.

- Chemical surveys should be performed at least one year before planting to give farmers enough time to correct soil pH, improve nutrient content, or perform other necessary soil amendments or adjustments.
- Physical surveys should be performed several months before planting to give farmers enough time to perform necessary soil preparations such as ridging, drainage improvement, and erosion control.

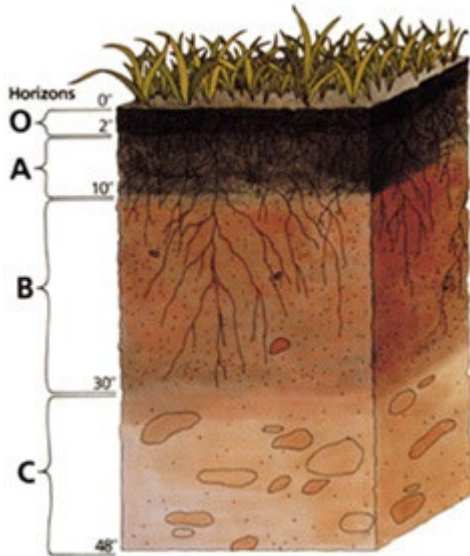
**IAC0303: The process of making a profile hole is outlined and the data which can be obtained is listed**

- Profile holes are pits or trenches dug into the ground that allow farmers to examine soil properties at various depths.
- Profile holes are essential tools in both chemical and physical surveys, as they allow farmers to study soil layers and their properties at different depths.
- Profile holes provide data on the soil texture, soil horizons, root depth, compaction, and drainage of the soil.
- The depth and number of profile holes needed will depend on the scale of the citrus farm and the level of detail required.
- Soil texture refers to the relative proportions of three primary soil particles, namely sand, silt, and clay particles.



- Texture affects the soil's physical properties, water-holding capacity, drainage, aeration, and suitability for farming.
- Soil textures are often classified into various categories, such as sandy loam, silty clay, or clay loam, depending on the predominant particle type present.
- Sand particles are the largest among the three types and feel gritty when rubbed between fingers.
- Sandy soils have larger pore spaces between particles, which allows for good drainage but may result in lower water and nutrient retention.
- Silt particles are smaller than sand but larger than clay particles and feel smooth and powdery when dry and slippery when wet.

- Silty soils have moderate water-holding capacity and moderate drainage.
- Clay particles are the smallest and finest of the three particles and feel sticky, forming a dense, compacted structure when wet.
- Clayey soils have high water-holding capacity but may drain poorly.
- Beyond the surface layer, soil has multiple layers, also called horizons.
- Each of these horizons have distinct physical, chemical, and biological characteristics that influence water retention, root development, and nutrient availability.
- Different types of soil have varying amounts and types of horizons; however, most soils have three major horizons (A, B, C) and some have an organic horizon (O).



- The O horizon (AKA organic or humus) is mostly organic matter, such as decomposing leaves.
- The O horizon is thin in some soils, thick in others, and not present at all in others.
- The A horizon (AKA topsoil) is mostly minerals from the parent material with organic matter incorporated.
- The A horizon is a good medium for trees and other organisms to live and grow in.
- The B horizon (AKA subsoil) is rich in minerals that leached (moved down) from the higher horizons and accumulated there.
- The C horizon (AKA parent material) is the geologic material (such as bedrock) from which soil horizons form.
- Root depth refers to the depth within the soil profile at which trees' roots typically extend and grow.
- The root depth of different trees and varieties can vary depending on factors such as soil type, cultivar, and environmental conditions.
- Root depth must be assessed when planning planting, as insufficient root depth might make planting unfeasible.
- Soil compaction is a condition which occurs when soil particles are pressed together, reducing pore space between them.
- Compaction results in increased soil density, reduced soil porosity, and limited air and water movement within the soil profile.

- These factors can adversely affect root growth, water infiltration, and overall soil health.
- When performing a survey, assessing soil compaction involves evaluating the soil's bulk density, penetration resistance, and visual characteristics.
- Soil compaction maps can be created to identify areas with compaction issues.
- Soil drainage is a natural process by which water moves through soil because of the force of gravity.
- Proper drainage is a crucial factor in agriculture as it directly impacts soil moisture levels, root health, and overall crop productivity.
- Adequate drainage is essential to prevent waterlogging, which can have detrimental effects on citrus trees.
- Drainage is closely linked to compaction, as a more compacted soil will have worse drainage.
- Drainage is also influenced by factors such as soil texture, water table depth, and the topography of the orchard.
- To dig a profile hole, workers will require a shovel, a tape measure, a marker or flagging tape, plastic bags or containers, and a notebook and pen.
- The procedure of digging a profile hole is as follows:
  1. Select a location.
  2. Clear the area.
  3. Measure depth.
  4. Dig the hole.
  5. Document soil horizons.
  6. Measure soil characteristics.
  7. Take soil samples.
  8. Mark the profile hole.
  9. Refill the hole.
  10. Clean up.
  11. Record data.

**IAC0304: The practical application of physical and chemical corrective measures such as mechanical soil preparation, pre-planting soil amelioration to improve fertility and soil conditions and methods of pre-planting fertiliser application during soil preparation based on analysis results is discussed**

- Soil surveys may reveal that the soil selected for planting is not totally suitable, requiring the use of corrective measures to improve its condition.
- Corrective measures are actions designed to address soil issues and are divided into physical and chemical corrective measures.
- Physical corrective measures generally involve physical or mechanical actions.
- Physical corrective measures address issues including texture, compaction, drainage, and other physical soil qualities.

- Physical corrective measures include subsoiling, grading, ridging, and the removal of debris.
- Subsoiling involves using specialised equipment to break compacted soil layers beneath the surface, improving aeration, water infiltration, and root penetration.
- Grading, ridging, and levelling involve using machinery to rearrange the soil into different "shapes", be they ridges or a flat level, ensuring uniform drainage and irrigation.
- Removing debris such as rocks or roots from the soil creates a clean planting surface and ensures tree roots can grow freely without obstruction.
- Chemical corrective measures generally involve the application of agrochemicals.
- Chemical corrective measures address issues including nutrient deficiencies and pH imbalances.
- If the soil pH is outside of the ideal range for citrus trees (between 6.0 and 7.0), the pH will need to be adjusted.
- If soils are too acidic (pH below 6.0), agricultural lime is usually applied to raise the pH.
- If soils are too basic (alkaline) (pH above 7.0), sulphur is usually applied to lower the pH.
- A nutrient imbalance can be corrected by applying fertilisers or specialised supplements that contain the specific nutrients which are deficient or excessive.
- Fertilisers can be either granular or liquid, and are applied uniformly across the planting area, before being incorporated into the soil during final land preparation to ensure even distribution.
- After applying any corrective measures, follow-up soil surveys are essential.
- These follow-up surveys are used to determine the effectiveness of corrective measures and the need for follow-up measures or changes to the soil preparation plans.

**IAC0305: The importance of soil conservation is explained**

**IAC0306: The basic principles of soil conservation and the application thereof are discussed**

- Soil conservation is a set of practices designed to preserve and improve soil resources.
- Soil conservation is vital for preserving soil fertility, particularly the nutrient-rich topsoil that is essential for healthy citrus tree growth.
- By preventing erosion and nutrient loss, farmers can ensure soil remains fertile and able to support healthy growth.
- Soil conservation reduces the need for soil amendments, fertilisers, and erosion control measures, saving farmers significant time, effort and money in the future.
- Well-managed soils are more resilient to the effects of climate change, including extreme weather events such as heavy rains and droughts, thereby reducing crop losses.
- Soil conservation focuses on four main areas, namely erosion control, compaction mitigation, crop rotation, and minimising soil disturbance.
- Erosion by wind or water removes the nutrient-rich topsoil essential for tree growth, and severe erosion can threaten infrastructure by undermining the land it is built on.
- Erosion can be controlled or prevented through practices such as contour farming, terracing, and planting cover crops.

- These practices slow water runoff and reduce wind impact, thus preserving topsoil.
- Soil compaction is often caused by heavy machinery or excessive orchard traffic and can limit root development and reduce water infiltration.
- Compaction can be prevented limiting vehicle access to designated areas, using equipment with wide tyres to distribute weight more evenly, and implementing controlled traffic systems.
- Traditional crop rotation (i.e., Replanting different crops every few seasons) cannot be performed on citrus, since citrus trees remain in one orchard for years, if not decades.
- Crop rotation can still be implemented through planting cover crops or interspersing citrus trees with other plants to maintain soil health and biodiversity.
- Excessive soil disturbance disrupts natural soil structure and increases erosion.
- Adopting minimum tillage or no-till practices during orchard establishment help to maintain healthy soil structure and avoid soil disturbance.

## self-assessment

### KT0301: Soil Preparation

| Can I?                                                                                                  | Y/N |
|---------------------------------------------------------------------------------------------------------|-----|
| Can I describe the process, importance, and timing of soil surveys?                                     |     |
| Can I utilise soil survey data to plan production practices?                                            |     |
| Can I identify the difference between the two types of soil surveys?                                    |     |
| Can I define soil texture and describe its influence on production practices and tree growth?           |     |
| Can I define soil structure and explain describe its influence on production practices and tree growth? |     |
| Can I dig and collect data from profile holes?                                                          |     |
| Can I define root depth and explain its relevance in planning production processes?                     |     |
| Can I define and address soil compaction?                                                               |     |
| Can I describe and implement physical corrective measures to improve soil?                              |     |
| Can I describe and implement chemical corrective measures to improve soil?                              |     |
| Can I implement follow-up soil surveys after applying corrective measures?                              |     |
| Can I explain soil conservation and its importance in citrus farming?                                   |     |
| Can I implement soil conservation practices?                                                            |     |
| Can I explain the process of erosion?                                                                   |     |
| Can I implement erosion prevention practices?                                                           |     |
| Can I describe how crop rotation can be adapted in citrus orchards?                                     |     |
| Can I explain the effects of excessive soil disturbance on structure, fertility, and erosion?           |     |
| Can I describe how minimum tillage or no-till practices help maintain healthy soil structure?           |     |

## work scenario reference

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

| <b>IAC Code</b> | <b>IAC Title</b>                                                                                                                                                                                                                                                                                      | <b>Relevant Work Scenario(s)</b> |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|
| IAC0301         | The difference between a chemical and physical soil survey as well as the need for both is explained                                                                                                                                                                                                  | A1, A3, B1, B2, B3               |
| IAC0302         | The need for and timing of a soil survey (chemical and physical) is described                                                                                                                                                                                                                         | A1, A3, B1, B2, B3               |
| IAC0303         | The process of making a profile hole is outlined and the data which can be obtained is listed                                                                                                                                                                                                         | A1, A3, B1, B2, B3               |
| IAC0304         | The practical application of physical and chemical corrective measures such as mechanical soil preparation, pre-planting soil amelioration to improve fertility and soil conditions and methods of pre-planting fertiliser application during soil preparation based on analysis results is discussed | A1, B1, B3, B6                   |
| IAC0305         | The importance of soil conservation is explained                                                                                                                                                                                                                                                      | B1, B3, L1                       |
| IAC0306         | The basic principles of soil conservation and the application thereof are discussed                                                                                                                                                                                                                   | B1, B3, L1                       |

## 2. KT0302: Crop System Installation

### **IAC0307: The purpose of vine plant or fruit tree development systems applicable to a given crop is explained**

- Tree development systems, such as trellises, stakes, or other frameworks, are primarily used during the early growth stages of citrus trees to guide their development.
- Development systems train and shape young trees, helping them develop a balanced and sturdy framework that allows for efficient nutrient distribution, optimal sunlight exposure, and adequate airflow within the canopy.
- Development systems also provide protection against environmental issues such as strong winds or heavy rainfall by providing stability, thus preventing structural damage.
- Development systems reduce the risk of fruit touching the ground, though skirting should already be implemented to prevent this issue.

### **IAC0308: The correct installation of vine plant or fruit tree systems described**

- The procedure of installing a development system is as follows:
  1. Determine the system type.
  2. Measure and mark.
  3. Prepare anchor points.
  4. Plant the trees.
  5. Secure the trees.
  6. Adjust for growth.
  7. Prune and train the trees.
  8. Monitor and maintain the system.
  9. Manage pests and diseases.
  10. Adapt to environmental conditions.

### **IAC0309: An irrigation plan and diagram is interpreted**

- The procedure of interpreting an irrigation plan is as follows:
  1. Locate the water source(s) on the plan and determine their capacity and flow rate.
  2. Trace the main distribution lines, branches, and sub-main lines from the water source or the main irrigation building to the orchard.
  3. Identify the types, spacing, and layout of irrigation components used in the system.
  4. Note the positions, number, types, and control mechanisms of control valves on the plan.
  5. Note any timing and scheduling information that may be included on the plan.
  6. Assess the water application rates required for the different trees and parts of the orchard.
  7. Locate the filters within the irrigation system, and, if included, note the maintenance schedule for cleaning or replacing filters.

8. Locate any safety measures related to the irrigation system, especially if there are electrical components or machinery involved.
9. If any unfamiliar terms or components are found on the plan, seek guidance from irrigation specialists, manufacturers, or experienced colleagues.

### **IAC0310: The importance of correct installation of an irrigation system for planting area is explained**

- Proper installation of an irrigation system is essential when establishing a new orchard block.
- Poorly designed or installed systems can lead to under- or over-irrigation.
- Under-irrigation can lead to water stress, which can stunt tree growth, reduce leaf size, and result in poor fruit development.
- Over-irrigation can lead to waterlogged soil, root rot, and nutrient leaching, which can harm trees.
- A well-designed and correctly installed system provides consistent and adequate moisture to the root zone.
- This promotes strong root development, canopy growth, and high-quality fruit production.
- Efficient water management is critical, particularly in regions facing water scarcity or droughts.
- Poorly designed or installed systems can lead to water wastage through runoff and evaporation, and environmental damage through erosion.
- Well-designed or installed systems minimise water wastage, reducing operational costs and aligning with sustainability goals by conserving water resources.
- Poorly designed or installed systems may fail to meet the changing water needs of mature trees, leading to declining tree health, lower yields, and reduced profitability.
- In severe cases, poor irrigation can force farmers to replant or abandon orchards altogether.
- Well-designed or installed systems can adapt to changing water requirements over time, ensuring long-term productivity and profitability.

## self-assessment

### **KT0302: Crop System Installation**

| Can I?                                                                                   | Y/N |
|------------------------------------------------------------------------------------------|-----|
| Can I explain what tree development systems are and why they are used in citrus farming? |     |
| Can I install a tree development system?                                                 |     |
| Can I interpret an irrigation plan?                                                      |     |
| Can I assist in the proper installation of an irrigation system for a new orchard block? |     |
| Can I describe the consequences of a poorly designed or installed irrigation system?     |     |
| Can I explain how under-irrigation negatively affects citrus trees?                      |     |
| Can I explain how over-irrigation negatively affects citrus trees?                       |     |
| Can I explain the necessity of proper irrigation?                                        |     |

|                                                                                   |  |
|-----------------------------------------------------------------------------------|--|
| Can I implement efficient water management when facing water scarcity or drought? |  |
| Can I explain the risks of poorly installed irrigation systems?                   |  |

## 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) |
|----------|-----------------------------------------------------------------------------------------------------|---------------------------|
| IAC0307  | The purpose of vine plant or fruit tree development systems applicable to a given crop is explained | B1, B6, B7, C1, C2        |
| IAC0308  | The correct installation of vine plant or fruit tree systems described                              | B1, B6, B7, C1, C2        |
| IAC0309  | An irrigation plan and diagram is interpreted                                                       | A1, B1, B2, E1, I7        |
| IAC0310  | The importance of correct installation of an irrigation system for planting area is explained       | A1, B1, B2, E1, I7        |

# KM-02-KT04:

## Crop Establishment

### (25%, 0.5 credits)

#### topic elements

The content of this chapter covers the following topic elements:

1. KT0401: Handling and storage of plant material before planting
2. KT0402: Planting of the tree/vine
3. KT0403: Young plant care

### 1. KT0401: Handling and Storage of Plant Material before Planting

**IAC0401: The handling of plant material from the nursery to the farm is described in terms of the impact it has on eventual young plant survival**

- Safe transport from nursery to farm is vital for young trees to grow into healthy, productive trees.
- Most trees received from nurseries are grown in plastic bags in a pathogen-free medium in a controlled environment and are usually transported in these bags until planted.
- These bags should provide adequate protection for the young trees' root systems during transport.
- The transport area must not be overcrowded to avoid physical stress and damage.
- The mode of transport selected should balance speed, safety, and cost, and trucks or bakkies are usually used.
- Young citrus trees are highly sensitive to moisture levels, and if they become dehydrated during transportation, this can significantly impact their chances of survival.
- Young citrus trees must be adequately watered before transport, and the soil or growing medium they are in must remain moist throughout the journey.
- On very long journeys, moisture levels can be maintained by covering the root systems with moistened material, such as damp burlap or peat moss.
- The transition from the nursery to the farm exposes young trees to various environmental stressors, including sudden shifts in sunlight, wind, and temperature exposure.
- To protect the trees from these stresses, protective measures such as suitable covers to protect the young trees from the shock can be put in place.
- Transportation and planting schedules should be timed to align with seasonal weather patterns to avoid planting during inopportune times.
- Before initiating the transition to the orchard, citrus plants must be adequately prepared for planting.

- This preparation includes monitoring their growth and development in the nursery, ensuring that they have well-developed root systems and healthy foliage.
- Young plants must meet specific criteria of size and health to withstand the transition successfully.
- The health of young trees must be monitored during the transportation process, and any signs of stress or damage should be addressed immediately.
- Trees may need additional moisture, protection from environmental factors, or other adjustments to the transport process.
- Upon arrival at the farm, careful planting practices must be followed, including proper hole preparation, appropriate spacing, and correct planting depth.

**IAC0402: The pre-planting storage and preparation of plant material is outlined in order to optimise for a maximum yield of young plants**

- When young citrus trees arrive from the nursery, they may have experienced a stressful journey and must be handled carefully and properly prepared to ensure successful planting.
- On arrival at the farm, trees must be inspected for signs of damage, disease, or stress, while being gently handled to avoid harming their roots or branches.
- If damage or stress is found to have been caused by reckless transport, this must be reported immediately to both the transport company's representative and farm management to avoid working with the negligent providers again.
- If the damage or stress was caused by negligence at the nursery, the nursery should not be used again, and depending on the severity, a partial or full refund may be in order.
- During inspection, plants may also be sorted by size to make planting easier, although this is not necessary.
- If immediate planting is not possible, plants may need to be temporarily stored.
- The young trees should be stored in a shaded, well-ventilated area to prevent overheating and drying out, as these conditions can slow early growth.
- The young trees must remain upright, well-supported, and properly labelled to keep track of which orchard each is destined for.
- Young citrus plants must be watered as soon as they arrive at the farm and kept moist in their bags until planting to protect root health.
- Roots must never be allowed to dry out, as dry roots hinder the development of new roots and delay growth after planting.
- The root system must not be allowed to dry out, as dried out roots severely affect root development and growth after planting.
- The amount of watering required will vary based on the temperature, precipitation, and humidity on the farm.
- Before planting, the root system of each tree must be carefully inspected, and any damaged or overly long roots should be trimmed to encourage healthy branching.
- Any dead or diseased branches on the aboveground parts should be pruned to maintain plant health.
- The root system must remain intact and stable after transportation to avoid transplant shock.

- During this inspection, any signs of damage, symptoms of disease, or signs of stress must be noted.
- If any are noted, the farmer must immediately investigate what went caused the issue(s) and which worker was (or should have been) responsible for their care to find the root of the issue(s) and prevent future issues.
- Some nurseries supply bare-root citrus trees, which are grown in open ground and removed from the soil just before transport.
- Bare-root nurseries are not common, as it is easier to control the factors affecting the development of nursery trees and produce quality trees in containers.
- Extra care should be taken with bare-root trees after removal from the soil at the nursery to prevent drying out of the roots.
- To prevent drying out, bare-root trees are normally bundled in multiples of 25 or 50 just after being removed from the soil.
- After removal, bare-root trees' roots are immediately covered in an absorbent material such as hessian, which is then kept moist until planting.
- Bare-root trees must be transplanted immediately, prior to the first spring flush.
- If it is not possible to transplant bare-root trees immediately, the roots must be kept moist.
- The bare-root trees should be removed from their protective packaging and layered in a trench with the roots completely covered with soil to keep them in a moist environment.
- They should not be kept in this trench too long, otherwise feeder roots will start to form, and the trees will start to grow.
- The young trees use their carbohydrate reserves in this process, and, when eventually planted, this loss of carbohydrates will result in poor growth.

## self-assessment

### KT0401: Handling and Storage of Plant Material before Planting

| Can I?                                                                                                                                       | Y/N |
|----------------------------------------------------------------------------------------------------------------------------------------------|-----|
| Can I ensure the safe transportation of young citrus trees from nursery to farm?                                                             |     |
| Can I explain why young trees are transported in planting bags?                                                                              |     |
| Can I explain how to select a suitable mode of transport that balances speed, safety, and cost?                                              |     |
| Can I describe how to maintain proper moisture levels during transport to prevent stress?                                                    |     |
| Can I explain how environmental stressors affect young trees?                                                                                |     |
| Can I describe how transport and planting schedules should align with seasonal weather patterns?                                             |     |
| Can I explain how to prepare citrus trees for planting?                                                                                      |     |
| Can I describe and implement proper planting practices?                                                                                      |     |
| Can I explain how to inspect young trees before planting?                                                                                    |     |
| Can I describe the procedures for reporting and managing issues with other organisations involved in producing and transporting young trees? |     |

|                                                                                                                 |  |
|-----------------------------------------------------------------------------------------------------------------|--|
| Can I safely store young trees before planting?                                                                 |  |
| Can I describe how to care for bare-root trees during transport and storage?                                    |  |
| Can I implement manipulation practices such as pruning and root trimming to maintain plant health pre-planting? |  |

## 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 handling of plant material from the nursery to the farm is described in terms of the impact it has on eventual young plant survival | B5, B6, B7, D1, D2        |
| IAC0402  | The pre-planting storage and preparation of plant material is outlined in order to optimise for a maximum yield of young plants         | B5, B6, B7, D1, D2        |

## 2. KT0402: Planting of the Tree/Vine

**IAC0403: The process of making planting holes is briefly described in terms of the specifications for a given crop**

- The procedure of digging a planting hole is as follows:
  1. Locate the area for the planting hole.
  2. Calculate the needed size and depth based on the size of the roots of the young tree.
  3. In the case of bare-rooted trees, the depth of the planting hole should be the same as the depth of the roots, but the width of the hole should extend beyond the roots.
  4. Use a garden fork, not a spade, to dig the hole, as spades may compact the insides of holes, limiting root penetration.

**IAC0404: Pre-planting soil improvement such as the correction of pH and nutrient status to improve fertility and soil conditions is explained in terms of the outcome of young plant growth**

**IAC0405: The methods of pre-planting fertiliser application is discussed in terms of efficacy in a given situation**

- Soil must be assessed and the need for improvement determined before planting to ensure optimal growth and healthy yields.
- This assessment and preparation process is normally performed about three to nine months prior to planting, depending on the soil's moisture status and the type of preparation required.
- Soil in good chemical condition has the right pH, salinity, and nutrient content.
- Soil preparation is divided into physical and chemical soil preparation, and both types are aimed at optimising conditions for root development.
- Chemical soil preparation involves adjusting the pH or the nutrient levels in the soil.
- Soil surveys are used to determine the need for preparation practices.
- Citrus trees grow best in slightly acidic to neutral soil, with an ideal pH between 6 and 7.
- If the soil pH is too low (acidic) or too high (alkaline or basic), this reduces nutrient availability, which can lead to nutrient deficiencies in trees.
- Soil pH can be corrected using agrochemicals, such as agricultural lime to raise the pH, or sulphur to lower the pH.
- These are not the only options, and consultation with experts or colleagues may present better alternatives to adjust the pH.
- Pre-planting fertiliser applications are performed to correct unsuitable nutrient statuses and encourage healthy growth in young trees.
- The most commonly applied essential nutrients include nitrogen (N), phosphorus (P), and potassium (K), along with secondary and micronutrients such as calcium (Ca), magnesium (Mg), and iron (Fe).
- Note that there are several other nutrients that citrus trees require in varying quantities, the study guide on plant growth requirements contains the full list.

- Untreated nutrient deficiencies can cause many issues, including slowed growth, smaller yields, and even the death of the tree.
- If a nutrient imbalance is discovered during the soil survey, the specific nutrients that are missing must be identified.
- Once the missing nutrients are identified, a fertilisation program must be created that uses fertilisers specifically tailored to rectifying those specific deficiencies.
- Soil test results should be used to identify specific nutrient shortages and to design a fertilisation program tailored to addressing those deficiencies.
- Fertilisers are categorised into two groups, namely organic and inorganic fertilisers.
- Organic and inorganic fertilisers are differentiated by their source.
- Organic fertilisers are derived from organic matter (living things), such as decaying plants and animal waste.
- Inorganic fertilisers are synthetic (manufactured) agrochemicals mixed with minerals.
- Inorganic fertilisers are further categorised into granular (solid) and liquid fertilisers.
- Granular fertilisers are solid granules which are applied as is.
- Liquid fertilisers come as water soluble powders or liquid concentrates that are mixed with water to form a liquid fertiliser solution.
- Trees tend to absorb liquid fertilisers faster, whereas granular fertilisers need a while to break down before plants can access their nutrients.
- Fertilisers can be applied through the soil applications, foliar applications, and fertigation.
- A soil application involves applying the fertiliser directly into the soil.
- Soil applications can be performed throughout the whole orchard, only into the soil directly around the newly planted trees, or only into the soil that was used to fill the planting holes.
- Soil applications can be performed with both granular and liquid fertilisers.
- Foliar applications are performed by applying the fertiliser directly onto the trees' leaves, usually by spraying.
- Foliar applications are usually only performed with liquid fertilisers.
- Fertigation is the process of applying fertiliser by incorporating it into the water being used to irrigate the plants.
- Fertigation is usually only performed with liquid fertilisers.

**IAC0406: The correct application of mechanical soil preparation methods is described**

- Physical (AKA mechanical) soil preparation involves physically "moving" or restructuring the soil.
- Physical soil preparation practices include ploughing, grading, ridging, levelling, subsoiling, and the removal of debris.
- Ploughing is usually the first step in mechanical soil preparation and involves turning the soil over to bury weeds and crop residues, and to incorporate organic matter.
- Ploughing also breaks up compacted soil layers, enhancing root penetration and growth, increasing effective depth, and improving drainage.

- In citrus orchards, deep ploughing is typically performed, down to depths of 60–100 cm, but the ploughing depth can be adjusted based on soil conditions and the desired depth of root systems.
- Grading and levelling involve using machinery to rearrange the soil into different "shapes," such as a flat level, ensuring uniform drainage and irrigation.
- Ridging involves forming raised ridges in which the trees are planted, leaving lower valleys between the rows.
- Ridging is mainly used to increase effective soil depth in tree rows and to improve surface drainage.
- Some growers also use ridging on deeper soils to restrict machinery to inter-row areas, thereby reducing soil compaction around the trees.
- Subsoiling involves using specialised equipment to break compacted soil layers beneath the surface, improving aeration, water infiltration, and root penetration.
- Subsoiling improves water infiltration and root penetration, promoting healthier root growth.
- Subsoiling should only be performed when necessary because excessive subsoiling can disrupt soil structure.
- Removing debris such as rocks or roots from the soil creates a clean planting surface and ensures tree roots can grow freely without obstruction.
- Vehicles are often necessary for some soil preparation methods or for moving trees or equipment into the orchard pre-planting.
- Vehicle use should however be minimised wherever possible, as heavy vehicles compact the soil, defeating the purpose of physical soil preparation.
- The orchard planting areas should be accurately measured and marked before vehicles are allowed in to ensure vehicles stay on the paths that will eventually become the inter-row areas.

**IAC0407: The correct application of crop establishment methods during the planting process is explained**

- Transplanting from a nursery container to the soil causes stress and shock to young trees, so the planting environment must be made as favourable as possible to help trees recover and adapt quickly.
- Planting stress can be reduced by planting only in the mornings when conditions are cooler, and storing trees pre-planting in a cool, shaded area.
- Trees should be transported to the orchard in batches small enough to be planted within 30 minutes.
- Weather and soil conditions play a crucial role in how well the plant establishes itself after planting.
- Temperature is the most important weather factor influencing young trees, as it directly impacts soil temperature, which in turn affects water and nutrient uptake.
- The physical environment of the root system, including temperature, is more stable than the canopy environment, as it changes less rapidly and severely throughout the day or season.

- However, extreme air temperatures can still negatively affect the trees' growth and survival.
- Planting should be avoided at air temperatures above 39°C, as this can cause heat damage and stress, both of which can limit future growth and productivity.
- Planting should be avoided at air temperatures below 13°C since growth does not occur beneath this temperature.
- Planting is best carried out in the mornings and must be suspended if temperatures rise or fall beyond this range.
- Rainfall is generally beneficial during and after planting, but very heavy rain that waterlogs the soil makes planting unsuitable and can cause flooding that dislodges young trees.
- Regions suitable for commercial citrus production have soil temperatures which range between 6°C and 16°C during the winter, and between 24°C and 36°C during the summer.
- Planting should not start before the soil has warmed up sufficiently (but not excessively) after winter, as this ensures good root growth and uptake of water and nutrients.
- Soil temperatures that are too high can severely affect establishment of the tree and cause moisture stress, resulting in root shock and poor growth.
- For planting, the soil should be:
  - Moist enough to ensure that the roots do not suffer root shock, while being dry enough to prevent clods from forming when compacted around the roots.
  - Above a temperature of 20°C, but not too warm.
  - Well-drained.
  - Well prepared, up to a depth of at least 600mm.
  - At optimum pH level and nutrient status.
- Root shock is the result of transplanting a tree from a medium in which conditions for growth are optimal to another medium.
- The extent of the root shock increases if the tree is subjected to stress during transplanting.
- The more root shock can be avoided, the quicker the plant will adapt to the new growth environment.
- In most instances, root shock is caused by poor moisture conditions that cause roots to dry out during the transport and pre-planting period.
- The feeder roots dry out first and could even die in extreme cases.
- If the roots dry out, the young tree must use energy from its reserves to revitalise the root system, which leads to poor development of new roots, and less energy for growth.
- The resultant vegetative growth will be diminished and severely-affected trees can even die.
- The procedure of planting is as follows:
  1. Dig planting holes.
  2. Remove the tree from the container, shaking off about 25% of the medium to ensure root contact with the soil.

3. Spread out any knots in the roots to give the tree a larger root-zone.
4. Position the tree on top of a small pile of soil at the bottom of the planting hole.
5. Backfill the hole with soil, adding fertiliser to the soil used to backfill if needed.
6. Gently agitate the trunk to ensure that the soil moves evenly around the roots to avoid air pockets and embed the tree firmly.
7. Gently compact the soil by treading on the soil around the root-zone, ensuring that the soil is not heaped around the trunk.
8. Ensure that the base of the tree stem is slightly higher than the surrounding soil surface, so that once the tree has settled no part of the stem is below ground level.
9. Water the newly planted trees immediately and turn on the irrigation system.
10. If a permanent irrigation system is not yet operational, create a basin which can hold 30 to 40 litres of water around each tree immediately after planting.
11. Plant a stake of approximately 1.5m in length next to the tree and tie the tree to this stake with twine, leaving around 1m of the stake aboveground.
12. Fasten a stem cover around the bottom part of the stem in the appropriate manner for the type of stem cover being used.

## self-assessment

### KT0402: Planting of the Tree/Vine

| Can I?                                                                                  | Y/N |
|-----------------------------------------------------------------------------------------|-----|
| Can I dig a planting hole?                                                              |     |
| Can I assess and prepare soil before planting to ensure optimal conditions?             |     |
| Can I evaluate soil pH, salinity, structure, and nutrient content through soil surveys? |     |
| Can I perform chemical corrective activities on soil?                                   |     |
| Can I design a fertilisation program to correct nutrient deficiencies?                  |     |
| Can I apply fertilisers safely and effectively?                                         |     |
| Can I perform physical corrective activities on soil?                                   |     |
| Can I manage vehicle use in the orchard?                                                |     |
| Can I store young trees in a manner that keeps them healthy before planting?            |     |
| Can I properly irrigate and otherwise care for young trees?                             |     |
| Can I plant trees in a manner that reduces transplant shock and stress?                 |     |

## work scenario reference

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

| <b>IAC Code</b> | <b>IAC Title</b>                                                                                                                                                                   | <b>Relevant Work Scenario(s)</b> |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|
| IAC0403         | The process of making planting holes is briefly described in terms of the specifications for a given crop                                                                          | B1, B3, B5, B6                   |
| IAC0404         | Pre-planting soil improvement such as the correction of pH and nutrient status to improve fertility and soil conditions is explained in terms of the outcome of young plant growth | B1, B3, B6, F2, J1               |
| IAC0405         | The methods of pre-planting fertiliser application is discussed in terms of efficacy in a given situation                                                                          | B1, B3, B6, F2, J1               |
| IAC0406         | The correct application of mechanical soil preparation methods is described                                                                                                        | A3, B1, B3, B6, L1               |
| IAC0407         | The correct application of crop establishment methods during the planting process is explained                                                                                     | B1, B3, B5, B6, B7               |

### 3. KT0403: Young Plant Care

**IAC0408: The aftercare required by a particular crop is outlined and the effect of insufficient aftercare on plant growth is discussed**

**IAC0409: The requirements of plants immediately after planting is outlined and explained**

**IAC0410: Production practices for young plants such as irrigation, weed control, pest and disease control are discussed**

- After the planting process is complete, diligent aftercare is essential for ensuring the healthy growth and development of the trees.
- Consistent, effective irrigation is the most important part of post-planting care, as young trees are particularly vulnerable to drought stress.
- Drought stress can cause stunted growth, leaf drop, and even death.
- Proper irrigation mitigates root shock and promotes root growth.
- Over-irrigation must be avoided as it can cause waterlogging and root rot.
- Soil moisture should be regularly monitored, and irrigation should be adjusted according to weather conditions.
- Irrigation systems must be installed immediately after planting and be fully operational within the same week.
- The root area of the young trees should be irrigated at least once a week for the first four to six weeks.
- With a permanent micro-irrigation system, the starter spreaders are used to supply water to the root area.
- The root area will still be small, and the area irrigated should not be too large at first, as this can cause waterlogging outside the root area, inhibiting lateral root development.
- The starter spreaders in micro-irrigation systems should be replaced with permanent spreaders six to eight months after planting once root development has taken place.
- In drip irrigation systems, farmers must ensure that the drippers deliver the water to the root-zone only in the required quantities, with the required volume increasing as the roots grow.
- Young trees often require nutrient supplementation to begin growing properly.
- Regular fertilisation helps prevent nutrient deficiencies that could cause yellowing leaves, poor fruit development, and reduced growth.
- While excessive fertilisation right after planting should be avoided, supplying balanced essential nutrients is critical.
- Slow-release fertilisers can be applied into the planting hole or on the soil surface to boost early growth.
- Over-fertilisation must be avoided, as this can cause nutrient imbalances and harm trees just as much as under-fertilisation.
- Effective, regular monitoring, including soil testing and leaf analysis, is needed to track nutrient levels and adjust fertilisation programs to address specific deficiencies.

- Pruning and training young trees shape their structure, encourage optimal branching, and prevent overcrowded canopies that limit air circulation and light penetration, which can increase disease risk.
- At planting, the root volume of the young tree is small relative to the leaf area.
- Pruning the canopy of young trees, leaving two or three well-spaced framework branches of between 20cm to 30cm in length, helps to reduce excessive moisture loss through transpiration.
- Pruning may also be necessary right after planting to remove any dead or damaged branches.
- Pruning should however only be performed when necessary to allow young trees to focus on their growth and not healing injuries.
- More extensive pruning is typically performed in the growing seasons following planting, to allow the trees to establish themselves first.
- In windy areas, some growers remove all the framework branches by topping the trees, giving the stem time to thicken and strengthen as the new framework branches are formed.
- Topping prevents the young trees from getting uprooted or otherwise damaged by strong winds.
- Any new growth (suckers) which develops lower down on the stem, and particularly at ground level, should be removed at regular intervals.
- Suckers must never be torn off and should be removed neatly with pruning shears.
- Tearing suckers off creates injuries in the bark that could be entry points for pathogens.
- Effective, regular pest and disease monitoring must begin immediately after planting and continue throughout the entire lifespan of the trees.
- Undetected pest or disease problems can severely impact tree growth and yield, or, in the worst cases, even kill entire orchards.
- Young trees sourced from reputable, certified nurseries should be disease-free upon arrival at the farm.
- However, even these trees should not be assumed to be disease-free and should therefore be carefully monitored for any signs of disease.
- Orchard sanitation is an important part of disease prevention.
- Implementing orchard sanitation measures, such as removing unwanted plant matter, can reduce the potential breeding grounds for diseases.
- Tools and equipment such as shears used on the trees must also be sanitised between trees and rows to prevent the spread of diseases throughout the orchard.
- Integrated Pest Management (IPM) practices are highly recommended for any citrus producers.
- IPM combines biological, chemical, and cultural practices, offering sustainable pest and disease control with reduced environmental impact.
- Regular scouting and monitoring are key components of IPM.
- Growers should implement a strict, well-managed monitoring program, and scouts must be well-trained in proper monitoring practices.

- Growers should use resources from the Citrus Academy and CRI to stay updated on best practices in terms of IPM.
- If pests and diseases are detected, appropriate control measures should be taken, but only where necessary and following recommended guidelines.
- These control measures could include agrochemicals, traps, biological control (like predators) and removing diseased trees from the orchard.
- Online resources, experienced colleagues, or industry experts should be consulted before undertaking any control measures, especially when using agrochemicals on young trees.
- A weed is defined as any plant growing out of its proper place, i.e., in an area where it is not wanted or desired.
- In orchards, there will often be a variety of different plants growing, as when birds defecate in the orchard, there are often seeds of other plants in their droppings.
- Weeds compete with citrus trees for water, nutrients, and sunlight, hindering growth and reducing fruit quality while increasing vulnerability to pests and diseases.
- Weed control methods can be categorised into preventive, mechanical, biological, and chemical methods.
- Preventive methods involve controlling the spread of weeds by preventing the entry of new weeds and weed seeds into the orchards area.
- Preventive methods include purchasing weed-free nursery plants, clearing weeds from non-orchard areas of the farm, and cleaning equipment and tools thoroughly.
- Mechanical methods involve physically removing the weeds from the orchard area, and are very effective, though time and labour intensive.
- Mechanical methods include hand pulling, hoeing, tillage, mowing and smothering weeds with non-living mulches.
- Biological methods involve using organisms (known as biotic agents) such as insects, pathogens, livestock, and parasites, to kill or consume the weeds.
- Biological methods can be highly effective but must be carefully managed to avoid upsetting natural ecosystems or inadvertently killing the young trees.
- Chemical methods use agrochemicals such as herbicides to directly kill the weeds.
- Herbicides are classified into three groups depending upon their effect on the plant system, namely growth regulators, soil sterilants, and contact herbicides.
- Herbicides are generally effective, but should be used with restraint, as many modern markets prefer minimal chemical use during production, and some herbicides can damage the trees if not applied properly.
- Young citrus trees are vulnerable to various environmental stressors, including wind, sunlight, and extreme temperatures, so protection is often necessary for healthy growth.
- In areas with strong wind, wind protection such as windbreaks can protect young trees from wind damage.
- Young trees require staking to help them establish a strong root system and prevent wind damage.
- Inadequate support or wind protection can lead to tree leaning or breakage, hindering overall growth and stability.

- When staking, damaging the tree's trunk must be avoided and the stake should not be too tight, to allow for some movement, which can stimulate root growth.
- The stake ties must be loosened as the trees grow, otherwise the ties will cut into the tree or inhibit growth.
- The young trees' stems are vulnerable to sunlight and should be protected.
- Stem protectors, usually made of paper or straws, or whitewash paint (diluted PVA) can be used to protect the trees from sun damage.
- Stem protectors also inhibit the growth of suckers.
- Consistent monitoring forms part of all aspects of young tree care, as it enables farmers to detect needs and respond appropriately.
- Monitoring is ineffective without good recordkeeping which allows for long-term comparisons across seasons and years.
- Detailed records of production practices should be kept, including irrigation, fertilisation, pest and disease management, and tree growth, along with any other practices performed on young trees.
- Data should ideally be stored in an electronic database, in a well-organised, easily accessible system.
- Specialised farm management software can assist in managing and organising this data.
- Workers must be trained in the importance of capturing accurate data and recordkeeping for all production practices.

## self-assessment

### KT0403: Young Plant Care

| Can I?                                                                                      | Y/N |
|---------------------------------------------------------------------------------------------|-----|
| Can I care for young trees after planting?                                                  |     |
| Can I consistently and effectively irrigate young trees?                                    |     |
| Can I design and install effective irrigation systems?                                      |     |
| Can I supply sufficient nutrients to young trees?                                           |     |
| Can I prune young trees?                                                                    |     |
| Can I top young trees?                                                                      |     |
| Can I remove suckers?                                                                       |     |
| Can I implement IPM practices from planting onwards?                                        |     |
| Can I sanitise the orchard and production tools?                                            |     |
| Can I train scouts to effectively monitor trees?                                            |     |
| Can I control weeds?                                                                        |     |
| Can I protect young trees from environmental stressors?                                     |     |
| Can I keep accurate, detailed records of all production practices performed on young trees? |     |
| Can I capture and manage data regarding young trees?                                        |     |

## work scenario reference

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

| <b>IAC Code</b> | <b>IAC Title</b>                                                                                                              | <b>Relevant Work Scenario(s)</b> |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------|----------------------------------|
| IAC0408         | The aftercare required by a particular crop is outlined and the effect of insufficient aftercare on plant growth is discussed | B1, B6, B7, D1, D2               |
| IAC0409         | The requirements of plants immediately after planting is outlined and explained                                               | B1, B6, B7, D1, D2               |
| IAC0410         | Production practices for young plants such as irrigation, weed control, pest and disease control are discussed                | B7, D2, E1, F1, H1, H2           |