
Citrus Planting Management

1 Introduction to Planting Management

Learner Guide



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Citrus Production Guidelines: Volume I – Citriculture: Establishment, *Citrus Research International*

Cultivar Fact Sheet, *Citrus Research International*

Citrus Academy production learning material:

Enterprise Selection and Establishment

Orchard Establishment

Propagation

Project coordinator:

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Introduction

definition

Planting Management

Planting management means planning and planting new citrus orchards, and maintaining records of individual orchards over their lifespans to assist with managing them in the best possible way. If done well, planting management contributes to the long-term profitability of your whole farm.

Planting new orchards is the most important part of establishing a new citrus production unit. It is often also the biggest capital investment a citrus grower makes, and from where the grower has to generate the returns on this investment.

If the citrus cultivar is not right; or if the orchard is not laid out well; or if preparation is not done well; or if trees are sub-standard; or if trees are not planted properly and looked after while they are young, it can mean that the orchard never reaches its full yield potential in terms of volume, or quality, or both. It can also mean that production practices will have to be changed to compensate, which can increase costs. It can make it more difficult to market fruit, or get decent prices. It can even mean that the orchard's lifespan will be shortened.

summary

Planting management involves:

- Selecting the optimal citrus type and cultivar
- Planning and laying out the new planting
- Preparing for establishing the trees
- Planting them and taking care of them while they are still young, and
- Keeping record of everything to do with the orchard for as long as it is in production.

Citrus Cultivars and Rootstocks

Today's citrus grower has an almost staggering choice of citrus cultivars and rootstocks. There are a myriad factors that play a role in this choice, and it is important to understand them and their significance. Once the choice has been made, trees are ordered from a citrus nursery, as long as two years before the orchard is eventually planted.

Orchard Layout and Planning

The next step is to plan the layout of the citrus planting.

- ❖ Where will the orchard be?
- ❖ What about the topography of the land?

- ❖ What do we need to know about the natural resources?
- ❖ What planting density must be used?
- ❖ How do we lay it out to limit its environmental impact?
- ❖ What about infrastructure?

Orchard Establishment

How long in advance physical preparation for the planting starts, depends on factors such as soil preparation and infrastructure.

At last the time will come for the trees to be planted, after which they must be cared for to make sure that they grow fast and well, and come into production in the shortest possible time.

Orchard Recordkeeping

Orchards have a commercial lifespan of eighteen to thirty years. If planting management was done properly, good volumes of marketable fruit will be produced as long as sound production practices are employed.

But can we simply assume that there will always be the same number of trees as the day it was planted? And how is the performance of the orchard monitored? We need proper records – after all, you cannot manage what you do not measure.

Conclusion

In farming there are always factors that cannot be controlled by the grower. This makes factors that can be controlled even more critical. Good planting management is such a factor, and can have a significant impact on the success of a citrus farm.

Citrus Planting Management

2 Citrus Types and Cultivars

Learner Guide



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Introduction

How many citrus types and cultivars can you name? It is safe to say that there are probably more commercially-produced citrus cultivars than what most people can name. From much-loved lemons, oranges, naartjies and grapefruit that can be found in every supermarket – and on every second street corner in the citrus season – to more exotic cumquats, shaddocks and Minneolas, citrus growers today have their pick when it comes to cultivar selection.

How does a citrus grower go about deciding what to plant? It is a choice that has to be made with a long-term view – once trees are in the ground, fruit that they produce will have to be marketed for eighteen to thirty years, for a price that will give the grower a worthwhile return on his investment.

Terminology

The first thing to understand is the terms that are used to describe kinds of citrus.

definition

Type

For the purpose of citrus production in South Africa, we distinguish between four main types of citrus, which you will probably know about already. These are oranges, grapefruit, soft citrus (also sometimes called easy-peelers), and lemons and limes.

Variety

Variety is the term used to divide citrus types into different kinds. For instance, oranges can be divided into navels and valencias.

Cultivar

Cultivar means cultivated variety and can be used to further distinguish between fruit of the same variety. So, cultivars of navel oranges include Palmer, Navelina and Washington.

Rootstock

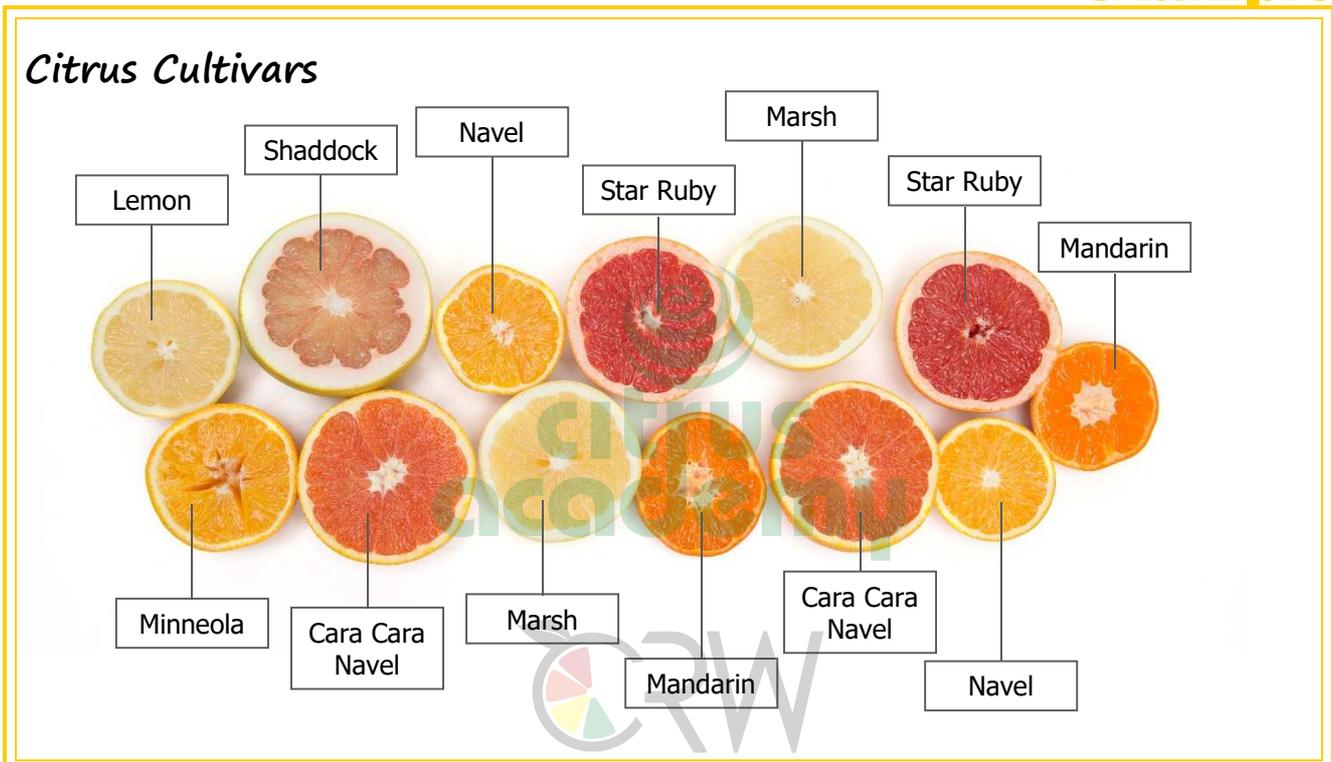
The last term that you need to understand before we get into the detail, is rootstock. First, you need to understand how young citrus trees are grown in a nursery. Seed is used to make seedlings. Once they have grown a little and the stems are about as thick as a pencil, a piece of budwood is grafted onto the seedling. The budwood is from the same cultivar that you want the fruit to be, and will grow to be the fruit-bearing part of the tree. The seedling part of the plant is called the rootstock.

Citrus Types and Cultivars

We will now look in more detail at the different kinds of citrus fruit.

Please keep in mind that new cultivars are constantly being developed. It is impossible to show every citrus cultivar here, but you need to understand what the major varieties and commercial cultivars are; also more or less when during the season different types and varieties are harvested and packed; which varieties are grown in which regions and how rootstocks and cultivars match up. You also need to know where you can find more information and sound advice about new cultivars.

example



Sweet Oranges

We will start with the citrus type that makes up the largest portion of production and exports from southern Africa: sweet oranges.

Oranges make up about two thirds of the citrus exports. Of the oranges that are exported, one third is navels and two thirds valencias.

information

Please Note

For the sake of clarification, horticulturally there are two other varieties of sweet oranges apart from navels and valencias, namely midseason oranges (referred to as mids), and blood oranges. Mids are traditionally marketed with valencias, and blood oranges with navels, so we will include them in those categories as well.

Navel Oranges

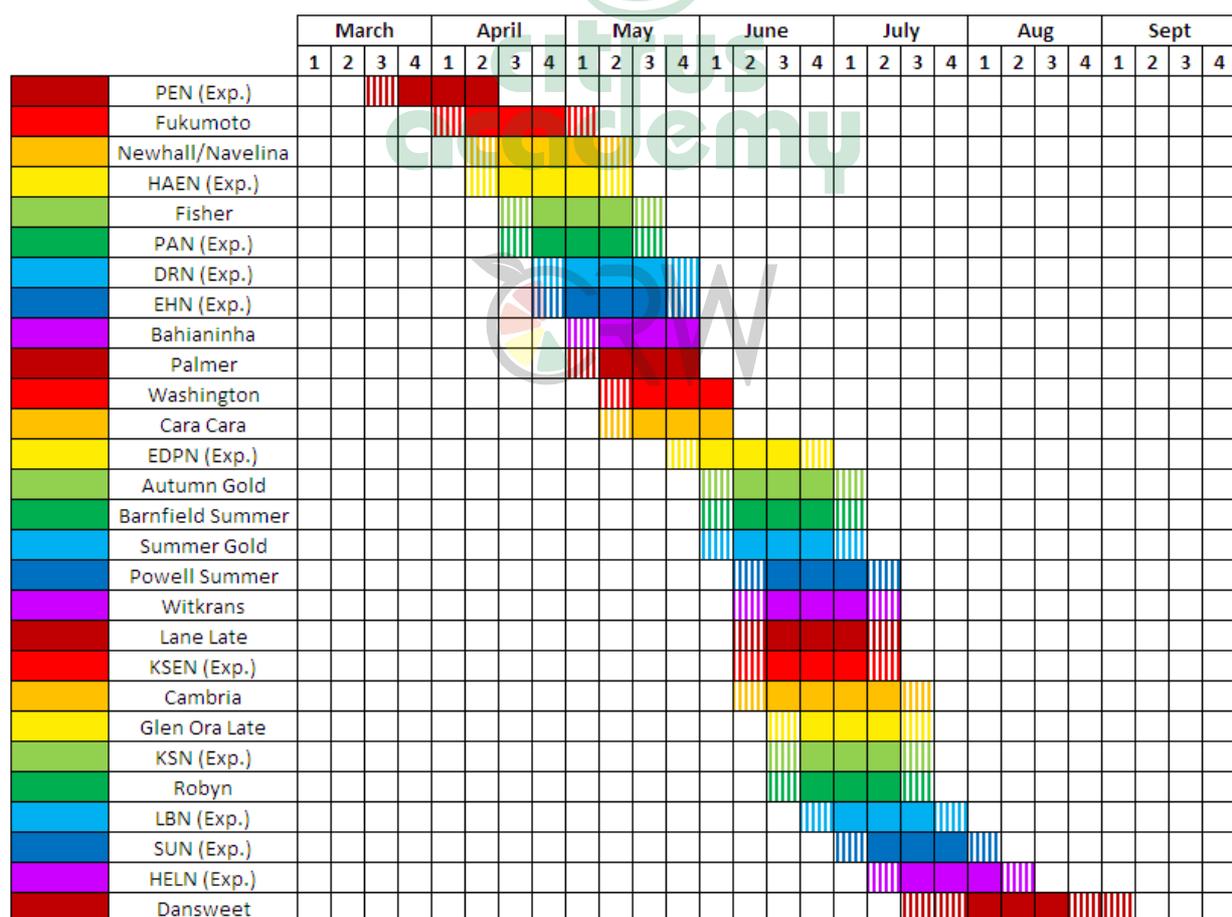


Navel oranges are named for the protuberance at the blossom-end of the fruit. It looks a little like a belly-button, but is actually is a small embryonic fruit. Navels are seedless, medium to large in size, and is a lovely yellow-orange colour when ripe. The fruit is easy to peel, and is known as a premier dessert fruit. The fruit shape and flesh colour varies depending on the cultivar.

Navels do well in the cooler production areas, where the night temperature drops considerably during the autumn. Remember that rind colour development in citrus depends on night temperatures dropping below 13°C while day temperatures are still relatively high.

The major production regions for navels are the Eastern Cape, cooler areas of the Limpopo province and the Western Cape.

The major commercial navel cultivars are Palmer, Bahianinha, Navelate, Washington and Cambria. There are cultivars that mature from as early as late-March and April, while the late varieties stretch into the season as late as August.



Source: CRI Cultivar Fact Sheets

Valencia Oranges

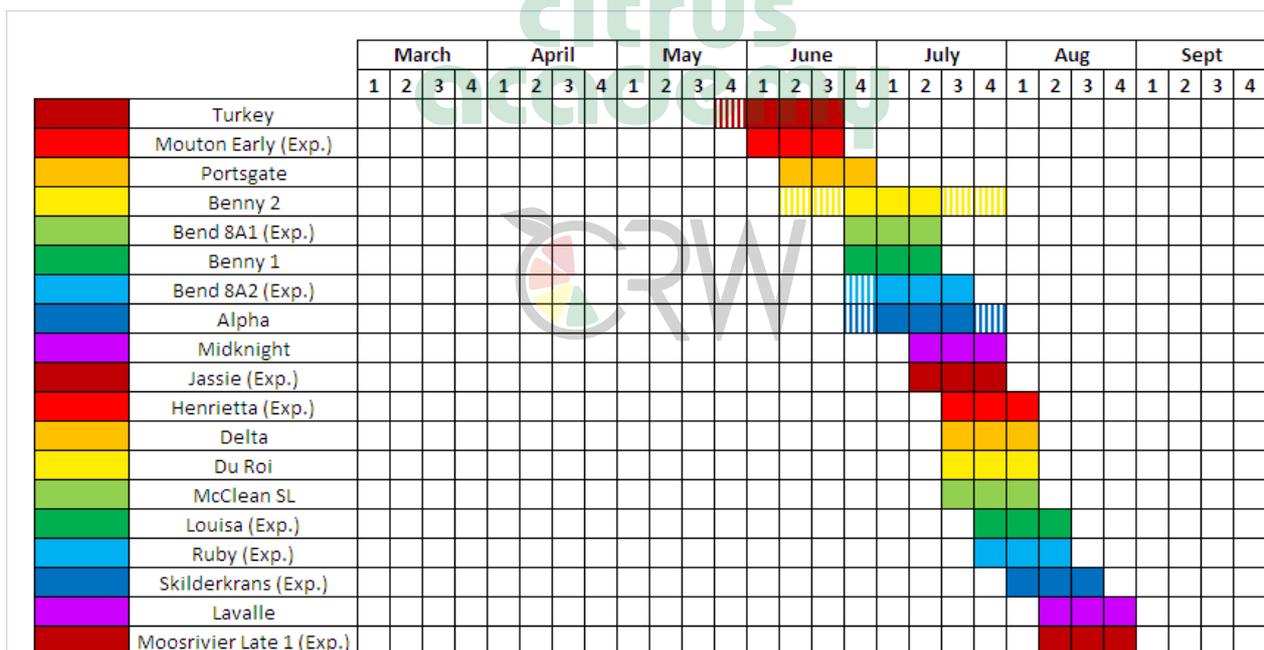


Valencias alone account for 44% of citrus exported from southern Africa, with 40% of hectares under citrus being used to produce valencia cultivars.

The fruit are medium to large, with a nice orange rind that is not too thick and have a smooth, finely pebbled texture. Valencias have a relatively high acid content and a high sugar content, which means that it has a lot of flavour and is delicious. It also has a high juice percentage. This makes Valencia oranges ideal for juicing and for eating fresh.

Valencias are suited to hot, humid areas. Two thirds of the valencias are produced in the Limpopo province and Mpumalanga, with the only other significant production being in the Eastern Cape, where we find 16% of the total planted hectares.

Midnight (technically a midseason orange), Delta valencia, Valencia Late, and Turkey valencia are the cultivars that are produced most, accounting for about 85% of the hectares used for valencia production. Turkey valencia is the first cultivar to mature, and are ready for harvesting from about the last week in May in the warmer production areas. The last Valencia cultivars mature around September.



Source: CRI Cultivar Fact Sheets

Soft Citrus

Soft citrus is a collective name for a group of fruit that is also referred to as easy-peelers or, in the common tongue, naartjies. The main characteristic that these fruit have in common is that they are easy to peel and tasty, making them the ideal snack fruit.

Soft citrus is grown in cooler, drier production areas, although there are some cultivars which have been shown to be suited to the hotter regions. Still, 75% of soft citrus in southern Africa is planted in the Eastern and Western Cape.

There are three distinct varieties of soft citrus, being satsumas, clementine and mandarin.

Satsumas



Satsuma cultivars are the earliest ripening soft citrus fruit. The fruit is usually seedless, with a loose rind that peels very easily. The most popular Satsuma variety is Miho Wase, making up 85% of the satsuma production.

Miho Wase is also the cultivar that matures the earliest of the Satsuma cultivars, and can be harvested from as early as mid-March. Other Satsuma cultivars are harvested until around the end of May.

	March				April				May				June				July				Aug				Sept			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Miho Wase																												
Kuno																												
Okitsu Wase																												
Miyagawa Wase																												
Ohtsu (Exp.)																												
Owari																												
Aoshima (Exp.)																												
Dobashi Beni																												
Ueno (Exp.)																												
Imamura (Exp.)																												

Source: CRI Cultivar Fact Sheets

Clementine



Clementine is the premier soft citrus variety. The fruit is easy to peel and if they are grown in exclusive blocks away from cross-pollinating varieties, they are seedless. When mature, the peel turns a lovely bright orange, and the flesh has a distinctive sweet flavour.

The most popular clementine cultivar is Nules, which accounts for about 75% of planted hectares. The earliest commercial clementine cultivar mature towards the end of March, with the last one finishing around mid-June.



	March				April				May				June				July				Aug				Sept			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Early Clementine (Exp.)																												
Oronules																												
Marisol																												
Early Oroval (Exp.)																												
SRA 63																												
Oroval																												
Nules																												

Source: CRI Cultivar Fact Sheets

Mandarins



Mandarin hybrids are similar to clementines. Mandarins are also excellent eating fruit, with a reasonably thin rind. The colour of the rind and flesh can vary from gold to deep reddish orange, depending on the cultivar.

Nadorcott is the most common mandarin cultivar, and accounts for about two thirds of the hectares planted with mandarin cultivars. Early mandarin cultivars are ready to be harvested around mid-May, and the season from there stretches as late as September.

Novas and minneolas are cultivars that are marketed under the mandarin umbrella, but which are actually separate varieties.

Novas are larger than other soft citrus fruit, and are not as easy to peel. The flesh of the Nova is deep orange and has a distinctive aroma. The segments are juicy, tender and sweet. They are harvested from April to mid-June.



The minneola is a hybrid grapefruit and tangerine. It tends to be a big fruit with a distinctive nipple at the stem-end of the fruit. When mature the rind is deep orange, and the flesh is juicy and aromatic, with a good, tangy flavour. They are ready to be harvested from mid-May to the end of July.

	March				April				May				June				July				Aug				Sept			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Nova																												
HEM (Exp.)																												
African Sunset																												
Or																												
Murcott X Clem																												
Valley Gold																												
Nectar (Exp.)																												
Sweet Spring (Exp.)																												
Nadorcott 1																												
Tango (Exp.)																												
Tasty 1 (Exp.)																												
Tahoe Gold (Exp.)																												
Mor																												
Yosemite Gold (Exp.)																												
Shasta Gold (Exp.)																												
Tasty 2 (Exp.)																												
Gold Nugget (Exp.)																												
Winola (Exp.)																												

Source: CRI Cultivar Fact Sheets

Lemons and Limes



Everybody is familiar with lemons – they are used fresh for cooking and in drinks, and lemon juice is a must-have in many kitchens. They are always available, and the average consumer expects to be able to buy them even in the middle of the summer.



Limes on the other hand are not as common. They are smaller, round and green in colour. They are not produced in South Africa in large volumes, because they need very hot and humid growing conditions.

The appearance and characteristics of lemon fruit vary considerably by cultivar, but they all have one characteristic in common – they are very sour. Lemons is the fastest growing citrus variety, and it has been extremely profitable for the last three or four seasons.

About half the lemons in South Africa is grown in the Eastern Cape, with the Limpopo province in second position. These two provinces together with the Western Cape account for 90% of lemon production.

The main lemon cultivar that is commercially grown in South Africa is the Eureka lemon, on its own accounting for about 85% of the planted hectares. The rind of the Eureka is smooth and reasonably thin, and a bright to golden yellow colour when the fruit is mature. The fruit has a high acid and juice content. There is also a seedless Eureka cultivar.

Eureka lemons can have as much as three fruit sets. This means that at the same time there can be as much as three lots of fruit on a tree that are at different stages of maturity. Because of this characteristic, trees can produce marketable fruit from as early as February in hotter areas, and to as late as mid-September in cooler regions. Other cultivars are used to fill in the periods between the maturation of the different fruit sets.

Grapefruit

This leaves us with the last citrus type, grapefruit. Grapefruit varieties share a distinctive tangy, sweet flavour. Grapefruit is a popular breakfast fruit, and for making marmalade. The three most common grapefruit cultivars are star ruby, marsh and rosé.

Grapefruit grows best in hot, humid conditions, with production shared mostly by the Limpopo province, Mpumalanga, Swaziland and KwaZulu-Natal. These regions account for 90% of production.

Star ruby is the earliest cultivar to mature, and is picked from around mid-May. The latest cultivars are harvested as late as August.

Star Ruby

Star ruby is by far the most common grapefruit cultivar, making up almost 85% of grapefruit hectares. The fruit is medium to large, and has a deep golden yellow to red colour. The flesh of the Star ruby is deep red, and it has a sweet flavour. The fruit rarely has more than one or two seeds, and it has a high juice content. It is the ideal fruit for fresh consumption.



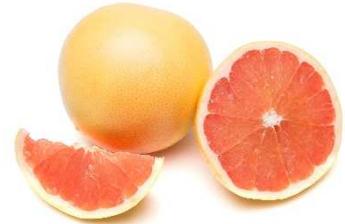
Marsh



Marsh is a large, whitish-yellow fruit and is also virtually seedless. Marsh has a characteristic sharp, tangy flavour. It is suitable for fresh consumption or for processing into juice and is the favourite fruit for making marmalade.

Rosé

Rosé fruit is slightly smaller than Marsh, and is also virtually seedless. The rind of the fruit is light yellow with a distinctive red blush, and its flesh is pale pink in colour. The flavour is similar to that of the star ruby, but not quite as intense.



Shaddock



The last variety that should be mentioned is the shaddock, also called the pomelo or sometimes pummelo. This variety is not strictly a grapefruit, but the fruit is marketed with other grapefruit. The fruit has a thick rind, and thick, spongy pith. The flesh is light pink, with tough membranes between the sections. This makes it into a fruit that is not easy to eat, but for those that know it, it is one of the best tasting citrus fruit that you can wish to find. It matures towards the beginning of the season, in April to May.

	March				April				May				June				July				Aug				Sept			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Star Ruby																												
Marsh / Nartia																												
Jackson																												
Ray Ruby																												
Henderson																												
Rosé																												
Flamingo																												
Star Ruby late																												

Source: CRI Cultivar Fact Sheets

Citrus Rootstocks

The most commonly used rootstocks in citrus production in southern Africa are Roughlemon, Volckameriana, Swingle Citrumelo, Carrizo Citrange, Troyer Citrange, X639 (or Cleopatra XP Trifoliolate), C35, MXT, and Yuma citrange.

Before we go about selecting the right rootstock, it is important to be clear on the function of roots. Roots anchor the plant in the ground, absorb and transport water and nutrients into the plant, synthesise growth regulators, and store food reserves.

The right sort of rootstock is one that meets the following requirements: it is compatible with the fruit-bearing scion cultivar; it is adaptable to the soil and climatic conditions; it makes the fruit-bearing scion more productive and vigorous, is resistant to pests and diseases; and it influences the fruit maturity, quality, colour, size and yield. This may seem like a tall order, but the right rootstock can achieve all of this.

summary

Rootstock Selection

In summary, we can say that rootstock selection serves two purposes, namely:

- Minimising the effect of limitations that there might be at the site, such as the soil type, the quality of the irrigation water and disease presence.
- Secondly the rootstock can enhance the yield, fruit size and fruit quality

This table summarises the characteristics of commonly used rootstocks. Take a careful look at the table. Note the amount of research that has been done and the information that is available to show what rootstocks work best and under what circumstances, and how it impacts on tree performance.

	Rough-lemon	Swingle Citrumelo	Carrizo Citrange	X639	C-35	MXT
Disease Factor						
Exocortis	Tolerant	Tolerant	Sensitive	Susceptible	Susceptible	Susceptible
Tristeza	Tolerant	Tolerant	Tolerant	Tolerant	Tolerant	Tolerant
Phytophthora	Susceptible	Tolerant	Tolerant	Susceptible	Tolerant	Tolerant
Citrus nematodes	Susceptible	Tolerant	Susceptible	(Not known)	Tolerant	Tolerant
Soil Factor						
Poor drainage	Susceptible	Tolerant	Sensitive	Sensitive	Tolerant	Sensitive
High clay content	Sensitive	Intermediate	Intermediate	Sensitive	Tolerant	Intermediate
High sand content	Tolerant	Intermediate	Intermediate	Intermediate	Intermediate	Intermediate
High chlorides	Tolerant	Intermediate	Sensitive	Intermediate	Sensitive	Sensitive
High pH	Tolerant	Sensitive	Sensitive	Tolerant	Sensitive	Sensitive
Drought	Tolerant	Intermediate	Intermediate	Sensitive	Sensitive	Sensitive
Replant	Sensitive	Tolerant	Intermediate	Sensitive	Tolerant	Intermediate
Tree Performance						
Tree growth rate	Vigorous	Moderate	Moderate	Moderate	Slow	Moderate
Final tree size	Large	Medium	Medium	Medium	Small	Medium
Cold hardiness	Poor	Good	Good	Good	Good	Good
Longevity	Fair	Good	Good	Fair	Good	Good
Yield per tree	High	Good	Good	Good	Good	Good
Fruit quality	Low	Good	Good	Good	High	High
Rind colour development	Intermediate	Late	Early	Early	Intermediate	Intermediate

information

Rootstock Selection

In volume 1 of the CRI Citrus Production Guidelines you will find more detailed information on rootstocks and on selecting the correct one. If you still need assistance and advice, consulting your nearest certified citrus nursery on the best choice of rootstock is the best way forward.

Safe Plant Material

Trees can be purchased from any of a number of accredited citrus nurseries. Trees must be ordered at least 18 months in advance to give the nursery enough time to make them. Make sure that the nursery you use is accredited by the Citrus Improvement Programme, so that you can be sure that they will supply trees that are true-to-type and of a high quality.

The nursery will use certified budwood from the Citrus Foundation Block for the fruit-bearing scion, and the trees will conform to the standards set by the Citrus Improvement Programme. In short, this means that the trees will be healthy with a good nutritional status; the trees will be free of pests and diseases; the stems of all trees will be straight; the bud union will be at least 20 cm above the soil level; the trees will have healthy with a well-developed root systems; and the trees will be free of harmful pathogens and nematodes.

Make sure that you discuss these details with the nursery owner when you order the trees. Visit the nursery from time to time to check in on your trees. When the trees are delivered, certificates issued by the CIP must accompany each consignment, certifying both the health of the trees and the origin of the budwood. Remember that this is a requirement for GlobalGAP registration.

definition

GlobalGAP

GlobalGAP is an internationally recognised set of farm standards dedicated to Good Agricultural Practices (GAP). Through certification, producers demonstrate their adherence to GLOBALGAP standards.

The Citrus Foundation Block is owned and operated by Citrus Research International, which means in essence that it belongs to the citrus growers of southern Africa. Most nurseries get the seed from which they grow their rootstock plants from the Citrus Foundation Block. All nurseries are however obligated under the Citrus Improvement Scheme to get all their budwood from the Citrus Foundation Block.

The Citrus Foundation Block is located in the Eastern Cape near Uitenhage, in a secluded valley where citrus is not commercially grown. The nearest commercial citrus orchards are located in Kirkwood, which is approximately 40 km from the CFB. To preserve this secluded location, South Africa's Department of Agriculture, which is the National Plant Protection Organisation of South Africa, endorsed a 5 km exclusion zone around the Citrus Foundation Block where no citrus trees are allowed to be grown, even in home gardens.

Conclusion

It is important to know your citrus, and particularly to know what grows best in your area. Seeing that export citrus has been grown in some production regions for up to 100 years, there is a lot of knowledge and data to tap into to find out what will work best. On the other hand, new cultivar development is one of the fastest growing areas of research, and new and exciting cultivars are being released onto the market all the time.

information

Stay Informed

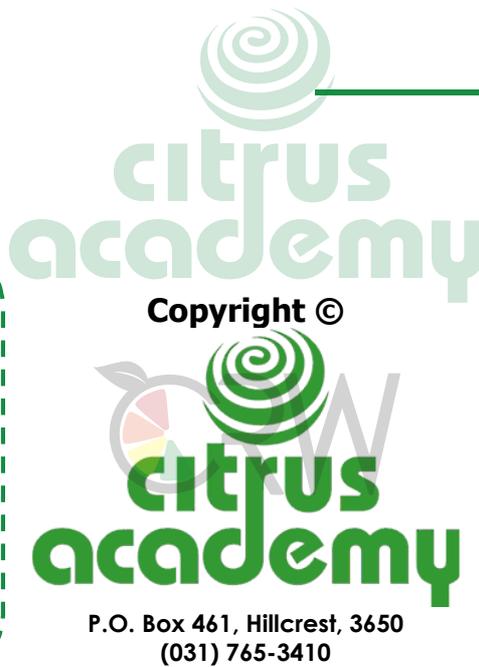
To stay informed, subscribe to and read industry publications, attend the Citrus Research Symposium and CRI study group meetings, and keep in contact with your CRI extension officer. Visit www.cri.co.za for contact details.



Citrus Planting Management

3 Orchard Layout and Planning

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Introduction

By the time you start planning the layout of a new orchard, you will already know what you will be planting in the orchard, and you will have an approximate idea of where on the farm the orchards are going to be. But what exactly will it look like? What factors must I think about when I decide on this? The two major factors which we will look at now are firstly, the natural resources and characteristics of the area where you want to plant, and secondly, the role that infrastructure plays.

Map

Before you start, however, you need a map of the farm that you can use to make notes on. A high-quality aerial photo works very well for this purpose, but a topographical map will also work, as long as it is large enough. As you gather the information we will be discussing, note it on the map, in as much detail as possible. This will help you understand what you have to work with when you come to the final planning.

information

Map of the Farm

Aerial maps can be obtained from your local survey office, or from National Geo-spatial Information (NGI), a component of Department of Rural Development and Land Reform (DRDLR). More information is available at www.ngi.gov.za. Topographical maps can be obtained from reputable suppliers such as MapStudio (www.mapstudio.com.za) or MapQuest (www.mapquest.com).

Natural Resources and Characteristics



The natural resources that are important for citrus production are soil, water, and natural vegetation. By natural characteristics we mean climatic conditions and topography. All forms of farming have an impact on the natural environment. Into an area where there is a huge diversity of plant and animal species, farming introduces one species – in our case citrus trees – that from then on dominate all other species. The available water and soil is also from then on used mainly to cultivate the species that is being farmed.

In order to maintain and protect the natural environment as far as possible, it is important to understand exactly what natural resources are needed for cultivation of citrus trees, how much of it is needed, and how we can use them in the best possible way. We also need to understand how to limit the impact of farming activities on the water, soil and natural vegetation. And we need to understand this before we start planning the layout of an orchard, along with understanding how certain characteristics of the natural environment impacts on layout planning.

Soil



Before we can start planning our new orchard, we need to know if the soil is suitable for growing citrus. Citrus can be grown in different soils, as long as the soil is prepared correctly, is deep enough, is within an acceptable acidity range, does not have layers of vastly different kinds of soil, and has reasonable drainage, which depends on the texture of the soil.

While planning a new orchard we will dig profile pits in the area where the orchards will be so that we can investigate exactly what the soil there is like. Soil samples are also taken at the pits for analysis. Profile pits are dug at least 1.2 m deep. We dig at least five profile pits per hectare if the soil is more or less the same, or homogenous. If there are different soil types in the same area it is better to dig more than five profile pits per hectare. Soil samples are marked clearly so that we know exactly at which pit the sample was taken, and sent to a laboratory for analysis. Mark the position of your profile pits on your map of the farm, and cross-reference them with the soil samples.

information

Accredited Laboratories

For a list of accredited laboratories in South Africa, you can contact Citrus Research International (CRI) at www.cri.co.za or visit the website of the South African National Accreditation System (www.sanas.co.za).

Once we have the result of the soil analyses, we add to that the observations made in the profile pits. Note these findings on your map. It is a good idea to consult an expert soil scientist to advise on soil preparation for the new orchard, and even on how to best manage the soil once the orchard has been planted.

Water Sources

Outside of rain, the main sources of water on most farms are rivers, canals, dams and boreholes. Make sure that your water sources are all marked on your map. We need to be sure that there is enough water available throughout the year from one of the above sources or a combination of them to sustain our new citrus plantings.



Mature citrus trees need between seven and 10,000 l³ of water per hectare per year. When during the year the water is required depends on the rainy season of that area, but generally more water is required during the summer months than in winter. The water sources must be able to supply this water when it is needed. It is good policy to develop a farm to within the capacity of available water and to build in a safety factor for water supply.

Where the water sources are in relation to where you are planning to establish a new orchard is important, because you need to factor in the cost of getting the water to the orchard.

Water quality is generally not critical when it comes to citrus production, because citrus trees are reasonably tolerant. As long as the water is not polluted or extremely acidic or alkaline, the trees will be able to grow well. It is still advisable, though, to take water samples before planting a new orchard and to have them analysed by a laboratory so that you know what the water is like. Add this information on your map, along with data on the volume of water available from each source.

Climate

Worldwide, citrus is produced almost exclusively in the band between twenty and forty degrees north and south of the equator, better known as subtropical regions. Summers must be hot enough for fruit to grow sweet, and winters must be cold enough for fruit to develop colour. In South Africa, commercial citrus production is confined to areas with hot, reasonably humid summers, mild and almost frost-free winters where temperatures seldom drop below -2°C, and with high enough rainfall, and not too much hail and wind.

Hail and wind cause external damage to the fruit, which makes them less marketable. Hail can in fact damage and destroy small fruit, while it will cause marks on more mature fruit. Wind makes fruit rub against twigs and branches which cause blemishes on the fruit. To limit wind damage, orchards are laid out so that the wind move between the rows of trees. To plan this, we need to know the direction and strength of the prevailing wind.

Windbreaks also assist in limiting wind damage. A windbreak is usually one or more rows of trees or shrubs planted around an orchard. If the orchard is large or the prevailing winds are particularly strong, a row of windbreak trees may even be planted in the orchard. Mark the position of windbreaks on your map, indicating what trees or shrubs you need to plant.

Gather as much historical weather data as possible, measured and recorded as close as possible to the site where we will be planting. Enter this information on your map, indicating especially the direction and strength of the prevailing wind, along with the historical seasonal temperatures and rainfall, and data on the prevalence of hail and frost.

Topography

In simple terms topography means the lay of the land. This is the characteristics of the natural environment that plays the biggest role when planning orchard layout.

Topography determines the placement of the orchard and row direction. On sloping land, rows of trees are planted on the contour lines, for the sake of limiting irrigation run-off and better storm water management and also because they will be easier to access by tractor.

Draw contour lines on you farm map if they are not there already, so that it will help you to form a picture of the lay of the land where your orchard will be.

Erosion

Erosion is one of the biggest dangers when the cultivation of a single crop is introduced in an area. Where in the past the natural vegetation and natural barriers might have protected the soil against erosion, these will be removed and replaced with – in our case – an orchard of trees neatly planted in rows. Over-cultivation can also destroy the topsoil structure, which will affect the movement of air, water and roots in the soil.

When you plan the layout of an orchard, look to limit the eroding effects of water and wind on the soil as much as possible. Where gullies are already forming, mark them on your map, and take steps to improve the situation even before the orchard is planted.

Infrastructure

Now that we have looked at the natural environment, let's take a look at the man-made environment. Infrastructure is put in place to make economic activity possible.

External Infrastructure



External infrastructure is developed and built by government, its agencies and private companies to bring services to businesses. This includes the road system, the electricity generation and supply system, the water supply system, telecommunication infrastructure, logistics infrastructure (like the ports), and even towns and local businesses.

In rural areas this sort of infrastructure is sometimes lacking, but most of the time it is good enough to make it possible to farm profitably with citrus. Make notes on your map of where access points are to external infrastructure, and where the closest town and human settlement is. Also make a note of the distance to the nearest port, market, packhouse and processing facility.

Internal Infrastructure

Internal, or on-farm infrastructure, is developed to make the economic activity of the farm possible. In our case, infrastructure is developed to make the citrus farming operation as efficient as possible, while at the same time minimising impact on the natural environment. On a citrus farm, we need the following sort of infrastructure: fencing, farm roads, irrigation system, electricity supply, and farm buildings. We might also need structures for erosion control.



If you are planning a new planting on an existing farm, you will work with the internal infrastructure that is already on the farm. Mark it on your map, also recording the

supply capacity where relevant. If it is a large new planting, it may be necessary to develop more infrastructure, but if it just a replanting or small expansion, you could just make use of what is already in place. If you are planning a whole new farm, you have the opportunity to plan and plot out the infrastructure optimally, which you will do as part of the land utilisation plan.

When you do need to development and build infrastructure, your thinking should be around the capital cost of equipment versus the ongoing cost of maintenance, not forgetting the cost of failure if the infrastructure is not of good quality. For specific kinds of infrastructure, also think about the following:

- ❖ Fencing around a farm is put up to mark the boundary line of the property, to keep unwanted visitors out, and to secure your crop, your equipment, and the people on the farm. Additional high-security fencing is often put up around farm buildings, especially around staff housing. If there is already fencing on the farm, mark it on the map, indicating the type of fencing, its height, and its condition.
- ❖ Farm roads are built to give delivery vehicles access to the farm, and to give tractors, spray equipment, bakkies and so on access to orchards. Access for heavy vehicles that come to the farm to deliver supplies or transport fruit should be as close to the main road as possible, and should preferably not run through the orchards. In fact, traffic through the orchards must be minimised and controlled. Mark existing and new roads on your map, indicating the condition of the roads and how much traffic each road should carry.
- ❖ The irrigation system brings water from whatever water source to the orchards. In some cases the system will include holding dams, while in other cases it may merely consist of pipelines leading from the main water source. Make sure that you mark clearly on your map where the water will be coming from, and in what volumes.
- ❖ The electricity system needs to bring power to the farm buildings and to pump houses. Electricity connections must be installed by a qualified electrician and must comply with regulatory standards. Notes on your map about where the transformer is from where electricity will have to be taken, will help with your planning.
- ❖ Farm buildings is a substantial investment so think carefully about what you need, what the requirements are, and where you place it. Health and safety legislation and codes of labour practices have very clear prescriptions for buildings in which people work and live. Make sure that you know these regulations, know how it applies to your situation, and know how to comply with them. Fixing bad buildings afterwards is very pricey and can be avoided with a little planning. Mark existing buildings clearly on your map

Orchard Layout and Orientation

Now that we have a good picture of the area where the new planting will be, we can plan the layout and orientation of the orchard. The orientation of a new orchard depends on a few factors. Erosion and wind direction are important, as is light interception. Ideally, citrus is planted in rectangular blocks on a 10° to 30° south-east facing slope, with rows running north-south for



maximum light interception, or otherwise on contour lines on sloping ground to minimise erosion.

But local conditions ultimately determine the layout. For instance, in the Western and Eastern Cape, fruit in orchards on east-facing slopes will be ready for harvest earlier than on west-facing slopes. In windy areas, an orchard at the top of a hill facing the prevailing winds will suffer much more wind damage than one on the lee side of the hill. The layout of each orchard block will differ slightly because of topography factors.

Tree spacing between rows and between trees within rows is determined by numerous factors including climate, variety and soil type. A typical tree spacing is 6m between rows by 3m between trees, meaning that 555 trees per hectare are planted.

Remember that rows must be far enough apart to allow access for spray equipment without damaging the trees even once the trees are mature, and to allow enough light interception. Trees in rows have to be far enough apart to allow for cultural practices and limit tree damage.

A lot of research is being done on tree spacing, which boils down to a simple principle – the more trees you can plant per hectare, the more fruit will be produced early in the orchard's lifespan, meaning the orchard will become profitable much sooner. But the production per hectare will eventually level out at the same volumes it would have been at a lower tree density, because the growth of densely planted trees is limited. Planting at a higher density does mean a higher capital outlay – you will have to buy more trees – but the cost of the trees is the smallest portion of the capital outlay per hectare of planting a new orchard.

Conclusion

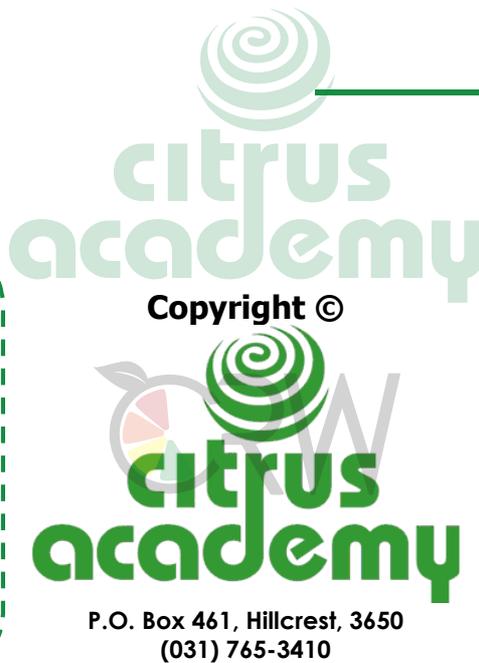
We now know all the factors that must be considered when planning the layout of our farm and the layout of our orchards. The layout of each block will determine the ultimate success of the orchard. Keeping environmental factors such as erosion and natural vegetation in mind when planting a new citrus block will lessen the impact of your new planting on the environment and it will ensure a more sustainable and profitable operation.



Citrus Planting Management

4 Orchard Establishment

Learner Guide



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Introduction

Once they have been planted, citrus trees will be producing fruit for up to thirty years, and they need to produce enough fruit of good enough quality. You get a chance to plant an orchard only once in this time, and it is worth doing well. Once the planning has been done around what will be planted, where it will be planted, and how the orchard will be laid out and orientated, we need to start preparing the orchard and get the trees into the ground.

Tools and Equipment

First of all, let's look at the tools and equipment that we will need during planting.

Measuring Tools



We will need measuring tools to peg out the orchard so that the trees will be planted in the right places. For this we will need a theodolite or dumpy level; a measuring tape; a plant line or cable; and stakes.

Theodolites and dumpy levels are used to mark out straight lines and to measure right angles. We will use it to make sure that the rows are straight and run parallel to each other.

The measuring tape is used to measure the distance between rows and between trees, and plant lines or cables are put in place to mark the position of the rows. We also sometimes use lime to mark the rows. You can make notches in the plant line or cable to show where each tree will be planted in the row, and then put stakes in where the trees will be planted.

Planting Tools

We will then need planting tools for when we plant the trees. This includes a planting board, spades, forks and a water-cart. Make sure that you have enough tools at hand and that they are in a good condition before you start planting.

Straight after planting you might also need pruning shears, biodegradable twine and stem covers. Pruning shears are used to cut away damaged or unwanted shoots straight after planting. Twine is used to fasten the tree to a stake so that it is stable. Stem covers of paper or straw are put around the lower part of the stem to prevent suckers from developing and to protect the tree from herbicides. It also helps to protect the trees from sunburn in hot areas.



Planting Preparation

Soil Preparation



Planting preparation starts with the preparation of the soil. This is normally done about three to nine months before we start planting, depending on how much moisture there is in the soil.

To prepare the soil, we need to apply physical and chemical preparation methods, so that the tree roots can develop properly. The roots need to be able to grow through the soil and take up water and nutrients from it, which is

easier to do if the soil has a good physical structure. The trees can now grow quickly and well, and start bearing fruit sooner.

Most soil has some sort of chemical imbalance that we need to do something about before we plant citrus trees. When we plan for a new planting, we dig profile pits and take soil samples, which we send to the lab to be analysed.

Qualified soil scientists advise us on what we need to work into the soil when we prepare it for planting, so that those chemical imbalances don't affect the trees once they are planted.

To prepare the soil, it is ripped or ploughed to a depth of between 60 and 100cm. This makes the soil deeper and helps the roots to develop well because it loosens the soil. It also assists in breaking up hard layers in the soil that might keep roots from developing, or cause water to dam up in the soil.

Sometimes we use soil from the area between the rows to make ridges on which the trees will be planted. We do this to increase the soil depth, and also allow water to drain better. Some growers even prefer to use ridges on deeper soil, because it forces tractors and other machinery to go only between rows.

We don't want tractors and machines to drive on soil above where tree roots are growing, because this compacts the soil and makes it more difficult for the roots to grow.

Once the soil has been ripped or ploughed it is important to keep tractors and trailers out of the orchard as much as possible so that the soil will not get compacted again. Tractors and trailers will be used for things like delivering trees and other supplies to the orchard once we are planting, but we need to be careful about where they drive. It is better to measure and peg out the orchard and clearly mark where the tree rows are going to be with agricultural lime. The vehicles can then stay on paths that will eventually become the areas between the rows.

Windbreaks

We now need to plant windbreak trees. These trees are planted on the borders of the orchard to protect the citrus trees against wind. Small fruit can get damaged by surrounding twigs and leaves if the orchard is exposed to wind, causing marks on the fruit that can mean that the fruit cannot be exported. Too much wind can also cause the soil to dry out faster and cause soil erosion, and it can damage the trees themselves.



Windbreaks must be planted well before the citrus trees so that they can protect the young trees from the start. The trees used for windbreaks must grow fast and be tall and strong. They should not require too much water, and they should also not be hosts to pest insects.

Irrigation Pipes

The next step is to install the irrigation system in the new orchard. Most irrigation systems have mainlines, sub-mainlines and mother-lines which bring the water to the orchard. These pipes are buried before we start planting a new orchard.

Once we have finished planting we can then immediately install the pipes and emitters by the trees.

Plant Material



As we get closer to the date when we start planting, the trees that were ordered from the nursery will be delivered to the farm. We need to be sure that the trees are healthy and strong when they arrive on the farm, and we need to look after them until they are planted.

At the nursery trees are grown in soil inside plastic bags, and this is how they will arrive at the farm.

The plants are watered well before they leave the nursery so that the soil won't dry out during transport to the farm. It is best to transport them in a closed vehicle so that they are protected from the heat and the wind, and from getting damaged.

When the trees arrive on the farm, put them in a safe place and water them. Make sure that the soil in the bags is kept moist until the trees are planted. The roots of the trees must not be allowed to dry out at any time.

Planting Conditions

It is now time to start planting the trees. Before we look at the best way to go about this, we need to think about the best conditions during planting. When the tree is moved from its bag and planted in the orchard it is a shock to the tree. It must recover from the shock before it can settle in the new soil and start growing. The more tree-friendly the conditions are when we plant, the less stress on the tree and the quicker it will settle and grow.

Weather Conditions

In terms of weather conditions, we must avoid planting in extreme temperatures. Remember that temperatures of above 39°C will damage trees, while the lowest temperature at which trees can grow is 13°C. Look to plant trees in the morning, with the temperature around the mid-twenties. Stop as soon as it gets too hot, and move the unplanted trees to a safe place where they are protected from the heat.

Rain during planting is mostly good, but if the soil becomes too wet you must stop planting and allow it to dry out a little before continuing. You don't want to plant in waterlogged soil.

Soil Conditions

The soil should also not be too hot or too cold when you plant trees in it. If the soil is too cold the tree can't absorb moisture and grow, and if the soil temperature is too high, it will dry out and cause moisture stress.

In short, when we plant the trees, the soil should be well prepared to a depth of about 60cm, well-drained, but wet enough so that the roots won't suffer moisture shock while not being so wet that clods start forming. The soil temperature should be above 20°C.

Planting Procedure

The time has now finally come to get the trees into the ground. We have our equipment at hand, the orchard has been pegged out, the irrigation supply lines have been installed, and we have made sure that the planting conditions are right.

- ❖ The first thing to do is to dig a hole for the tree just before you plant it. It is better to use a garden fork to make the hole – a spade might smear the soil on the inside of hole if it is too wet, which makes it more difficult for roots to penetrate. To know what size the hole should be, use the plastic planting bag that the tree is in as a guide. The hole should be just deep enough for the roots of the tree, but a little bit wider than the size of the planting bag. Make a little pile of soil in the bottom of the planting hole.
- ❖ Now take the tree from the bag. Shake about a quarter of the soil from the roots, so that at least a third of the roots will be in direct contact with the soil in the orchard after the tree is planted. We don't want to disturb the roots too much so that the tree is protected from transplant shock, but we do want the roots to settle into the new soil.
- ❖ If there is a knot of roots at the bottom of the plastic bag, loosen them and spread them out carefully. Place the tree on the pile of soil in the bottom of the hole and backfill the hole with soil.

- ❖ Move the tree around gently to make sure that the soil settles evenly around the roots, and to make sure that there are no air pockets around the roots. This will also help to embed the tree firmly in the soil. Gently tamp down the soil around the trunk and above the root-zone. Soil mustn't be heaped around the trunk, because this will make water run away from the root-zone.
- ❖ The base of the tree stem must be slightly above the soil surface. Ideally, you should just be able to see the place from where the first roots grow from the stem above the soil surface. We do this so that once the tree has settled, no part of the stem will be below ground level. If the stem is below ground level, there is a danger that the stem will get infected with phytophthora, which causes collar rot.
- ❖ Water the tree once it has been planted, and then tie it to a stake with twine. The stake should be about 1.5m long, and planted so that about a metre of it is above the ground. The stake will stay there for a year to help the tree grow straight. Lastly, fasten a stem cover around the bottom part of the stem.

Young Tree Care



Now that our trees are in the soil we can't just leave them alone and hope for the best. It is important that we care for these young trees. Looking after the irrigation of the trees is essential, as is making sure that pests, diseases and weeds are controlled in the young orchard. We also need to fertilise the young trees to make sure they have all the nutrients they need. It is also important to check that the stake remains in place for the first year, and that the stem protector is there to protect

the tree against herbicides and to keep suckers from growing out. It will also protect the tree from the sun in hot areas. If you don't use stem protectors, you can paint the stems with whitewash, which is diluted PVA paint, to protect them against the sun.

When a tree is planted, its root volume is a lot smaller than its leaf area. It may seem strange to want to prune such a small tree, but if we do this to leave two or three well-spaced framework branches of twenty to thirty centimetres, it helps the tree to grow better. In windy areas, all the framework branches are even sometimes removed by topping the trees, so that the stem can have a chance to thicken first while the new framework branches grow. You must also remove suckers that grow below the framework branches and particularly at ground level by cutting them off with pruning shears, and never by breaking them off.

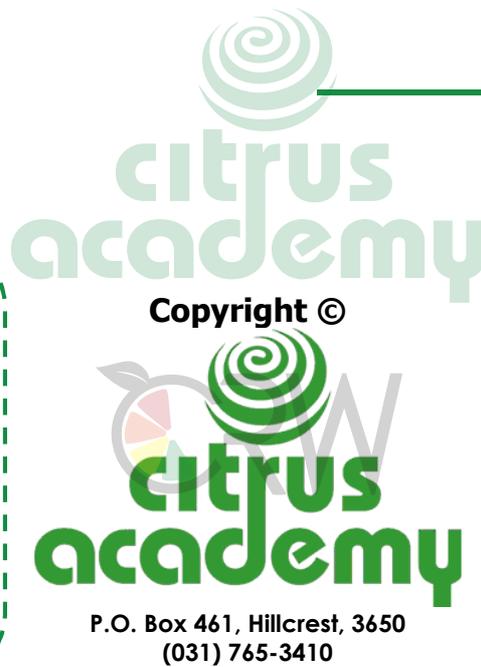
Conclusion

Planting new orchards can be a stressful process, because getting it right is so critical to the success of our farming operation. If we prepare for it properly and spend time ensuring that everything is in place before we start planting, we can take the stress out of the process, and we can give our new young trees the best chance of becoming productive, profitable members of the orchard.

Citrus Planting Management

5 Orchard Recordkeeping

Learner Guide



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Citrus Academy production learning material:
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Introduction

Now that the hard work of planning and planting a new orchard is done, the long work of managing the orchard begins. Over the next eighteen to thirty years, the orchard will have to be looked after, managed and monitored, so that it will produce good volumes of good quality fruit.

For the first few years, the young trees have to be taken care of to ensure that they grow vigorously so that they start producing marketable fruit as soon as possible. Assuming that your cultural practices are in order and that you will have all the necessary pest and disease control measures in place, you should see the trees coming into production within three to four years.

information

Production Practices

For more information on correct cultural practices as well as pest and disease control measures, you can consult the CRI's Citrus Production Guidelines (www.cri.co.za). Production learning material in the form a series of audio-visual DVD's can also be ordered from the Citrus Academy, or can be downloaded in pdf-format from the website: www.citrusacademy.co.za.

The Importance of Recordkeeping

To comply with the requirements of accreditation systems such as GlobalGAP, you have to keep records of a wide range of production practices. This already forms a good basis for the sort of orchard records that make for an effective management tool. But it does require that one views recordkeeping as more than a compliance issue, and rather as a function essential to management.

definition

GlobalGAP

GlobalGAP is an internationally recognized set of farm standards dedicated to Good Agricultural Practices (GAP). Through certification, producers demonstrate their adherence to GLOBALGAP standards.

Tree Census Records

Central to the recordkeeping that is necessary for effective orchard management is the tree census. A tree census accurately records how many trees there are in every orchard on the farm, and includes details of the cultivar, rootstock and planting year of each orchard block. Apart from being necessary for the sake of compliance and a handy management tool, tree census information must be submitted to the Citrus Growers' Association every year. This enables the CGA to keep track of the citrus plantings per cultivar, per region, per province, and for the whole country. It also enables them to develop long term projection models,

which use current planting data combined with data on the bud-wood sold by the Citrus Foundation Block to project the planted area and production per cultivar for the next ten to fifteen years.

It would be tempting to think that the tree census can be recorded when the orchard blocks are planted, and then to assume that this will remain accurate and true for the whole lifespan of the orchard. This is however not a safe assumption to make. Keeping the map and plan that you developed while planning for the establishment of new citrus plantings is an excellent start, but this cannot be the end of it. Things happen to trees in orchards, and it should be recorded whenever there is significant tree loss, or replacement of lost trees. To be safe, it is good practice to double-check tree census records at least every three years by physically counting the trees.

If you for some reason do not have any records of orchards that have already been planted, it is essential that you put these records together. Hopefully you will at least have a map of the farm with numbered orchard blocks and the area of the blocks in hectares. If you do not even have this, you will need to obtain a map from the survey office, or have one drawn up by a surveyor. A surveyor will also be able to measure the area of the orchards for you. If you know the area of an orchard block, you can use the tree spacing to calculate the number of trees planted in that area.

example

Calculating the Number of Trees

If you know that the tree spacing is six by three (meaning six metres between rows and three metres between trees in the rows), you can work out that there are 555 trees planted per hectare, as follows:

- $6\text{m} \times 3\text{m} = 18\text{m}^2$ (meaning that one tree takes up 18m^2)
- $1\text{ha} = 10,000\text{m}^2$ (a hectare being an area that is 100m by a 100m)
- $10,000\text{m}^2 \div 18\text{m} = 555$ (meaning that in one hectare of $10,000\text{m}^2$, there is space for 555 trees if they each take up 18m^2)

Once you know how many trees are planted per square metre, it is short work to calculate the number of trees in each orchard block, and on the whole farm. It is a good idea to double check your calculations by physically counting the trees in at least one or two of the blocks. Also, be careful to assume that the tree spacing on the whole farm will be the same. It can vary between orchard blocks, depending on the cultivar and orchard layout.

Determining what cultivar was planted in orchards that you don't have records for, and how old the trees are is more difficult. Your best bet is to first try and get more information, starting with individuals that might have been involved in the planning or establishment of the orchards. You can also approach the nursery that supplied the trees, where they may still have records of the sale.

If you cannot get this information, your last port of call would be to consult an expert to help you determine the cultivar. From the growth habits of the trees, the maturation date of the fruit, and the fruit characteristics, an expert will at least be able to make an educated guess, which will be accurate enough for your purposes.

Other Records

Other records that must be kept for individual orchard blocks include:

- ❖ Production records
- ❖ Spray records
- ❖ Weather data
- ❖ Results of annual leaf sample analyses, and
- ❖ Yield records showing volume, internal and external fruit quality measurements, maturity indexing data, export pack-out percentage, and so on.

Conclusion

You need to keep track of what is happening in the orchards on your farm – remember always, you cannot manage what you do not measure. There are a great many things that can go off the rails in citrus production, and finding out about a threat once it has already done damage to your trees and to production is too late. With good recordkeeping systems, you will be able to pick up deviations before they develop into problems, and be able to address them in good time.


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