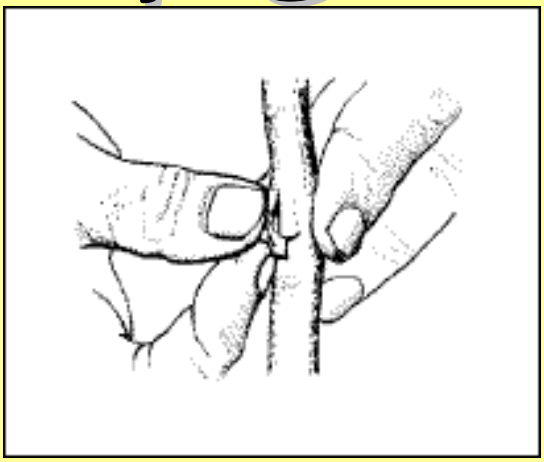
NQF Level: 2 **US No: 116119**

Learner Guide

Primary Agriculture

Plant Propagation



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Before we start...

Dear Learner - This Learner Guide contains all the information to acquire all the knowledge and skills leading to the unit standard:

Title:	Demonstrate an Understanding of Plant Propagation				
US No:	**116119**	**NQF Level:**	2	**Credits:**	3

The full unit standard will be handed to you by your facilitator. Please read the unit standard at your own time. Whilst reading the unit standard, make a note of your questions and aspects that you do not understand, and discuss it with your facilitator.

This unit standard is one of the building blocks in the qualifications listed below. Please mark the qualification you are currently doing:

Title	ID Number	NQF Level	Credits	Mark
National Certificate in Animal Production	48976	2	120	❒
National Certificate in Mixed Farming Systems	48977	2	120	❒
National Certificate in Plant Production	48975	2	120	❒

Please mark the learning program you are enrolled in:

Your facilitator should explain the above concepts to you.

Are you enrolled in a:	Y	N
Learnership?	❒	❒
Skills Program?	❒	❒
Short Course?	❒	❒

This Learner Guide contains all the information, and more, as well as the activities that you will be expected to do during the course of your study. Please keep the activities that you have completed and include it in your **Portfolio of Evidence**. Your PoE will be required during your final assessment.

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What is assessment all about?

You will be assessed during the course of your study. This is called *formative assessment*. You will also be assessed on completion of this unit standard. This is called *summative assessment*. Before your assessment, your assessor will discuss the unit standard with you.

Assessment takes place at different intervals of the learning process and includes various activities. Some activities will be done before the commencement of the program whilst others will be done during programme delivery and other after completion of the program.

The assessment experience should be user friendly, transparent and fair. Should you feel that you have been treated unfairly, you have the right to appeal. Please ask your facilitator about the appeals process and make your own notes.

How to use the activity sheets...

Your activities must be handed in from time to time on request of the facilitator for the following purposes:

- The activities that follow are designed to help you gain the skills, knowledge and attitudes that you need in order to become competent in this learning module.
- It is important that you complete all the activities and worksheets, as directed in the learner guide and at the time indicated by the facilitator.
- It is important that you ask questions and participate as much as possible in order to play an active roll in reaching competence.
- When you have completed all the activities and worksheets, hand this workbook in to the assessor who will mark it and guide you in areas where additional learning might be required.
- You should not move on to the next step in the assessment process until this step is completed, marked and you have received feedback from the assessor.
- Sources of information to complete these activities should be identified by your facilitator.
- **Please note** that all completed activities, tasks and other items on which you were assessed must be kept in good order as it becomes part of your **Portfolio of Evidence** for final assessment.

Enjoy this learning experience!

How to use this guide ...

Throughout this guide, you will come across certain re-occurring "boxes". These boxes each represent a certain aspect of the learning process, containing information, which would help you with the identification and understanding of these aspects. The following is a list of these boxes and what they represent:

What does it mean? Each learning field is characterized by unique terms and **definitions** – it is important to know and use these terms and definitions correctly. These terms and definitions are highlighted throughout the guide in this manner.

You will be requested to complete **activities**, which could be group activities, or individual activities. Please remember to complete the activities, as the facilitator will assess it and these will become part of your portfolio of evidence. Activities, whether group or individual activities, will be described in this box.

Examples of certain concepts or principles to help you contextualise them easier, will be shown in this box.

The following box indicates a **summary** of concepts that we have covered, and offers you an opportunity to ask questions to your facilitator if you are still feeling unsure of the concepts listed.

My Notes ...

You can use this box to jot down questions you might have, words that you do not understand, instructions given by the facilitator or explanations given by the facilitator or any other remarks that will help you to understand the work better.

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What are we going to learn?

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What will I be able to do?

At the end of this learning module, you will be able to:

- Propagate plants.
- Gain specific knowledge and skills in plant propagation and will be able to operate in a plant production environment implementing sustainable and economically viable production principles.

Learning Outcomes

At the end of this learning module, you must is able to demonstrate a basic knowledge and understanding of:

- Basic safety requirements related to the propagation environment and procedures.
- Basic hygiene requirements for the propagation environments.
- Growing media - wet and dry.
- Weeds, pest and diseases.
- Nomenclature related to all aspects of plant propagation.
- Sensory cues related to the various aspects of plant propagation
- The purpose of learning about plant propagation.
- All procedures, legislation, rules and codes of conduct pertaining to plant propagation.
- All procedures related to the propagation of plants.

What do I need to know?

It is assumed that a learner attempting this unit standard will show competence against the following unit standards or equivalent:

- NQF4; Literacy and Numeracy
- *NQF Level* 1; 116205; Propagate plants
- *NQF Level* 1; 116156; Collect agricultural data
- *NQF Level* 2; 116053; Understand basic soil fertility and plant nutrition
- *NQF Level* 2; 116060; Utilise and perform minor repair and maintenance tasks on implements, equipment and infrastructure

Session 1

Environmental Requirements for Propagation

After completing this session, you should be able to:
SO 1: Recognize the environmental requirements for propagation in a specific agricultural production context.

In this session we explore the following concepts:

- Environmental requirements for propagation

1.1 Introduction

Propagation
Plant propagation refers to the multiplication of plant material of a specific cultivar, variety, breeding line or strain that possesses desirable characteristics, (such as fruit shape and internal quality) in such a way that more daughter plants are obtained from the mother plant.

Man has propagated plant material almost as long as he has cultivated the land to produce food. For a long time, plant material was propagated mainly by using the seeds of existing plants.

Better methods were discovered over time, methods that allowed the farmer to retain the desirable qualities of the plant material, while eliminating some of the less desirable qualities. Through these methods, the farmer was also able to eliminate the variations between plants of the same cultivar and produce more consistently.

Today, farmers buy their plant material consisting of seed and seedlings from commercial seed companies or nurseries. The farmer is able to obtain plant material of a wide variety of cultivars, and that has qualities most suited to his specific environment.

1.2 Environmental Requirements for Propagation

Newly propagated plants or seedlings must be healthy and adhere to specified standards. To achieve this, the following factors are monitored closely:

- Humidity
- Aeration
- Light quality and quantity
- Temperature
- Moisture

In nature, there is an interaction between these factors and they all affect each other. In a controlled environment, such as a nursery or open field seed bed, temperature is the most influential factor in this interaction.

A plant has the natural ability to regulate its level of activity according to environmental conditions, such as at specific levels of temperature and humidity. At extreme temperatures and humidity, such as when it is extremely dry or humid or extremely hot or cold, growth will stop, which may lead to the plant dying if the conditions persist.

Environmental conditions therefore play an important role in the ability of a plant to grow and in general plant health. Effectively controlling these factors enables one to propagate and grow healthy plants.

Controlling these factors is important in all the propagation methods, but even more so for cuttings. A cutting is a separate part of a plant and care must be taken that the metabolic processes continue without interruption, otherwise the plant-part will not survive. There is no element of dormancy in this case.

Dormancy
Dormancy refers to the ability of certain plant-parts, such as seeds, to slow down metabolic processes until ideal environmental conditions inductive for regrowth occur.
Metabolic Processes
Metabolic processes refer to organic chemical processes inside a cell that enable life.

Humidity

Humidity
Humidity, also referred to as *relative humidity*, is the amount of water vapour in the air at a given temperature, and is expressed as a percentage. This means that at 20% relative humidity, 20% of any given volume of air will consist of suspended water molecules.

Humidity levels are especially important in allowing the plant to carry on with its metabolic processes at desired rates.

The ideal relative humidity for propagation ranges between 80% and 95% for seeds and cuttings, and in the region of 60% outdoors for budding, grafting and seedbed methods. Seed germination is faster at higher humidity levels, as is the case in cuttings. In warm and dry areas, the level of humidity often falls below 55% on hot summer days, making budding and grafting more delicate and requiring close monitoring.

Ventilation

Plants can only grow and survive in a balanced environment, where both oxygen (O_2) and carbon dioxide (CO_2) are sufficient. The processes of respiration and photosynthesis make use of both O_2 and CO_2 to sustain the growth and development of the plant.

Respiration
Respiration refers to the process during which the plant takes up oxygen (O_2) for 'burning' (oxidizing) carbohydrates to release energy. Water and carbon dioxide (CO_2) is released.
Photosynthesis
Photosynthesis refers to the chemical reaction that takes place in green plants when the plant takes up CO_2, uses the energy from light to combine it with water molecules in the plant to produce carbohydrates (food). O_2 is released during this process.

In the open, such as under shade-cloth or in seedbeds, the ambient air movement is sufficient to aerate plants. In structures such as tunnels, ventilation becomes important. Ventilation extracts warm air containing the CO_2 produced by plants from tunnels, thereby maintaining a balanced environment.

Figure 1.1: Tunnels with Extractor Fans

Light

All green plants require light for growth to take place. Some plants (most species) prefer growing in direct sunlight, while others prefer growing in the shade where they are subjected to indirect sunlight. Light is essential for photosynthesis, while light quality, which is determined by the wavelength of the light, also influences germination and flowering.

Plants in grown under protection such as greenhouses and shade-houses, require adequate light for the process of photosynthesis. If the plant does not receive enough light, which may be due to shading or over-crowding, it displays symptoms of retarded growth.

In seed germination, red light, with a wavelength of 660 nanometer (nm), is used in chambers to stimulate germination of certain kinds of seed. Incandescent globes are commonly used as an artificial source for red light for this purpose, while fluorescent tubes provide the blue light required for photosynthesis after germination. These lights are used extensively and kept on for as long as possible. It is not uncommon to have lights on 24 hours a day week round.

The depth of sowing light sensitive seed also determines the time seeds take to geminate, because light cannot penetrate deeply into the soil. Therefore light sensitive seed should be planted shallower than non sensitive seed.

With no or inadequate light, weak seedlings of poor quality are produced. These seedlings display an excessive elongation, referred to as etiolation.

Figure 1.2: Light in Germination Room

Temperature

If heat and light, which cause an increase in temperature, is not controlled properly, plants may suffer from heat injury. The ideal temperature for propagation is 29°C, and it must be monitored closely.

In propagation chambers the temperature can often be maintained at this ideal level by heating and cooling systems. The heat is also used for increasing the humidity in the chambers, by drenching the trays and dampening the floor.

Moisture

Moisture is essential for germination and healthy plant growth.

Too much water suffocates the plant roots, and can cause diseases such as root rot, damping off, and collar rot. The other extreme is insufficient water supply, or drought, and is detrimental to all plants, but even more so to cuttings and young seedlings. A uniform and constant water supply is required for seed germination to produce healthy and vigorous seedlings, and for seedlings to grow into healthy plants.

In all propagation methods, the properties of the growth-medium determine the quality and quantity of water that will be available for uptake by the plant. A good medium is one that has a low salinity level, a water holding capacity, being the amount of water that the medium retains, of between 55% and 60%, make it available easily, and the ability to allow lateral water movement.

In the case of germination, the seed, and the later seedling stage, has to be kept in media wetted to field capacity, being the maximum amount of water that a particular soil can hold.

- Propagation means the multiplication of plants of a specific type.
- Environmental conditions that must be controlled during plant propagation are humidity, aeration, light quality and quantity, temperature and moisture.
- Humidity is important for a plant to carry on metabolic processes at desired rates.
- Plants require an environment with sufficient oxygen and carbon dioxide for respiration and photosynthesis to take place. Tunnels in which plants are propagated are ventilated.
- All green plants require light for photosynthesis. Red light is used to stimulate seed germination in certain species.
- The temperature during germination must ideally be maintained at 29°C to optimize growth and prevent heat injury.
- A uniform and constant supply of good quality water is required for the propagation of healthy plants. Over-irrigating seedlings is as dangerous as under-irrigating.

Please complete Activity **1** at the end of this session.

My Notes ...

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Concept (SO 1)	I understand this concept	Questions that I still would like to ask
Suitable humidity levels for propagation of a specific agricultural production system are described.		
Suitable ventilation for the propagation of a specific agricultural production system is defined.		
The ability to distinguish between direct and indirect sunlight requirements are demonstrated.		
The suitable moisture levels of growth media are described.		

1

SO 1, AC 1-4

Brainstorming

My Name:

. . . . . .

My Workplace:

. . . . . .

My ID Number:

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Brainstorm with a partner and answer the questions below:

1. Name the environmental factors that must be controlled during propagation.

2. Define the term respiration and name the environmental factor that promotes for this process.

3. Define the term photosynthesis. What substance is produced during this process?

4. What methods are used to maintain the ideal temperature for propagation?

a) Open field

b) Nursery

Facilitator comments:

Assessment:

Session 2 Appropriate Propagation Methods

After completing this session, you should be able to:
SO 2: Identify appropriate propagation methods and applicable tools for specific agricultural production systems.

In this session we explore the following concepts:

- Means of propagation.
- Methods of propagation.
- Propagation tools.
- Sanitation.

2.1 Introduction

In this session, the various methods used in propagation are described, along with the tools that are required. The choice of methods depends on the propagator and his goals.

2.2 Means of Propagation

There are two means by which plants propagate, being sexual and asexual.

Sexual propagation is the production of new plants by means of a seed that is formed when a pollen grain lands on the stigma of the flower, and sends down a pollen tube, which releases two sperm cells into the ovule. This double fertilization or joining of one sperm cell and ovule and another sperm cell with the central cell form two zygotes. The zygote resulting from the fertilized egg cell develops into an embryo and the zygote of the fertilized central cell formed the endosperm. The embryo, along with the food storage organs, cotyledons and/or endosperm, and the seed coat make up what is called the seed. The embryo is different properties to its parents.

Asexual or vegetative propagation is the production of new plants by means other than seeds, for instance by rooting stem or leaf cuttings, or by layering a stem or dividing clumps. The new plant has exactly the same properties as its parent. It also includes grafting where the qualities of two different plants are combined.

Plants are propagated asexually for the following reasons:

- To preserve the genetic characteristics of a particular plant;
- To propagate plants that do not produce viable seeds, such as bananas, pineapples, and seedless grape;
- To propagate plants that produce seed that is difficult to germinate or has a very short storage life, such as cotoneaster and willow; and
- To bypass the juvenile stage of plant growth when the plants will not flower and bear fruit for a long time
- Disease tolerance is obtained by using tolerant rootstocks during grafting and budding.

2.3 Methods of Propagation

The methods generally used to propagate plants are given in the table below:

Methods of propagating plants, with typical examples

Propagation	Propagation by		Typical examples
Sexual	Seed		Annual (maize), biennial (cabbage) and many perennial plants like tomatoes
Asexual (Vegetative)	Cuttings	Stem cuttings	Hardwood – fig, grape, rose Semi-hardwood – lemon, camellia Softwood – lilac, pyracantha, weigela Herbaceous – begonia, sugar cane, chrysanthemum
		Leaf cuttings	*Begonia rex*, sansevieria, African violet
		Leaf-bud cuttings	Blackberry, hydrangea
		Root Cuttings	Phlox, daphne, horseradish
	Grafting	Root grafting	Apple, pear
		Crown grafting	Persian walnut, camellia, grape
		Top grafting	Various fruit trees
	Budding	T-budding	Stone and pome fruit trees, rose
		Patch budding	Walnut, pecan
	Layering	Tip	Trailing blackberry, black raspberry
		Simple	Honeysuckle, spirea, grape
		Mound or stool	Apple rootstock, gooseberry

		Air	Litchi, Indian rubber plant
	Runners		Strawberry
	Suckers		Red raspberry, blackberry
	Separation	Bulbs	Hyacinth, lily, tulip
		Corms	Gladiolus, freesia
	Division	Stem tubers	White potato
		Tuberous roots	Sweet potato, dahlia
		Rhizomes	Iris, cannas
	Micro-propagation	Shoot-tip culture	Orchid, carnation, asparagus, chrysanthemum
		Tissue culture	Rhododendron

Propagation of tree crops most commonly makes use of a combination of two propagation methods, being seed propagation and vegetative propagation. This is because vegetative reproduction allows the propagator to make an exact copy of the parent plant, while propagating with seed combines the properties of two parent plants and results in a completely new individual plant with completely new properties.

Seed propagation is used to produce seedlings that are used as rootstocks.

Rootstock
Rootstock means the part of the plant containing the root system when grafting and budding is done. A scion (grafting) or a bud (budding) is then 'implanted' onto the rootstock to produce the fruit or flower bearing canopy of the new combination.
Grafting
Grafting refers to any process of inserting a part of one plant into or onto another plant in such a way that they will unite and grow as a single unit. Grafting is the form of vegetative propagation that is used in propagation of some fruit trees, ornamental trees and shrubs and even vegetables like tomatoes and for specific reasons.

A plant part, (a scion or bud), is grafted onto the seedling rootstock. The scion then grows to form the fruit-producing part of the plant. The scion is taken from a plant of the variety of fruit that the grower eventually wishes to produce. The scion that is used in citrus propagation is a bud, or bud-eye, which is inserted into a cut on the seedling. For mangoes it is usually a scion.

Remember that budding is a form of grafting, which is a form of vegetative propagation.

The advantages of this dual propagation method can be summed up as follows:

- ***Cultivar and Variety Development*** – Cultivars and varieties of fruit trees, shrubs and vines are developed and perfected over many years of breeding and have superior horticultural characteristics, such as the ability to produce fruit of high exterior and interior quality. These characteristics must be retained consistently during propagation, and vegetative propagation is more effective in this regard, because the new plant is an exact copy of the original plant.

- ***Adaptability to Soil*** – Crop plants are grown in a variety of soil types. Certain traits of the plant determine its ability to survive and grow in less than ideal soil conditions, such as its rooting pattern, tolerance to salinity or acidity, drought tolerance, and pathogen (disease) resistance. These are traits of the rootstock, meaning that certain rootstocks are able to adapt better to soil conditions than others, and better than the plant of the actual cultivar or variety that is being grown.

- ***Genetic Segregation*** – With few exceptions, seeds do not produce true-to-type seedlings, meaning that seedlings are not identical in all aspects to the plant from which the seed was taken. A seed is formed from the pollen (male) from one plant and the ovum (female) of another plant, in other words two parents were involved, and both parents contribute characteristics to the embryo, or seed. Although there is a possibility that the seedling will have superior characteristics, more than likely it will be inferior.

- ***Prolonged Juvenility*** – Some plants propagated through seed takes a longer time, from 5 to 8 years, to reach maturity and to bear fruit. Scions from plants that are sexually mature, it is, plants that are already flowering and bearing fruit, retain their ability to flower when grafted onto seedling rootstocks. The juvenile phase can therefore be skipped by grafting.

Propagation by means of seed in nurseries

Seed is the manner in which most plants propagate naturally, and has therefore always been the most common means of crop propagation. In most field crops like maize, wheat, sunflower and many more, it is the only way of propagation, although for the production of potatoes, vegetative material namely tubers, are used. In fruit tree crop production, seed is used to produce rootstocks. An individual plant, referred to as seedling, develops from a seed. This plant is used as rootstock for the qualities that it transmits to the scion and ultimately to the fruit.

Seed propagation normally produces disease-free plants unless the seed is contaminated after harvesting and represents a crucial stage in the production cycle. The process begins with seed germination, which is dependent on environmental factors as discussed in session 1, and on seed viability, meaning the ability of the seed to germinate and grow into a seedling.

Seeds used for rootstock come from a tree with known and desired qualities. In the case of citrus production, seed from common, edible citrus fruits, such as sweet orange, grapefruit or mandarin, can be used for growing rootstock plants at home, but this is not recommended for commercial purposes. For other crops like tobacco, vegetables and flowers, seed used for seedling production must be obtained from a reputable source since the use of high quality hybrid seed has become a standard procedure.

- Sand Seedbed Germination

  Seeds can be planted in a sterile river-sand bed in the open, where they are watered regularly. After germination, seedlings are kept in the coarse river-

sand until ready to be budded. Inferior plants are removed and only vigorous ones are selected for budding.

- Seed Germination Trays

  Unless new trays are used, seed germination trays used for seedling production are first washed with clean water and then sterilized with a fungicide, such as copper oxychloride at 200g/100l.

  Trays are filled to three-quarter level with a propagation media, normally a mixture of decomposed bark and vermiculite. Seeds are spread and arranged in such a way that all can germinate with as little obstruction as possible. When germination is obstructed, bench roots and other seedling malformation can occur.

  Germination takes place in a sterile room where optimum temperature and high humidity can be maintained. After the seed has germinated, trays are moved to tunnels or shade houses for seedling growth.

  Certain seeds like 'Sabre' mango and citrus produce more than one, generally three, seedlings per seed. One of the seedlings is sexual, while the others are apomictic (asexual) seedlings developing from nu cellar tissue and are exact copies of the mother-plant. Apomictic seedlings are of great significance in fruit tree propagation, since they are the uniform and true-to-type seedlings. The vigour and freedom from viruses of apomictic seedlings are other superior traits.

Vegetative Propagation

There are many methods of vegetative propagation that is used. The choice depends on the propagator and his goals. Grafting, in the form of budding, is explained here by using citrus as and example.

- Budding or bud grafting

  Budding is the method where the bud-eye along with some bark and wood, referred to as bud-wood, is inserted into the rootstock seedling. The bud-wood is the scion from a plant of the selected fruit variety with desirable traits, selected properly and treated to avoid infections that may jeopardize the quality of the produced tree.

  Budding is done when the bark of the rootstock is "slipping", i.e. when the bark separates easily from the wood. The most appropriate period for budding in South African nurseries that use shade-houses is from end August to April. In the case of plants that are kept in greenhouses with a controlled environment, the bark slips anytime the plant is in active growth, which is practically year-round.

  In commercial citrus propagation, bud-wood is collected only from sources that are certified to be free of a number of viral diseases, including such diseases as Tristeza. These sources have a quarantine or isolation policy to prevent the

movement of propagation materials, in order to prevent the spread of citrus diseases from or to other citrus areas.

Definition

Tristeza
Tristeza is a virus that is located in the phloem of the host plant, and it disturbs the transportation systems of the plant. It is transmitted by some species of aphids found on citrus plants, with citrus brown aphid, *Toxoptera citricida Kirkaldy*, being the most effective vector.

The procedure used for budding is as follows:

- Make an inverted T-cut on the stem of the rootstock.

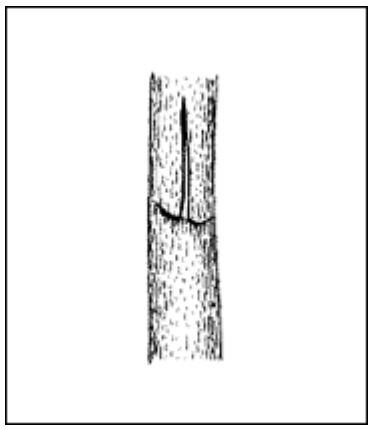

Figure 2.2: Inverted T-Cut on Stem of Seedling

- Cut a very thin slice of bark and a piece of wood beneath the bud evenly and smoothly from the bud-wood with a knife.

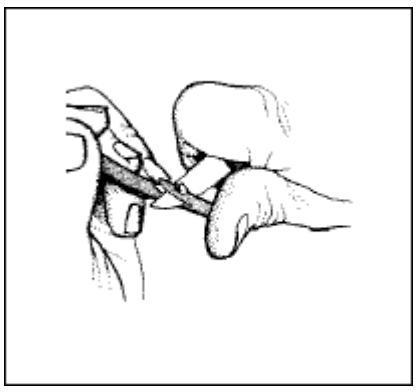

Figure 2.3: Cutting Bud-Wood

- Place the upper end of the bud piece beneath the bark flaps at the bottom of the inverted T-cut. Gently but firmly push it upward with the thumb.

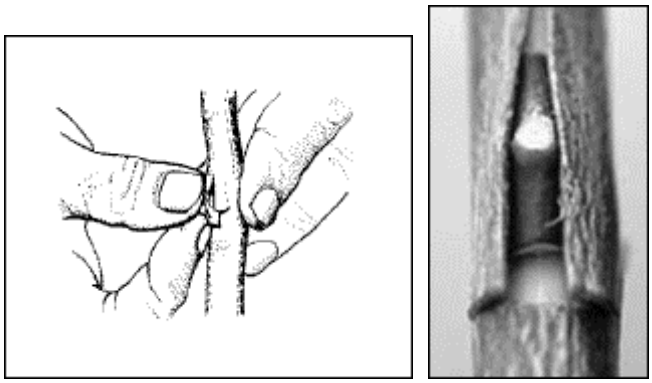

Figure 2.4: Inserting the Bud Piece

- Seal the join with a wrap to hold the bud firmly in place on the rootstock until union and healing of wounds is complete, and to keep rain and irrigation water from running down the stem and from entering the join, which can prevent the bud from healing and which can cause diseases and infections. Fifteen days are generally long enough for the wounds to heal.
- Wrap the bud from below the incision, making several overlapping turns around the stem until the entire bud and incision are covered. Tuck the end of the tape beneath the last turn. Maintain firm pressure on the tape, but not so hard that it breaks. If the tape breaks it has to be removed and the wrapping started over again with a new strip.

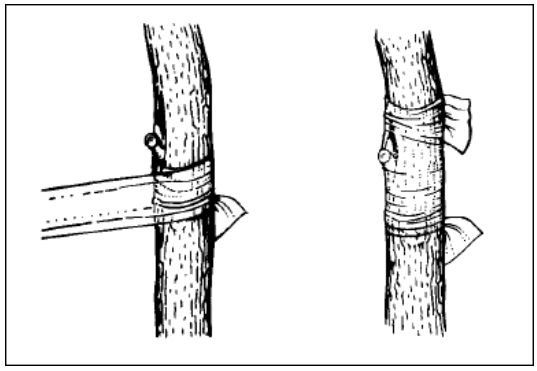

Figure 2.5: Wrapping the Budding Union

- After two weeks, when healing and union has occurred, remove the tape by making a vertical cut through it on the back of the rootstock. A live bud will still be as green as it was when inserted, while a dead bud will look brown or blackish, meaning that it did not take. If the bud did not take, another spot on the rootstock is selected for re-budding.
- The growth energy of the seedling must now be directed to the green bud, forcing it to grow. The rootstock seedling is subjected to practices, such as lopping or bending (gently bending the top of the rootstock above the union to tie it to itself) and topping (cutting off the

seedling 5cm above the union) to direct all its energy into the bud. These practices break bud dormancy and force the bud to grow within a week.

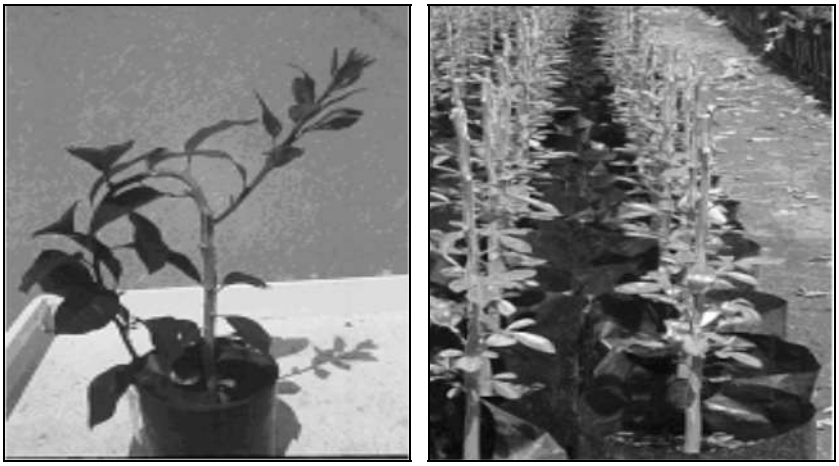

Figure 2.6: Lopping (left) and Topping (right)

- Other shoots that grow from the rootstock influence bud-growth. To reduce competition for food, trimming is done as soon as side-shoots are noticed on the rootstock.
- When the shoot reaches 20cm to 25cm, insert a treated stake, such as a wooden cleat, a bamboo stick or twisted thick wire, alongside the plant extending 20cm into the medium and about 70cm above. Tie the plant to the stake for stability and directed growth. As the plant grows, it is continually tied up until it reaches the top of the stake.

Figure 2.7: Staked Trees

- When the plant reaches pencil-thickness at the top of the stake, it is topped to suppress apical dominance and to allow branching. The headed tree is ready to be planted.

Apical Dominance
Apical dominance refers to powerful tip growth that suppresses translocation of nutrients to other plant parts.

Figure 2.8: Headed Trees Ready for Planting

Depending on the season, rootstock and scion, the whole process takes about six to eight months.

Incompatibility between the rootstock and the scion is a possible problem that can occur with this method.

Sometimes cultivar change is required on older citrus trees in orchards. This procedure is referred to as top-working and involves grafting a scion of a new cultivar onto the existing trees.

♦ Cuttings

Propagation by means of cuttings is the most easy and cheapest way of vegetative propagation. Different types of cuttings can be classified as follows:

- Stem cuttings
  - Herbaceous stem cuttings – using stems of herbaceous plants like tomatoes, mint lavender and many herbaceous ornamentals. A stem cutting consists of two or more nodes and internodes, cut below the bottom node and above the top node.

- Harwood cuttings – using dormant, mostly one year old shoots like grape vine, apples and some ornamental trees and shrubs. Cut in the same way as above.
- Softwood cuttings – using the immature, top section of vigorous shoots bearing young leaves and the terminal bud
- Making cuttings is another method that produces true-to-type plants of high quality.
- Cuttings are only propagated in a controlled environment where humidity levels are between 80% and 95%, and not uncommonly at 100%. Required temperatures for successful propagation through this method are between 27°C and 32°C.
- A section of the plant is cut, treated in a fungicide mix (Captab and Benlate) and the end dipped in a growth hormone, for example Seradix B. The cutting is then planted in a growth-medium for rooting. Two weeks later rooting takes place and the rooted cutting can be transferred to a hardening-off area after six weeks.
- The disadvantage of this method is that it is management intensive and requires high-tech equipment.

♦ Tissue Culture Propagation

Tissue culture propagation refers to procedures used to maintain and grow plants and organs in-vitro, or aseptic culture. This is when small pieces of plant material or plant cells are manipulated and used to grow new plants in a controlled laboratory environment. This method is used for both regenerating clonal copies of the mother plant and virus elimination in a plant, or virus indexing.

Take note: Full details on propagation methods and the tools and equipment used in performing these tasks, are available in Unit Standard 116205 (Propagate plants). The methods and tools/equipment mentioned in this unit standard are only examples, and should be supplemented on your own by making use of Unit Standard 116205.

2.4 Propagation Tools

The following tools are used in the propagation methods described above. For a full list of tools and equipment which can be used in propagation, the learner should consult the Learner Guide of Unit Standard 116205.

♦ ***Budding Knife*** – A razor sharp knife used to make cuts on the seedlings and to cut off the bud-eye. The knife must always be sharp and in a good working condition to prevent tissue damage to the plant when cutting through it. If tissue damage occurs, the graft will most likely fail.

♦ ***Budding Tape*** – Clear polyethylene strips, used to maximize contact between the bud and the rootstock until the union and the healing is complete. It also prevents drying and excess water from getting in and rotting the bud.

- ***Pruning Shears*** – Bud-wood is cut using pruning shears. Pruning shears are also used where cuttings are used for propagation.
- ***Sharpening Stone*** – All blades become blunt with use and require periodic sharpening. A sharpening stone, or wet stone, and honing oil are required.
- ***Sterilization Liquid*** – Knives and shears must be periodically cleaned and sterilized properly with a solution of 10% bleach (Jik).

2.5 Sanitation

Although seed treatment reduces the possibility of infections, infected fruits should be avoided when collecting seeds. Only healthy fruit still hanging on the tree are to be used, as rotten fruit and fruit lying on the ground might carry brown rot (Phytophtora) and contaminate the medium.

Sanitation treatment is extended to the media used, the containers, floors and benches. Propagation media, such as perlite and vermiculite, are sterile and classified as very low-risk by virtue of the temperatures they are subjected to during their processing.

For budding and cuttings, sterilization of pruning shears and budding knives ensures that the propagation material remains virus-free. Sterilization is accomplished by cleaning tools thoroughly with clean water and wiping the blades with a solution of 10% chlorine bleach (Jik). The solution should not be kept for more than five hours. A wetted cotton swab kept in a capsule is used to periodically treat propagation tools during nursery operations. Budding tools should be sterilized every time varieties are changed.

Because the bleach solution (Jik) is corrosive to most metals, sterilized tools must be rinsed in clean tap water, dried thoroughly and given a light coating of protective oil at the end of the day to prevent rust. A mixture consisting of 390ml clean tap water, 100ml clear vinegar, and 10ml oil provides long-term protection from rust. Blunt knives and pruning shears must be sharpened using a sharpening stone.

- Plants can propagate through sexual (seeds) and asexual (vegetative using plant parts) means.
- In citrus, seed propagation and vegetative propagation is used together to produce new plants.
- Seed propagation is used to produce seedlings that are used as rootstock.
- Vegetative propagation is used to graft a bud of the fruit cultivar onto the rootstock seedling, referred to as budding.
- Budding is a form of grafting, which is a form of vegetative propagation.
- Seeds from specific cultivars with desired qualities are used for producing rootstocks.
- Seeds can be bought from certified sources, or extracted from the fruit of rootstock trees that have been established for this purpose.
- Seeds are propagated in sand seedbeds in the open, or in seed trays in special germination rooms.
- Budding is done when the bark of the rootstock seedling is slipping by making an

inverted T-cut on the stem of the seedling, cutting a bud piece from the bud-wood, inserting the bud piece into the T-cut, and wrapping the join with clear tape.
- After about 2 weeks the wrapping is removed, and if the union was successful, growth energy is directed to the bud by lopping or topping the rootstock seedling.
- Plants are staked for support and directed growth.
- Plants are topped before being planted in the orchard.
- Propagating plants through cuttings involves planting a scion treated with growth hormones in a growth medium and allowing it to form roots.
- Tissue culture propagation in citrus involves growing plants from the embryo of a seed in vitro in a laboratory.
- Propagation tools that are commonly used are budding knives, budding tape, pruning shears, a sharpening stone and sterilization liquid.
- Propagation tools must be sterilized to prevent the development of pathogens.

Please complete Activity **2** at the end of this session.

My Notes ...

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Concept (SO 2)	I understand this concept	Questions that I still would like to ask
The appropriate method for the propagation of a specific crop is described.		
The appropriate tools for a propagation method are selected.		
The safe and proper use of the applicable tools is demonstrated.		
The necessary hygiene requirements applicable to the appropriate methods used are described.		
The basic troubleshooting of equipment is described.		

2

SO 2, AC 1-5

Explore, identify and report back.

My Name:

. . . . . .

My Workplace:

. . . . . .

My ID Number:

. . . . . .

Go around in your community and identify the crops being produced in your area. Enquire from the farmer(s) how he/she propagates the specific crop(s) and what tools and equipment are used for propagation of the crops. Also find out if they use any safety, sanitation and hygiene protocols when propagating their corps. Take pictures of the propagation material (if available), tools and equipment used in propagation and facilities where propagation is done. Make notes of the answers and answer the following questions.

1. Name at least three crops generally produced in your community.

2. What propagation method(s) are used for the crops you named for question 1? Paste pictures.

3. What tools or equipment are used in the propagation of the crops in question 1?

4. Do you think the farmers could have used other, more safe or applicable tools and equipment, than the ones mentioned in question 3? Defend your answer.

5. Why are sanitation, sterilization, safety and hygiene important?

6. Are there any safety, hygiene and sanitation protocols in place on the farms you visited? Make a list of these protocols.

7. What safety, hygiene and sanitation protocols would you recommend for those situations where there are no or very little protocols in place?

Facilitator comments:	**Assessment:**

Session 3 Successful and Unsuccessful Propagation

After completing this session, you should be able to:
SO 3: Distinguish between successful and unsuccessful propagation under specific agricultural production context.

In this session we explore the following concepts:
- Indicators of successful propagation.
- Indicators of unsuccessful propagation.
- Environmental factors for successful propagation.

3.1 Introduction

Propagation is an important process in citrus production, and its success is determined by the end-result. The Citrus Improvement Programs (CIP) has set standards for a trees sold by nurseries in South Africa. Accredited nurseries produce trees that comply with these standards and any trees that do not meet these requirements, are considered substandard.

3.2 Indicators of Successful Propagation

- ***Trueness-to-Name*** – Different cultivars of citrus have different traits. These traits must be retained in the propagated plant material. The correct cultivar with few deviations from the original stock is expected at the end of the production chain.
- ***Trueness-to-Type*** – The external traits of the plant, such as fruit-shape and –size, must be identical to those of the mother-plant in a given environment.
- ***Freedom from Pathogens*** – Viruses and bacteria are a threat to the survival of the citrus industry and must not be present in propagated plant material. Once a plant has been infected, the pathogen may become part of the plant. Only propagating clean plant material will ensure success.

The source of propagated plant material, the citrus nursery, has the responsibility of ensuring that plant material complies with all of the above indicators.

3.3 Indicators of Unsuccessful Propagation

Failure to produce plants that meet set standards is a potential source of conflict between the propagator and the farmer, who may suffer financial loss as a result.

Dead buds, diseased plants, mixed cultivars, and inferior plants are the main indicators of unsuccessful propagation.

Unsuccessful propagation indicators are not to be viewed from a completely negative perspective. Cultivar development and improvement programs around the world have made use of some of these deviations to produce new cultivars. The known source of Bennie Valencia orange is a case in point. Standing in the middle of a late Valencia orchard, these trees expressed traits that are different to the rest. Fruits had a rounder shape, a sweeter taste, a thicker rind, were bigger in size and juicier, and matured earlier. Subsequently, a new variety was developed.

3.4 Environmental Factors for Successful Propagation

Good and rapid growth is important for both the propagator (nurseryman) and the fruit producer (farmer) since trees are brought to bear sooner. To produce such a tree, environmental conditions must be regulated.

The environmental conditions described in session 1 must be maintained to ensure successful propagations of healthy, disease-free, and true-to-type plants.

- Indicators of successful propagation are trueness-to-name, trueness-to-type and freedom from pathogens.
- Indicators of unsuccessful propagation are deviations from type, diseased plants, mixed cultivars and inferior plant quality.
- Environmental conditions must be maintained to ensure successful propagation.

Please complete Activity **3** at the end of this session.

My Notes ...

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Concept (SO 3)	I understand this concept	Questions that I still would like to ask
The indicators for successful propagation of a specific crop are described.		
Indicators of unsuccessful propagation are described.		
The necessary environmental factors for successful propagation are explained.		

My Notes ...

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3.1

SO 3, AC 1-3

Worksheet:
Answer the following questions

My Name:
. . . . . .
My Workplace:
. . . . . .
My ID Number:
. . . . . .

1. What are the indicators of successful propagation?

2. What are the indicators of unsuccessful propagation?

3. Who sets the standards for successful propagation?

Facilitator comments:

Assessment:

3.2

SO 3, AC 1-3

Practical experience of propagating a crop

My Name:

. . . . . .

My Workplace:

. . . . . .

My ID Number:

Go to a nursery and produce tomato seedlings with the material provided. Make notes of all that you do as you go along. Ask the manager in charge to take care of the seedlings if you are not able to go there on a regular basis. Go back to the nursery six weeks after sowing and evaluate the resulting seedlings. Take pictures of every step as well as of the final product.

Now write a report on how you propagated the tomato seedlings. This includes the initial preparation of the growing media etc. Make use of your notes and pictures to facilitate this process. Evaluate your success or failure to produce seedlings which are in accordance to the guidelines set by the nursery manager. Also include any problems, mistakes etc. which was made during the propagation action and say how you can improve future endeavours.

Facilitator comments:

Assessment:

Glossary

Term	Description
Apical dominance	Apical dominance is the phenomenon whereby the main central stem of the plant is dominant over (i.e., grows more strongly than) other side stems, and on a branch, the main stem of the branch is further dominant over its own side branchlets.
Asexual propagation	Asexual or vegetative propagation is the production of new plants by means other than seeds, for instance by leaf cuttings.
Dormancy	Dormancy refers to the ability of certain plant-parts, such as seeds, to slow down metabolic processes until ideal environmental conditions inductive for re-growth occur.
Etiolation	A form of growth seen in plants receiving insufficient light. It is characterized by long, weak stems, small leaves, and a pale yellowish colour (chlorosis) due to a lack of chlorophyll. The rapid increase in height enables a plant that is surrounded by others to quickly reach a source of light, after which a return to normal growth usually occurs.
Fertilization	Fertilization or fertilization (also known as conception, fecundation and syngamy) is fusion of gametes to form a new organism of the same species.
Fluorescent tubes	Fluorescent lights come in tubular design and in many compact shapes and sizes. Compact fluorescent lamps are five times more efficient than ordinary incandescent globes. Compact fluorescent lights are the most energy efficient form of lighting commonly available today. They also last much longer with a lamp life of around 8000 hours compared to 1000 hours for an ordinary bulb. Although they cost more to buy, compact fluorescent lights cost less to run, so they are best used to light areas where they will be on for long periods. Most compact fluorescent lights pay for themselves in around 1000 operating hours.
Gametes	Gametes are the specialized cell that comes together during fertilization (conception) in organisms that reproduce sexually.
Grafting	Grafting refers to any process of inserting a part of one plant into or onto another plant in such a way that they will unite and grow as a single unit.
Humidity	Humidity, also referred to as relative humidity, is the amount of water vapour in the air at a given temperature, and is expressed as a percentage.
Incandescent globes	Incandescent lighting technology is commonly used in ordinary globes and heat lamps. Use three to five times the energy to provide the same level of light as a fluorescent tube. Also produce significantly more heat which results in shorter lifespan in an enclosed environment.

Metabolic Processes	Metabolic processes refer to organic chemical processes inside a cell that enable life.
Photosynthesis	Photosynthesis refers to the chemical reaction that takes place in green plants when the plant takes up CO_2, uses the energy from light to combine it with water molecules in the plant to produce carbohydrates (food). O_2 is released during this process.
Propagation	Plant propagation refers to the multiplication of plant material of a specific cultivar, variety, breeding line or strain that possesses desirable characteristics, (such as fruit shape and internal quality) in such a way that more daughter plants are obtained from the mother plant.
Respiration	Respiration refers to the process during which the plant takes up oxygen (O_2) for 'burning' (oxidizing) carbohydrates to release energy. Water and carbon dioxide (CO_2) is released.
Rootstock	Rootstock means the part of the plant containing the root system when grafting and budding is done.
Sexual propagation	Sexual propagation is the production of new plants by means of a seed.
Tissue culture	Plant tissue culture, also called micro propagation, is a practice used to propagate plants under sterile conditions, often to produce clones (exact copies) of a plant. Different techniques in plant tissue culture may offer certain advantages over traditional methods of propagation, including: The production of exact copies of plants that produce particularly good flowers, fruits, or have other desirable traits. The production of plants in sterile containers that allows them to be moved with greatly reduced chances of transmitting diseases, pests, and pathogens. The production of plants from seeds that otherwise have very low chances of germinating and growing, i.e.: orchids and nepenthes. To clean particular plant of viral and other infections and to quickly multiply these plants as 'cleaned stock' for horticulture and agriculture. Plant tissue culture relies on the fact that many plant cells have the ability to regenerate a whole plant. Single cells, plant cells without cell wall, pieces of leaves, or roots can often be used to generate a new plant on culture media given the required nutrients and plant hormones.
Ventilation	Air movement.
Zygote	A zygote is a cell that is the result of fertilization. That is, two reproductive cells—usually (but not always) an ovum from a female and a sperm cell from a male merge into a single cell called the zygote.

Am I ready for my test?

- Check your plan carefully to make sure that you **prepare in good time**.
- You have to be found **competent** by a qualified **assessor** to be declared competent.
- Inform the assessor if you have any **special needs** or requirements **before** the agreed date for the test to be completed. You might, for example, require an interpreter to translate the questions to your mother tongue, or you might need to take this test orally.
- Use this worksheet to help you prepare for the test. These are **examples** of **possible questions** that might appear in the test. All the information you need was taught in the classroom and can be found in the learner guide that you received.

1. ***I am sure*** *of this and understand it well*
2. ***I am unsure*** *of this and need to ask the Facilitator or Assessor to explain what it means*

Questions	1. I am sure	2. I am unsure
1.Describe the ideal propagation environment for a plant?		
2.Explain what kinds of Hygiene procedures you would apply during the propagation process.		
3.Explain how you prepared the propagation material and propagation media before propagation starts.		
4.If you had to explain to a friend or fellow worker what kind of routine duties someone who works in a propagation environment would do, what would you say?		
5.Explain what kinds of tools and equipment you can use to prepare propagation material, and how you used them correctly.		
6.Give a step-by-step account of a grafting procedure.		
7.Explain the difference between sexual and asexual plant propagation. Give an example of plants at each method of propagation.		
8. List 3 hygiene/sanitation risks in a plant propagation environment. What risk do they pose?		

Checklist for practical assessment ...

Use the **checklist** below to help you prepare for the part of the practical assessment when you are observed on the **attitudes** and **attributes** that you need to have to be found competent for this learning module.

Observations	Answer Yes or No	Motivate your Answer (Give examples, reasons, etc.)
Can you identify problems and deficiencies correctly?		
Are you able to work well in a team?		
Do you work in an organised and systematic way while performing all tasks and tests?		
Are you able to collect the correct and appropriate information and / or samples as per the instructions and procedures that you were taught?		
Are you able to communicate your knowledge orally and in writing, in such a way that you show what knowledge you have gained?		
Can you base your tasks and answers on scientific knowledge that you have learnt?		
Are you able to show and perform the tasks required correctly?		
Are you able to link the knowledge, skills and attitudes that you have learnt in this module of learning to specific duties in your job or in the community where you live?		

- The assessor will complete a checklist that gives details of the points that are checked and assessed by the assessor.
- The assessor will write commentary and feedback on that checklist. They will discuss all commentary and feedback with you.
- You will be asked to give your own feedback and to sign this document.
- **It will be placed together with this completed guide in a file as part of you portfolio of evidence.**
- The assessor will give you feedback on the test and guide you if there are areas in which you still need further development.

Paperwork to be done ...

Please assist the assessor by filling in this form and then sign as instructed.

Learner Information Form				
Unit Standard	**116119**			
Program Date(s)				
Assessment Date(s)				
Surname				
First Name				
Learner ID / SETA Registration Number				
Job / Role Title				
Home Language				
Gender:	Male:		Female:	
Race:	African:	Coloured:	Indian/Asian:	White:
Employment:	Permanent:		Non-permanent:	
Disabled	Yes:		No:	
Date of Birth				
ID Number				
Contact Telephone Numbers				
Email Address				
Postal Address			Signature:	

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Terms & Conditions

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■ **Layout:**

Ms A. du Plessis

Ms N Matloa

SOUTH AFRICAN QUALIFICATIONS AUTHORITY

REGISTERED UNIT STANDARD:

Demonstrate an understanding of plant propagation

SAQA US ID	**UNIT STANDARD TITLE**		
116119	Demonstrate an understanding of plant propagation		
SGB NAME	**NSB**	**PROVIDER NAME**	
SGB Primary Agriculture	NSB 01-Agriculture and Nature Conservation		
FIELD		**SUBFIELD**	
Agriculture and Nature Conservation		Primary Agriculture	
ABET BAND	**UNIT STANDARD TYPE**	**NQF LEVEL**	**CREDITS**
Undefined	Regular	Level 2	3
REGISTRATION STATUS	**REGISTRATION START DATE**	**REGISTRATION END DATE**	**SAQA DECISION NUMBER**
Registered	2004-10-13	2007-10-13	SAQA 0156/04

PURPOSE OF THE UNIT STANDARD

The learner achieving this unit standard will have the ability to propagate plants.

Learners will gain specific knowledge and skills in plant propagation and will be able to operate in a plant production environment implementing sustainable and economically viable production principles.

They will be capacitated to gain access to the mainstream agricultural sector, in plant production, impacting directly on the sustainability of the sub-sector. The improvement in production technology will also have a direct impact on the improvement of agricultural productivity of the sector.

LEARNING ASSUMED TO BE IN PLACE AND RECOGNITION OF PRIOR LEARNING

It is assumed that a learner attempting this unit standard will show competence against the following unit standards or equivalent:

- NQF 1: The propagation of plants.
- NQF 2: Basic soil fertility and plant nutrition.
- NQF 2: Utilise and perform minor repair and maintenance tasks on implements, equipment and infrastructure.
- NQF 1: Collect agricultural data.

UNIT STANDARD RANGE

Range statements are neither comprehensive nor necessarily appropriate to all contexts. Alternatives must however be comparable in scope and complexity. These are only as a general guide to scope and complexity of what is required.

UNIT STANDARD OUTCOME HEADER

N/A

Specific Outcomes and Assessment Criteria:

SPECIFIC OUTCOME 1

Recognise the environmental requirements for propagation in a specific agricultural production context.

OUTCOME RANGE

The environmental needs may include but are not limited to humidity, ventilation, temperature, light intensity, moisture, etc.

ASSESSMENT CRITERIA

ASSESSMENT CRITERION 1

Suitable humidity levels for propagation of a specific agricultural production system are described.

ASSESSMENT CRITERION 2

Suitable ventilation for the propagation of a specific agricultural production system is defined.

ASSESSMENT CRITERION 3

The ability to distinguish between direct and indirect sunlight requirements are demonstrated.

ASSESSMENT CRITERION 4

The suitable moisture levels of growth media are described.

SPECIFIC OUTCOME 2

Identify appropriate propagation methods, applicable tools and equipment for specific agricultural production systems.

OUTCOME RANGE

Propagation methods include but are not limited to direct sowing, seeding tray, seed bed, vegetative cuttings of rhizomes, corns, tubes, scaling of bulbs and tissue culture, budding, grafting and layering. Appropriate tools include but are not limited to pruning shears, budding knives etc. while equipment could include heating, cooling, hydration etc.

ASSESSMENT CRITERIA

ASSESSMENT CRITERION 1

The appropriate method for the propagation of a specific crop is described.

ASSESSMENT CRITERION 2

The appropriate tools for a propagation method are selected.

ASSESSMENT CRITERION 3

The safe and proper use of the applicable tools is demonstrated.

ASSESSMENT CRITERION 4

The necessary hygiene requirements applicable to the appropriate methods used are described.

ASSESSMENT CRITERION 5

The basic troubleshooting of equipment is described.

SPECIFIC OUTCOME 3

Distinguish between successful and unsuccessful propagation under specific agricultural production context.

OUTCOME RANGE

Success indicators include but are not limited to root development, germination of seed, bud / graft union, shoot development, etc.

ASSESSMENT CRITERIA

ASSESSMENT CRITERION 1

The indicators for successful propagation of a specific crop are described.

ASSESSMENT CRITERION 2

Indicators of unsuccessful propagation are described.

ASSESSMENT CRITERION 3

The necessary environmental factors for successful propagation are explained.

UNIT STANDARD ACCREDITATION AND MODERATION OPTIONS

The assessment of qualifying learners against this standard should meet the requirements of established assessment principles.

It will be necessary to develop assessment activities and tools, which are appropriate to the contexts in which the qualifying learners are working. These activities and tools may include an appropriate combination of self-assessment and peer assessment, formative and summative assessment, portfolios and observations etc.

The assessment should ensure that all the specific outcomes; critical cross-field outcomes and essential embedded knowledge are assessed.

The specific outcomes must be assessed through observation of performance. Supporting evidence should be used to prove competence of specific outcomes only when they are not clearly seen in the actual performance.

Essential embedded knowledge must be assessed in its own right, through oral or written evidence and cannot be assessed only by being observed.

The specific outcomes and essential embedded knowledge must be assessed in relation to each other. If a qualifying learner is able to explain the essential embedded knowledge but is unable to perform the specific outcomes, they should not be assessed as competent. Similarly, if a qualifying learner is able to perform the specific outcomes but is unable to explain or justify their performance in terms of the essential embedded knowledge, then they should not be assessed as competent.

Evidence of the specified critical cross-field outcomes should be found both in performance and in the essential embedded knowledge.

Performance of specific outcomes must actively affirm target groups of qualifying learners, not unfairly discriminate against them. Qualifying learners should be able to justify their performance in terms of these values.

- Anyone assessing a learner against this unit standard must be registered as an assessor with the relevant ETQA.

- Any institution offering learning that will enable achievement of this unit standard or assessing this unit

standard must be accredited as a provider with the relevant ETQA.

- Moderation of assessment will be overseen by the relevant ETQA according to the moderation guidelines in the relevant qualification and the agreed ETQA procedures.

UNIT STANDARD ESSENTIAL EMBEDDED KNOWLEDGE

The person is able to demonstrate a basic knowledge of:

- Basic safety requirements related to the propagation environment and procedures.
- Basic hygiene requirements for the propagation environments.
- Growing media - wet and dry.
- Weeds, pest and diseases.
- Nomenclature related to all aspects of plant propagation.
- Sensory cues related to the various aspects of plant propagation
- The purpose of learning about plant propagation.
- All procedures, legislation, rules and codes of conduct pertaining to plant propagation.
- All procedures related to the propagation of plants.

UNIT STANDARD DEVELOPMENTAL OUTCOME

N/A

UNIT STANDARD LINKAGES

N/A

Critical Cross-field Outcomes (CCFO):

UNIT STANDARD CCFO IDENTIFYING

Problem solving: Related to all outcomes.

UNIT STANDARD CCFO WORKING

Teamwork: Relates to specific outcome:
- Identify appropriate propagation methods and applicable tools for specific agricultural production systems.

UNIT STANDARD CCFO ORGANIZING

Self-Management: Relates to all outcomes.

UNIT STANDARD CCFO COLLECTING

Interpreting Information: Relates to all outcomes.

UNIT STANDARD CCFO COMMUNICATING

Communication: Relates to all outcomes.

UNIT STANDARD CCFO SCIENCE

Use Science and Technology: Relates to all outcomes.

UNIT STANDARD CCFO DEMONSTRATING

The world as a set of related systems: Relates to all outcomes.

UNIT STANDARD CCFO CONTRIBUTING

Self-development: Related to all outcomes.

UNIT STANDARD ASSESSOR CRITERIA

N/A

UNIT STANDARD NOTES

N/A
