Citrus Plant Propagation

Module 1:
Citrus Propagation Requirements

Learner Guide

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Citrus Growers' Association OF SOUTHERN AFRICA
Grower levies working for you!

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Contents

Introduction

Southern African citrus growers make a profit from producing quality fruit for the export market. It all begins with planting quality, true-to-type citrus trees, produced by certified citrus nurseries.

Citrus nurseries come in all sizes. The largest nurseries can in a year produce up to 800,000 trees of a wide range of cultivars that are sold all over the country. On the other end of the scale, small nurseries may focus on a few cultivars and produce trees only for citrus growers in their area.

The Citrus Improvement Scheme

When choosing a nursery, growers need to be sure that the nursery will be able to supply them with quality, disease-free, true-to-type trees. The term 'true-to-type' means that the tree will bear fruit of the variety and cultivar that the grower requires. On top of this, trees must be healthy, vigorous, and free of diseases. To assure growers that a nursery can comply with these standards, the nursery is certified through the Citrus Improvement Scheme.

The Citrus Improvement Scheme was put in place to ensure that growers are supplied with nursery trees of the highest possible quality, made from the best genetic material, and being free of diseases. A central component of the Citrus Improvement Scheme is the Citrus Foundation Block near Uitenhage in the Eastern Cape, which is where most of the budwood used in South African citrus nurseries is produced.

The Citrus Improvement Scheme certifies all citrus trees sold by nurseries in South Africa, and growers are strongly advised to only buy trees that have been certified through the scheme. In addition to tree certification, the Citrus Improvement Scheme also certifies nurseries according to a quality management system, on which they are audited twice a year.

Citrus Propagation Process

Before we look at the requirements for citrus propagation, we need to understand the process of making citrus trees.

As a first step, please make sure that you understand citrus types, cultivars and rootstock. If you need to learn more about this, please watch the Citrus Types and Cultivars module that is part of the Citrus Planting Management series.

The first step in the propagation process is to sow seeds in seedling trays. After a few days, the seeds germinate. The seedlings are left to grow until they have more than two differentiated leaves. The seedlings are now ready to be transplanted to seedling trays. Only seedlings that are vigorous and true-to-type are selected to be transplanted. If they are not, they are discarded.

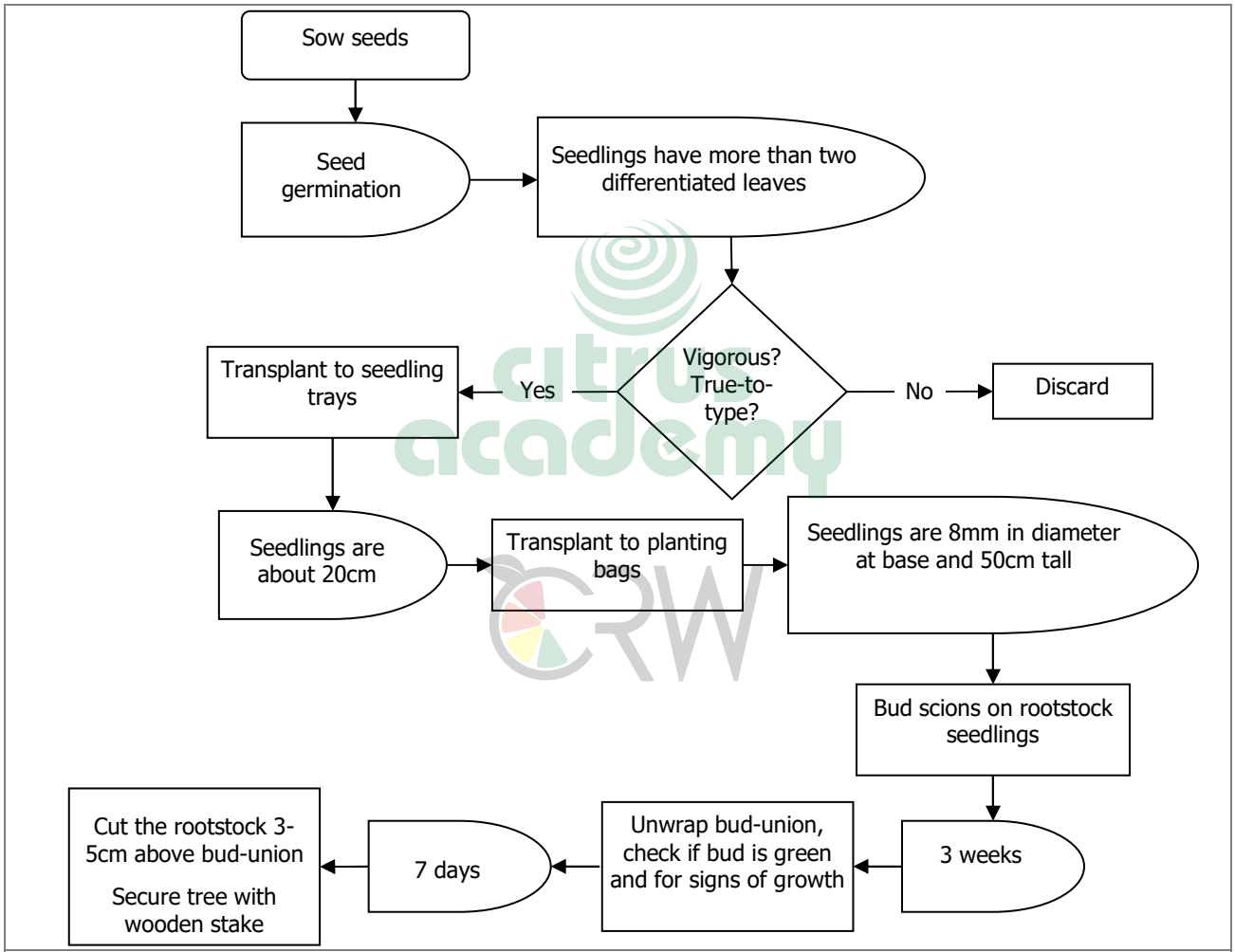
The selected seedlings are transplanted into individual cavities in seedling trays. Seedlings are left to grow until they are about 20cm long. They are then transplanted to planting bags, where they are left to grow until they are at least 50cm tall and the stems are at least 8mm in diameter at the base.

Once they have reached this size and are in active growth, scions of the correct cultivar of the fruit-bearing part of the tree are grafted, or budded, onto the seedlings and the bud-union is wrapped in tape.

The trees are now left to grow for three weeks after which the bud-union is unwrapped to check that the budding was successful; if it was the bud will be green and would have started to grow. If the bud is dead, the rootstock seedling is set aside for re-budding at a later stage. If the bud is green and growing, it is left for another seven days before the rootstock is cut back to 3cm to 5cm above the bud-union.

The tree is also bound to a stake that is planted next to it to make sure that it grows upright. The trees are left to grow tall. After about sixteen to eighteen months, the trees will be ready for delivery.

This flow diagram shows how citrus trees are propagated.



Citrus propagation process

Nursery Requirements

What do we need in the nursery during the process of making citrus trees? In this module, we will look firstly at the tools and equipment we need, then at the propagation media that is used at each point in the process, thirdly at the propagation structures in the nursery, and we will finish with looking at the ideal environmental conditions for plants to grow in.

Tools & Equipment

Seed Germination Trays

The first equipment we need is seed germination trays. They are 5cm deep, with a square wooden frame and a gauze, or shade cloth, base for air root pruning and drainage. Germination trays are placed on special metal racks. Air root pruning is when seedling roots grow through the gauze in the base of the germination tray and die off when exposed to air. It ensures that roots don't grow too long, and is also why these trays must be put in racks and not on solid surfaces.

Every time after a batch of seedlings has been removed from germination trays, the trays must be sterilised. All the growth medium and bits of plant material are removed and the trays are dipped in a suitable sterilisation solution.

Seedling Trays

Seedlings are transplanted from germination trays into individual cavities in seedling trays, which are the next items we need. Cavities in seedling trays have a volume of 60ml.

There are two types of seedling trays. The one kind is solid polystyrene trays, and the other plastic trays with loose inserts. Plastic trays work better because the seedlings can be moved around with their inserts so that trays with uniform plants can be made up, but they are also more expensive than polystyrene trays. Both polystyrene and plastic trays can be used more than once.

Seedling trays must also be sterilised every time after they are used. Remove all the growth medium and plant material from the trays, wash them with clean water, and sterilise them, either with a sterilisation solution or with a steam steriliser.

Planting Bags

Next we need planting bags to transplant the seedlings into, and in which the young trees can stay for up to 24 months, until they are ready to be planted in the orchard. It is important that bags are good quality and strong, so that they will last. Nurseries use different planting bags, but they usually have a volume of 4l or 5l, and it is important that the bag must be tall but not too wide so that it will drain well. Bags also have holes low down on their sides for drainage.

Planting Tool

When you transplant seedlings to the seedling trays, you will need a planting tool to make a hole of the right size in the growth medium in the seedling tray. This planting tool is sometimes called a dibber.

You will also need a dibber when you transplant the seedlings from seedlings trays to planting bags. In this case it is easiest to use one of the loose inserts from the seedlings trays, attached to a stake, because it will make a hole of exactly the right size. Remember to sterilise the planting tool before you use it.

Budding Tools

When you bud scions onto rootstock seedlings you need a budding knife and tape. The budding knife is used to make an inverted T-cut on the stem of a seedling, and to cut the bud-eye from the budwood. A budding knife must always be razor sharp so that it won't bruise the plant tissue around the cut on the stem. Bruising can cause budding to fail.

Clear polyethylene tape is used to bind the bud to the stem after it is inserted in the T-cut, so that the bud is kept in place until the bud-union and the healing is complete. It also keeps the bud-union from drying out completely, and from too much water getting in and rotting the bud.

Plant Stakes

The last special items you need in the nursery are the stakes or cleats that trees are bound to. These cleats are usually about 1m long, and made of wood. The end of the cleats which are planted in the growth medium is treated with copper, which makes it green, so that it is sterile.

Other Equipment

In addition to this special nursery equipment, you will also need general items, such as pruning shears, spraying equipment, water sprayers and cans, herbicide sprayers, and so on.

Propagation Media

Next we take a look at the propagation media, or soil, used during the propagation process. Generally, three different kinds of growth media are used in the germination trays, seedlings trays and planting bags.

In germination trays we use a medium grade vermiculite or perlite, which is sterile and has a low risk of contamination. Most nurseries use pine bark, peat moss or coir in seedlings trays. This growth medium must hold water well, because the cavities are small. If the growth medium is too sandy, it can be difficult to remove the roots from the cavity and the plant can be damaged easily. Most nurseries have their own secret recipes for the growth medium used in planting bags. It is, however, important for it to have an air-filled-porosity of between fourteen and 20% and electrical conductivity lower than 60mS/m, and for it to be sterile, with a pH value of 6.5.

Propagation Structures

Now that we know what equipment, tools and media we need, let's look at the structures we will be working in. In most nurseries you will find germination rooms, greenhouses and shade houses. The most important job that structures must fulfil is to create and maintain the right environmental conditions for that stage of the propagation process.

Germination Rooms

During seed germination the temperature, humidity and light must be carefully controlled in the germination room. The ideal temperature is between 26°C and 28°C, and humidity must be higher than 80%.

For light, the quantity and the colour matter. It is important to have enough light in the germination room, otherwise the seedlings will not germinate properly or they will grow etiolated. Red light promotes germination and growth, and rooms should be equipped with sources of artificial red light.

Greenhouses

Greenhouses, also known as tunnels, are the next structures in which the citrus seedlings are housed. In greenhouses, plant growth and development are promoted and accelerated. Most nurseries will have greenhouses of different sizes, used to house plants at different growth stages.

The environmental conditions in greenhouses are still controlled to some extent, but not as closely as in germination rooms. Ideally the temperature should be kept between 26°C and 28°C and humidity should be between 40% and 65%. It is also important to ensure that there isn't a build-up of carbon dioxide (CO2) in the greenhouse, because this will limit plant growth. For this reason, greenhouses are equipped with extraction fans which are used to aerate the rooms at regular intervals.

Another important factor in greenhouses is light. Light is essential for photosynthesis and also increases the rate of transpiration, which makes more energy available for plant growth. In the greenhouses the plants are placed very close together, so light penetration can be a challenge. Trees in planting bags are arranged in the greenhouse in groups of the same size, but in most greenhouses groups of plants of different sizes and ages alternate to help with light interception and aeration, and there is usually pathways between the groups of trees.

If the greenhouse is kept cooler, the plants' respiration rate decreases meaning that less energy is used for respiration and more is available for plant growth. Remember transpiration is when a plant loses water through its surface, and respiration is when the plant takes up oxygen to be delivered to the different parts of the plant, and releases carbon dioxide and water.

Shade Houses

Shade houses are the last place the seedlings go to in the propagation process. Conditions in shade houses are determined mostly by ambient weather conditions. While the plants are protected from wind and direct sunlight, the temperature and humidity cannot be controlled to a great extent, and the light is controlled only by the percentage of shade cloth used. Ideally light intensity should be reduced, which in turn reduces the temperature and increases humidity.

Environmental Conditions

We briefly made mention before of the humidity, temperature and light conditions in the various structures. Let's look in more detail at these environmental conditions.

Plants naturally regulate their level of metabolic activity according to environmental conditions. In extreme temperatures and humidity plants stop growing altogether, and they may even die if the conditions persist. Even in conditions that are reasonable but not ideal plant growth will slow down, which can have a significant impact on the efficiency in the

nursery and its ability to produce quality trees in the shortest possible time. Effectively regulating these factors is an important part of nursery management.

The most important environmental conditions are humidity, aeration, light quality and quantity, and temperature. In nature, there is an interaction between these factors, and they all affect each other. In a controlled environment such as a nursery, light is the most influential factor in this interaction. Light changes the temperature, which in turn affects the humidity level.

Humidity

Humidity levels are particularly important in allowing the plant to carry on with its metabolic processes. The ideal relative humidity for citrus propagation ranges between 80% and 90% for seed germination, and in the region of 50% for budding. In warm and dry areas, the humidity level often falls below 50% on hot summer days, making budding more delicate and requiring close monitoring.

Aeration

By aeration we mean the balance of the gasses in the structure where the plants are kept, of which the most important gasses for our purposes are oxygen and carbon dioxide. Plants grow best in a balanced environment, where both gasses are sufficient, as the processes of respiration and photosynthesis make use of both oxygen and carbon dioxide to sustain and develop the plant. In the open and under shade cloth the ambient air movement is good enough to aerate plants. In structures such as tunnels, ventilation becomes important. Ventilation extracts 'old' air which may have excess oxygen or carbon dioxide, produced by plants during the day or night respectively.

Light

All plants require light to grow. Light is essential for photosynthesis, while light quality, which is determined by the wavelength of the light, influences germination. In greenhouses and shade houses there has to be 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 will display symptoms of retarded growth.

In germination rooms, red light with a wavelength of 160nm (nanometre) is used to stimulate seed germination. Fluorescent tubes are commonly used as an artificial source for red light. These lights are used extensively and kept on for as long as possible – it is not unusual to have lights on 24 hours a day, week-round. This is also why seeds must not be too deep in the growth medium, because light needs to penetrate to the seed.

Some red light sources also increase the temperature in the room, otherwise additional heating units are used. Humidity can be increased by using a humidifier, or by wetting the floor. It is essential to have accurate, dependable monitoring equipment installed in the room, and to keep record of the temperature and humidity.

Temperature

The ideal temperature for propagation and plant growth is between 26°C and 28°C, and it must be monitored closely. If the temperature rises above 30°C the stomata on the leaves close and no further respiration takes place. This means that plants will start drying out and wilt.

Conclusion

Now that we have all our equipment ready and the conditions in our buildings are ideal, the next step is to start the propagation process. In the next module we look at this processes in detail.