

Managing and maintaining a healthy citrus root system

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"Soil, tree and root health" are the new buzzwords in most of the agricultural industries and research institutes worldwide. It's a way of developing and maintaining good management practices that ensure well-managed sustainable farming units able to provide good quality products to the markets.

In order to sustain a healthy citrus tree, specific growth conditions are necessary. Many citrus tree health problems occur as a result of improper growing conditions. Poor planting material, poor soils or poor soil preparation, a lack of nutrient content or inappropriate irrigation practices can contribute to citrus tree health conditions. These unsuitable growing conditions will stress trees and increase the risk of secondary challenges to growers. A typical declined tree will have yellowing, discoloured and distorted leaves, loss of leaves, branch die-back and ultimately fruit size and yield reduction as well as fruit quality challenges (Figure 1 below).



Fig. 1

Decline of citrus trees is complex due to the lack of knowledge regarding the original causes and also the consequences thereof. In many instances decline is only emphasised when the symptoms become visible and then it is often too late to make any corrections. Any interventions are very cost-intensive with no guaranteed results. Numerous factors can play a role in causing citrus root disease related decline and, in many instances, it is not only one factor, but a combination of different factors being responsible. *Regular sampling for soil pathogen*

and nematode status (described below) and integration of results is currently the only reliable indication of your orchards soil health.

A healthy root system is the unsung hero of citriculture, which directly influences the profitability of an orchard. The direct contribution of a healthy root system to each season's return on investment is difficult to quantify, but if an orchard's root system was neglected, a gradual loss of income over consecutive seasons would occur. During a high-stress season, e.g. high temperature or low water availability, this gradual loss of production will suddenly turn into a dramatic loss of yield in the season.

A root system, therefore, needs to be maintained by direct orchard management practices allowing for the anchorage of the tree, as well as transport of water, nutrients and plant hormones from the constantly developing feeder roots mining the soil. Compromising the root health will lead to a cascade of negative events, starting with declining tree vigour and leading to small fruit and poor yields.

Orchard management actions

Tree and root health starts with proper and effective soil preparation, right choice of rootstock and planting of certified trees that complies with minimum standards like pest and disease free material, horticultural sound and vigorous trees that also comply to the minimum tree size standard. Cultural practices should, therefore, focus on not only maintaining root health, but also developing new roots for efficient water and nutrient uptake. *Management practices should include diligent irrigation scheduling (prevent over- and under-irrigation); correct nutrition application; and control of soil pathogens and nematodes are the critical pillars ensuring the sustainable quality of the root system of a citrus tree.*

Soilborne diseases associated with tree decline include *Phytophthora* spp. responsible for stem canker, root and collar rot. Citrus nematodes cause a slow decline in citrus. Managing soilborne pathogens to ensure a healthy root system forms part of the *Disease Management and Integrated Pest Management (IPM) approach* and *chemical control should only be implemented once all other aspects that could have an influence on good quality root development have been considered. Monitoring the soil pathogen status in the soils on a regular basis*



Fig. 2



Fig. 3

with soil and root sampling (every three years), is needed to enable growers to make informed decisions. Do not postpone sampling until deterioration has reached an advanced stage, as it can make the diagnosis of the problem difficult. The sample should be collected at visually healthy trees and if trees **do** show symptoms of deterioration, collect samples at trees that show these initial signs of deterioration.

By implementing such an approach, only registered chemical products must be utilised in a responsible manner without abusing the products. Remember that unregistered products and snake oils should never be an option, because they will be very costly in the long run. For recommendations, contact your Area Extension Manager or M.C. Pretorius from CRI.

Sampling guidelines to determine *Phytophthora* and Nematode status in citrus soil and roots

- Soils should be moist when orchards are to be sampled (not excessively wet or dry).
- Samples should be collected from trees appearing visually healthy (< 3 years old).
- Randomly select 20 trees in a block of 1000 trees. Subdivide larger orchards, different rootstocks or soil types, collect separate samples.
- Collect a sub-sample at each of the 20 selected trees, halfway between the trunk and the canopy drip line of the tree (Figure 2).



Fig. 4



Fig. 5



Fig. 6

- Remove weeds and the top 2 cm of soil in the sample area. Use a spade to collect a sample from the top 15 cm of soil (Figure 3).
- For *Phytophthora* analysis only, each sub-sample should consist of approximately one handful (20 g) of soil (Figure 4). Combine all sub-samples (20 samples) in a bucket (Figure 5), mix thoroughly and take one composite sample - two large handfuls of soil (maximum 200 g of soil) (Figure 6).



Fig. 7

- For nematode analysis, each sub-sample should consist of one palmful (40 g) of feeder roots (Figure 7). Roots not thicker than 1 - 2 mm. Mix thoroughly and take one composite sample - two handfuls of feeder roots (200 g feeder roots). Do not separate the roots from the soil as the roots will dry out. For both *Phytophthora* and nematode analyses, combine the 200 g (two handfuls) soil and 200 g (two handfuls) feeder roots (Figure 8).
- Place the sample in a plastic bag, press out any excess air, seal and store in a cool place (do not freeze) until dispatched to the Diagnostic Centre. Use a cardboard box while collecting the sample and keep away from direct sunlight at all times.
- Each sample bag should be clearly marked on the outside (Figure 9). Relevant information needed by the CRI Diagnostic



Fig. 8



Fig. 9

Centre includes farm name and orchard number. Do not place the information inside the bag, as the paper can disintegrate during transit.

- Complete the "request for analysis" form and send with samples to the Diagnostic Centre. Attention: Diagnostic Centre; Citrus Research International, 2 Baker Street, Nelspruit, 1200, 013 759 8000.
- Soil samples for *Phytophthora* should be taken at the beginning of (and during) the rainy season of the area.
- Root samples for nematode analysis can be taken at any stage during the year.

Samevatting:

- Plant slegs gesertifiseerde bome van 'n geakkrediteerde kwekery.
- Ordentlike grondvoorbereiding is belangrik vir langtermyn-wortelgesondheid (Dieprip bewerking).
- Jong bome moet nie dieper as in die plantsakkie geplant word nie – dit voorkom *Phytophthora*-infeksie op stamme.
- Korrekte onderstamkeuses volgens kultivar/bo-stamkombinasie en grondtipe
- Goeie kulturele praktyke is baie belangrik vir boom- en wortelgesondheid, veral besproeiing (voorkom oor- of onderbesproeiing), bemesting, lighuishouding, plaag- en siektebeheer.
- Grond- en wortelmonsters vir aalwurm en *Phytophthora* behoort elke drie jaar geneem te word by visueel-gesonde bome wat as 'n bestuurshulpmiddel sal dien en kan bydra tot wortelgesondheid.

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