

February and March 2022

By Hannes Bester, MC Pretorius, Wayne Mommsen and Catherine Savage, André Combrink, Coenraad Fraenkel, Jan Landman and Natasha Jackson (Citrus Research International)

Integrated pest management

Mealybug (S.D. Moore)

Growers should be scouting for mealybug regularly by inspecting underneath calyces and thereby determining the percentage of infested fruit. Where mealybug is under good biocontrol, infestation should peak during December in the northern production areas, and during January in the Cape production areas. If mealybug infestation does not decline during January and February, respectively, suppression with a chemical treatment is advisable on early maturing cultivars. Unfortunately, buprofezin (Applaud), which was the most effective corrective option for mealybug control, may no longer be used at this time. Therefore, the available corrective options are sulfoxaflor (Closer), spirotetramat (Tivoli) and fenpyroximate (Lesson). These products may not have a specific corrective registration, but their withholding periods do permit late season use. The first two mentioned are particularly effective. Although registered, methomyl is not a preferred option, as it is not effective at the dose generally registered for mealybug. And methomyl is the only registered corrective option for red scale. It would therefore be wise to restrict corrective usage to red scale alone, in order not to expedite the onset of resistance. Ensure that the preharvest interval of any product used is complied with.

Another very important consideration in achieving and maintaining good mealybug control, is diligent exclusion of ants from the tree canopy.

The species of mealybug present should also be determined, as it appears that the biocontrol complexes of mealybug species other than citrus mealybug, might not be as effective as that of citrus mealybug. Therefore, treatments can be applied more readily when other species are identified as the dominant species. The phytosanitary status of certain species must also be borne in mind. Note that colour plates and a key for identification of the different mealybug species are available to order from CRI. If necessary, please also bear in mind the molecular identification service offered by CRI's diagnostic laboratory in Nelspruit and the DALRRD Plant Health Diagnostic Laboratory in Stellenbosch.

Finally, a mealybug infestation can also attract a carob moth infestation. Therefore, if the fruit is to be exported to a market that is sensitive to carob moth, mealybug must be effectively controlled well before harvest.

False codling moth (S.D. Moore)

All growers intending to export to Europe should be fully compliant with the False Codling Moth Risk Management System (FMS) for export of citrus to the European Union, and consequently the Good Agricultural Practices (GAP) described in CRI's Production Guidelines for the control of FCM on citrus. For phytosanitary reasons, FCM must be controlled throughout the season to as close to a non-detectable level as possible, using a combination of orchard sanitation and various effective registered control measures. Weekly monitoring of fruit infestation, as

described in the FMS, will provide an accurate indication of how effective the control programme has been and what level of compliance there is with the export (shipping) options described in the FMS. Note that the mandatory preharvest fruit infestation monitoring system has changed from the five-tree data set protocol to sampling of sanitation fruit. The new protocol is slightly more complex and labour intensive and thus requires thorough diligence in its application. Personnel conducting the monitoring must also be retrained.

The following sprayable insecticides are registered and available for use against FCM: the granulovirus products (Cryptogran, Cryptex and Gratham), Methoxyfenozide (Runner, Walker, Sprinter, Chaser, Marksman), Delegate, Coragen, Warlock, Broadband and Eco-Bb (both entomopathogenic fungi (EPF)), ensuring compliance with market-specific restrictions. The granuloviruses and EPF can be used up until the day of harvesting. However, note that according to label recommendations, the EPF are not suitable corrective options for FCM and are thus not listed as such by PhytClean. A virus application should be applied shortly after a peak in FCM activity, determined by the use of a pheromone trap. However, this may be difficult to determine late in the season when FCM levels are low and generations are overlapping.

Methoxyfenozide (Runner or Walker), Delegate and Coragen are all registered to be applied once or twice per season and all have withholding periods of 30 days or less for most markets. Warlock is recommended to be reapplied 7 - 10 days after the first application. These products are therefore suitable for a final application against FCM before harvest. Ideally, this should not be applied later than 3 - 5 weeks before harvesting begins. Such a practice is strongly recommended.



MC Pretorius



Hannes Bester

Other chemical options are triflumuron (Alsystin), teflubenzuron (Nomolt), fenprothrin (Meothrin) and Cypermethrin. However, there are some difficulties associated with these products, such as prohibitive MRLs for certain markets, development of resistance by FCM, or secondary pest repercussions. They are therefore not preferred as options for FCM.

In addition to the insecticides, there are now four mating disruption products – Isomate, Checkmate, Splat and X-Mate – and an attract-and-kill product, namely Last-Call FCM. However, all of these products are most effective when their use is initiated early in the season while FCM levels are still low. If this has not been done,

initiation of their use late in the season is not recommended. Additionally, as the weather cools towards autumn, these pheromone-based products may become less effective due to a reduction in release rate. In such a case it may be necessary to follow up these treatments with a spray for FCM.

Bud mite (T.G. Grout)

The period February to May is the optimal time for bud mite sprays and fenpyroximate (Mitigate or Lesson) can be used during this period at 150 ml per 100 l water. The preharvest interval for all markets is 28 days. In trials with fenpyroximate, this product was found to have similar efficacy to Acarol against bud mite. Fenpyroximate will also suppress citrus red mite when sprayed during autumn for bud mite and the Lesson product is registered against all other citrus mites too, and most recently, also mealybug.

Fruit fly (A. Manrakhan)

Fruit flies are pests of phytosanitary concern. There is a zero tolerance of fruit fly eggs and larvae in fruit consignments for export. The fruit fly pests affecting citrus are *Ceratitis capitata* (Mediterranean fruit fly or Medfly), *Ceratitis rosa* (Natal fly) and *Bactrocera dorsalis* (Oriental fruit fly). The latter is present in the provinces of Limpopo, Mpumalanga, North-West, Gauteng and KwaZulu-Natal (excluding magisterial districts of Amajuba, uMgungundlovu, uMzinyathi, uThukela and Zululand) and in Sundays River Valley in Eastern Cape Province.

For export of citrus to the EU, growers must implement the Citrus Fruit Fly Management System (Citrus FFMS) which consists of two Fruit Fly Systems Approaches (FF SA): one for lemons and limes (FF-SAL) and one for other citrus types (FF-SAO). For both FF-SAL and FF-SAO, Phytclean registration are as prescribed by the False Codling Moth Management System (FMS). In FF-SAL, there are two independent measures that mitigate the risk of fruit flies: (1) non-host status of commercial export

grade lemons and limes for fruit fly pests of citrus and (2) PPECB phytosanitary inspections of fruit packed for export. In FF-SAO, there are three independent measures that mitigate the risk of fruit flies: (1) Fruit Fly Good Agricultural Practices (FF GAP) with Packhouse Delivery Inspections as the end point, (2) packhouse grading and PPECB phytosanitary inspections of fruit packed for export and (3) postharvest shipping conditions as determined by FMS.

The two components that make up FF GAP are monitoring and pre-harvest control. Monitoring of all fruit fly pests of citrus should be carried out using registered traps as recommended in CRI's production guidelines. Thresholds exist for all registered trapping systems and these should be adhered to, particularly when fruit is susceptible to attack (at and after colour break). The threshold levels in all registered trapping systems are provided in CRI's production guidelines. Monitoring of Oriental fruit fly per production unit code (PUC) is a requirement for phytosanitary registration of citrus, deciduous and subtropical fruit, for export to the special markets (the US, Japan, South Korea, China and the EU). Each PUC should have at least one ME baited trap for monitoring of Oriental fruit fly. Monitoring of Oriental fruit fly should be carried out throughout the year, and trapping guidelines for surveillance of Oriental fruit fly in fruit production areas should be followed. Guidelines are available either at [https://www.dalrrd.gov.za/under Plant Health/Exporting from SA/ Phytosanitary registrations for special export markets](https://www.dalrrd.gov.za/under%20Plant%20Health/Exporting%20from%20SA/Phytosanitary%20registrations%20for%20special%20export%20markets%20or%20at%20https://www.citrusres.com/public-downloads/) or at <https://www.citrusres.com/public-downloads/>. All trapping results should be supplied to DALRRD at the end of each export season. Monitoring of Medfly and Natal fly should start before peak fruit fly activity in citrus orchards usually between January and May. In regions



Catherine Savage



Wayne Mommsen

under historically high fruit fly populations, such as the Western Cape and Eastern Cape regions, monitoring of Medfly and Natal fly should be initiated from October. Monitoring should continue until completion of harvest. All fruit fly traps must be checked weekly and trapping records should be documented. Lures and insecticides inside traps must be replaced every 6 - 8 weeks. Detection of suspect Oriental fruit fly specimens in areas considered free of this pest should be reported immediately to the relevant surveillance co-ordinator (Citrus - Aruna Manrakhan: aruna@cri.co.za).

Fruit fly control should be initiated in middle to late summer (either January or February, depending on regions). However,

for farms either with mixed fruit crops (such as mangoes or deciduous fruit) or near fruit types prone to high fruit fly infestation, fruit fly control should be implemented by December. Fruit fly baiting and good orchard sanitation form the core of fruit fly control practices. Bait spray products and bait stations registered for fruit fly control in citrus orchards are provided in CRI's production guidelines. In areas affected by the Oriental fruit fly, the Male Annihilation Technique (MAT) must also be used. MAT products registered for *B. dorsalis* control in SA are also provided in CRI's production guidelines. All fruit fly control products should be applied correctly. Instructions provided in labels of control products must be followed strictly. Fruit fly control must always be combined with proper management of insect pests such as FCM, which also damage mature fruit. All records of fruit fly control practices including MAT application, need to be kept.

In all *B. dorsalis* infested areas, a removal permit is required for movement of fruit outside those areas. For applications of removal permits, send an e-mail to RemovalPermits@daff.gov.za.

Grondgedraagde siektes

(J. van Niekerk & M.C. Pretorius)

Grond- en wortelmonsters behoort elke drie jaar geneem te word om sodoende die sitrusaalwurm en *Phytophthora*-status in sitrusboorde te bepaal. Resultate sal dien as 'n bestuurshulpmiddel wat gebruik kan word om grondpatogene effektief te beheer.

Phytophthora bruinvrot/wortelvrot

Weens die gevaar van fitotoksiseit op gevoelige sitruskultivars tydens hoë temperature wat gedurende Februarie/ Maart kan voorkom, moet die gebruik van fosfonaatblaarbespuiting streng volgens die etiket geskied (geen sagtesitruskultivars behoort weens hul gevoelige skille gedurende hierdie tyd van die jaar met hierdie produkte gespuit te word nie). Hoë

dagtemperatuur, tydelike vogstremming en warm bergwinde kan veroorsaak dat fosfonate swart stippeltjies soortgelyk aan koperskade op vrugte veroorsaak. Bome moet daarom nie gespuit word as toestande nie optimaal is nie. 'n Wortelvrotbeheerprogram (blaarbespuiting) sal bruinvrot ook effektief kan beheer.

Bruinvrot ontwikkel slegs wanneer die klimaatstoestand gunstig is vir die patogeen (*Phytophthora*) om te infekteer en te ontwikkel. Indien dit dus h droë najaar is en geen of slegs ligte reënbuie voorkom, is voorkomende fosfonaatblaarbespuitings nie nodig nie. Indien dit egter h nat na-jaar is kan bome met kontakmiddels soos koper of mancozeb (let op beperkings na markte) asook sistemiese produkte soos fosfonate (let op etiket-aanbevelings vir weerhoudingstydperk en waarskuwings), gespuit word om bruinvrot te beheer. Bo en behalwe droogte en hitte kan h oormaat vogtige toestande (baie reën) ook bome onder tydelike verwelkte toestande plaas wat h gevaar inhou vir blaarbespuitings. Bome moet dus nie tydens of kort na sulke toestande gespuit word nie. Laastens beïnvloed drag ook h boom se gevoeligheid vir droogtespanning. Hoe hoër die drag, hoe gevoeliger is die boom vir uitdroging en hoe groter is die risiko vir fitotoksiseit.

Sitrusaalwurm

Wortelmonsters kan enige tyd van die jaar getrek word om die status van die sitrusaalwurmpopulasies in boorde te bepaal. Wyfielings word gebruik om te bepaal of die toediening van h aalwurmdoder geregverdig is. Die drempelwaarde voordat h aalwurmdoder oorweeg word is 1000 wyfies/10 g wortels. Daar word aanbeveel dat aalwurmdodertoedienings 'n aanvang neem tydens die begin van die reënseisoen. Dit sou daarom die regte tyd wees vir produsente in die Wes-Kaap om hulle aalwurmmonsters in Maart te trek sodat hulle weet watter boorde om te behandel wanneer winterreëns begin. Residu-weerhoudingstydperk moet

in ag geneem word. Dit is belangrik om h aalwurmbesproeiingsprogram te volg aangesien h enkele aalwurmdodertoediening nie effektief genoeg is nie en het geen noemenswaardige onderdrukking van die aalwurmpopulasies op die lang duur nie. Meermalige toedienings twee maande uit mekaar verseker dat die larwetjies wat uitbroei gedood word voordat hulle volwasse wyfies kan raak wat weer eiertjies kan lê.

Tydens die toediening van aalwurmdoders is dit uiters belangrik dat ten minste 40 mm besproeiing toegedien word nadat produkte toegedien is om te verseker dat die middels in die grondprofiel ingewas word. Die meeste aalwurmdoders loog baie stadig. Die effektiwiteit van die



Coenraad Fraenkel



André Combrink

doders word dus belemmer indien hulle nie behoorlik deur die wortelsone versprei word nie. Geen aalwurmdoder behoort deur drupbesproeiingsstelsels toegedien te word nie. Indien toedienings in boorde met druptoediening gedoen moet word, behoort die middels as h bandplasing (half meter aan beide kante van die drupperlyn) oor die drupperlyn gedoen te word. Dit kan wel deur mikro-besproeiingsstelsels toegedien word.

Indien dit beplan word om h boord te verwyder behoort h aalwurmmonster geneem te word voordat die boord verwyder word, sodat dit bepaal kan word of sitrusaalwurms teenwoordig is. Dit dien as h bestuursriglyn om 'n geskikte onderstam te kies in gevalle waar h herplantstrategie uitgewerk moet word.

Citriculture

Fruit production and quality
(P.J.R. Cronjé)

Internal quality: If properly timed, regulated deficit irrigation can result in increased total soluble solids (TSS) and an increase or no response in titratable acidity. Deficit irrigation retards the breakdown of acid and can influence the solids:acid ratio at harvest for better or worse, depending on cultivar characteristics. It is mainly aimed at early cultivars like Satsuma, but other early maturing cultivars with low internal quality could also benefit. Less water is applied, and at longer intervals. Therefore, irrigation is continued but at a reduced level. Trees should be irrigated lightly two weeks prior to harvest. No water stress should be imposed during the initial growth phase of the fruit, i.e. during and after flowering, but only during the final maturation phase, i.e. the last two months prior to harvest (January for Satsuma). Any water stress earlier than the end of January could lead to reduced fruit size and loss of rind integrity. In high rainfall areas, regulated deficit irrigation may not be successful. The deficit should be imposed

slowly, so that the trees can adjust without symptoms of drought. Severe water stress can have adverse effects on tree health, fruit size and fruit quality. High nitrogen is antagonistic to the effect of deficit irrigation. Management of this technique is much easier when trees are planted on ridges and when the right scheduling equipment is used. Additionally, regulated deficit irrigation imposed the last two months prior to harvest also enhances the rate of colour development. Selective harvest of outside fruit and delaying harvest of inside fruit will result in a higher proportion of fruit with higher TSS and better colour.

Maturity indexing on early cultivars like Satsuma should commence. Maturity indexing is done to predict the rate of change in fruit maturity in order to harvest fruit at optimal maturity, to maintain acceptable commercial shelf life. The aim is to define changes or rate of change in acids and sugars and to build up a data base over a number of years for comparison. Random sampling of fruit every week from each of 10 representative trees should start four to six weeks before the expected harvest date. Titratable acidity is determined by titration with sodium hydroxide; sugar content (Brix) is determined using a refractometer. The sugar:acid ratio calculated and fruit colour should be read from a colour chart. All the parameters mentioned above should be plotted on a graph over time. Once plotted, trends will become apparent, harvest dates can be estimated and problem areas in internal and external quality parameters can be identified and manipulated.

Fruit growth and size: Fruit growth during this time is important to achieve optimum size at harvest. Fruit growth is in the peak of phase II, in which the majority of fruit size increase takes place for most cultivars (Figs. 1 and 2). Ensure optimal irrigation and try to avoid stress conditions, as this might have an adverse effect on fruit

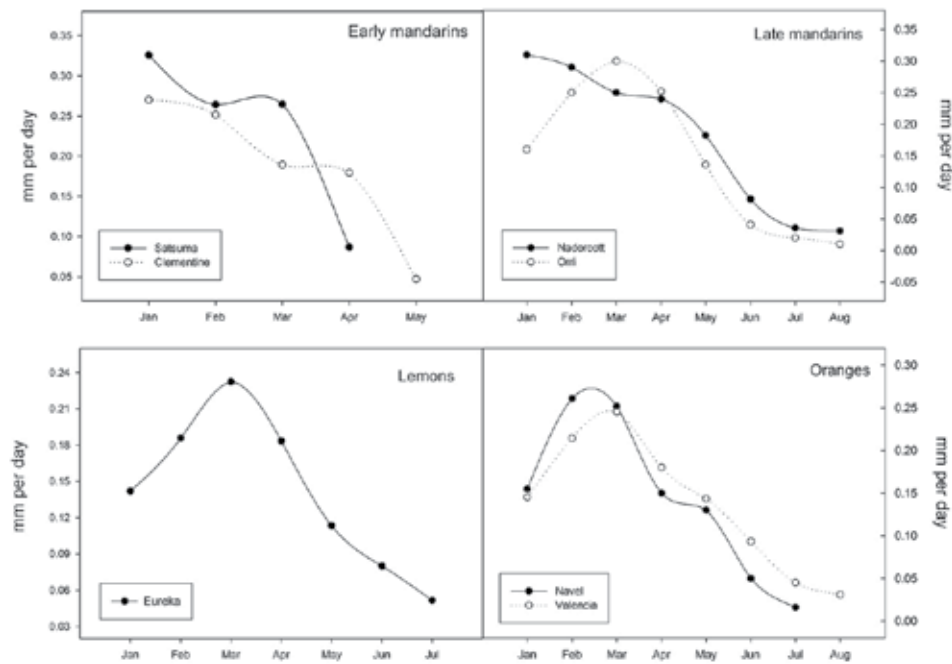


Figure 1. Historical fruit growth rates (mm per day) of different citrus cultivars in the Western Cape region

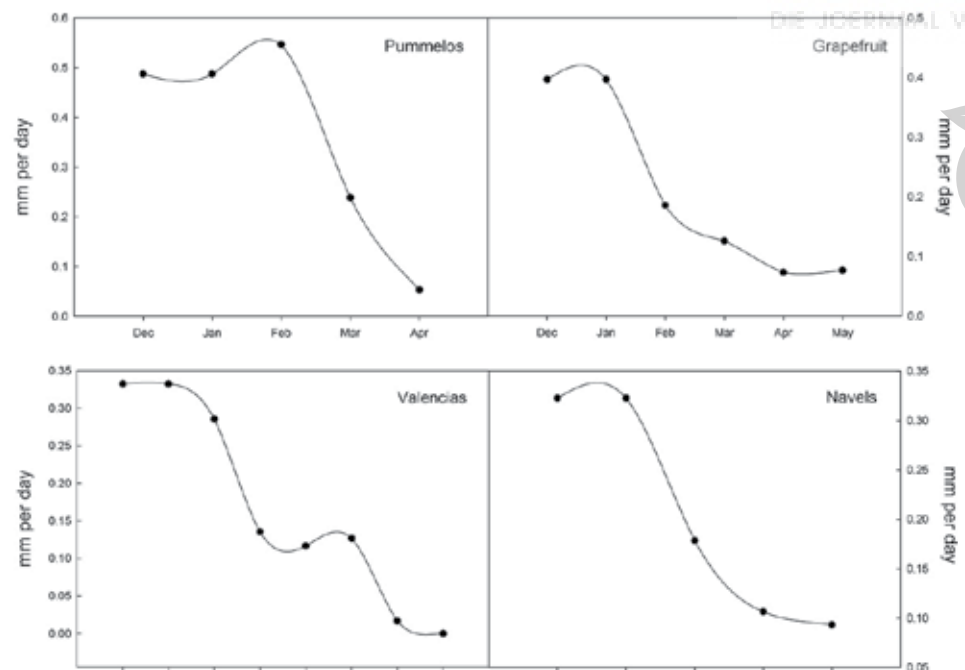


Figure 2. Historical fruit growth rates (mm per day) of different citrus cultivars in Limpopo

size. Fruit thinning plays a critical role in fruit size (see Cutting Edge no. 32: Fruit size improvement). Correct pruning practices are the most effective way to manipulate the number of fruit per canopy volume and the

eventual fruit size. For more information, refer to the *SA Fruit Journal* Oct/Nov 2015: "The reproductive phenology of Citrus III: Morphogenesis from flower to fruit". **Regrowth** control should be done,

especially after heavy pruning earlier in the season. A lot of regrowth adversely affects fruit size and is antagonistic to fruit colour development, especially for early maturing cultivars.

Oleocellosis: Late summer vegetative growth of bearing trees should be kept to a minimum as excessive vegetative vigour during this period is associated with high incidence of oleo at harvest.

Rind colour development: Late nitrogen application and the use of heavy summer oil sprays should be avoided, as these treatments are antagonistic to rind colour development.

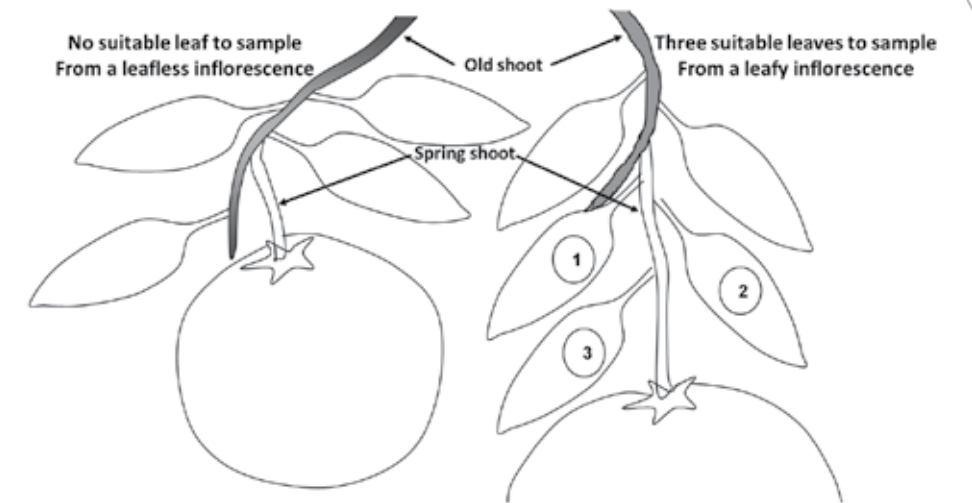
GEïNTEGREERDE BEMESTING/ INTEGRATED FERTILISATION (P. Raath)

Neem van blaar- en grondmonsters

Die periode vanaf Februarie tot Junie moet gebruik word vir jaarlikse blaar- en grondontledings. Blaarmonsters behoort jaarliks geneem te word, terwyl grond elke twee tot drie jaar gemonster kan word, afhangend van grondtekstuur. Omdat die waarde van die ontleding geheel en al afhang van die mate wat die monster die blok se voedingstatus verteenwoordig, moet baie moeite gedoen word met die monsternemingsproses. Standaardiseer die monsternemingsprosedure.

Monster blare elke jaar:

- 1) Randon dieselfde datum - pluk blaarmonsters elke jaar vir elke spesifieke blok gedurende 'n bepaalde week vanaf Februarie tot einde April.
- 2) Vanaf dieselfde groep bome (sogenaamde "indeksbome") - verdeel boorde in monsternemingseenhede wat nie groter as 5 ha is nie - kies dan drie tot vier indeksrye wat verteenwoordigend van die hele eenheid is - merk die rye en gebruik elke jaar dieselfde rye vir monsterneming. Swak of geil kolle moet egter afsonderlik gemonster en gemerk word.
- 3) Op dieselfde posisie in die bome - slegs



Figuur 3/Figure 3. Voorstelling van die posisie van die blare wat vir blaarontleding geneem moet word / Illustration of the position of the leaves that must be sampled for analysis

blare agter 'n vrug, wat in die lengte op dieselfde takkie as die vrug ontwikkel het, word gemonster - d.w.s. blare wat tussen vyf en agt maande oud is (Figuur 3) – monster blare tussen heup- en skouerhoogte.

Pluk tussen 75 en 100 blare, van beide die ooste- en westekant van die ry, plaas dit in 'n skoon plastieksakkie, druk die lug uit, knoop die sakkie toe en hou koel. Merk die monster deeglik – moet nie direk op die sakkie skryf nie, aangesien selfs permanente inkt geneig is om af te kom.

Sample soil at least every three years:

- 1) When fertilisation has stopped or application rates are low, e.g. late summer to autumn (February to June).
- 2) From the same position (e.g. the index trees) - use the same three to four index rows that are used for leaf sampling - they must be representative of the whole unit – take samples according to the fertiliser application pattern/wetted zone – micro-irrigated blocks must be sampled under the tree canopy, while drip-irrigated blocks are sampled either between the dripper and the perimeter of the wetted zone, or if the wetted zones of adjacent

drippers overlap, take it halfway between two drippers.

Ten to 15 sub-samples must be taken and mixed in a bucket, from which a 500 g representative sample is then sent to the laboratory. Poor or vigorous areas must be sampled separately.

- 3) At the same depth – remove organic debris from the soil's surface and take the sample from the top to 30 cm depth – if occurrence of soil acidity or salinity is suspected, an additional sample must be taken from the 30 – 60 cm layer also.

Use either an auger or spade to take the samples over the full top 30 cm. Put the sample in a plastic bag that can be thoroughly sealed and mark it properly (do not write directly on the plastic bag).

Interpretation of leaf analyses

Leaf analyses are an indicator of the nutritional status of the trees. There is an established relationship between the concentration of the nutrient elements in the leaves and tree performance. The goal should be to achieve a plant nutrient status that falls within the optimal range for each nutrient.

Interpretasie van grondmonsters

Grondontledings verskaf inligting wat help om te besluit watter stappe geneem kan word om tekorte, wanbalanse en oormate in die voedingstatus van die bome reg te stel. Ongelukkig word interpretasie van die chemiese resultate dikwels gekompliseer deur die verskeidenheid ekstraksie-metodes en maniere waarop resultate uitgedruk word. Interpretasie van grondontledings moet dus met begrip van die ekstraksie-metodes gedoen word.

**POST HARVEST PATHOLOGY
- PRE-PACKING POINTERS**

(C. Savage and W. Du Plooy)

Orchard sanitation: Just before the picking season starts, sanitation is of crucial importance. This practice is key for reducing fungal spore load, as well as keeping FCM and fruit fly under control. Orchard sanitation involves removing all fallen, decayed and injured fruit (including in the trees) from the orchard and then burning or macerating the fruit. If the macerating route is followed, the fruit should be cut into fine pieces and allowed to dry in the sun away from the orchards and packhouses. Sanitation fruit can also be used as animal feed. Remember to follow the FMS guidelines and examine a sample of the sanitation fruit if you export to the EU.

Skirt trees for sour rot and brown rot

control: Ensure that trees are adequately skirted before the tree starts bearing to prevent low hanging fruit, especially in heavily laden trees, touching the ground or being in range of water splash. This practice will reduce the risk of *Phytophthora* brown rot infection during the rainfall season as well as *Galactomyces* spp. sour rot infection. Keep in mind that no fungicides are available to control sour rot so orchard sanitation and skirting are crucial. Remove dead wood from all citrus

trees to reduce the spore load of the latent citrus pathogens.

Prevent injuries: Ensure that picking teams are trained to focus on the prevention of injuries. Avoid snap picking, unless pickers have mastered the technique and the fruit is not to be exported. Injuries are the number one cause of postharvest decay. Keep in mind that some markets may be stricter this year on the stem end length so ensure pickers cut the stem end as short as possible without damaging the rind.

Packhouse sanitation: Before any fruit is brought to the packhouse in the new season, the entire building and line need to be thoroughly cleaned. Use an appropriate sanitiser to clean everywhere from the roof to the floor. Include walls and hard to reach nooks and crannies.



Jan Landman



Natasha Jackson

- Never allow any fruit, and more importantly any fungicide-treated fruit, to lie around in the packhouse
- Spray the packhouse with sanitisers regularly and immediately after finding a single rotten fruit
- Constantly monitor concentrations of sanitisers in dump tanks, sprays, rinses, etc. Ensure that these sanitisers are being used according to the correct specifications (e.g. pH)
- Wash trailers/harvesting bins with a suitable sanitiser before they leave for the orchard
- Ensure that packed cartons are cooled as soon as possible to prevent decay development
- Store retention samples for each consignment and check them regularly for waste and other developing factors.

Selection of fungicides: In many packhouses the chemicals that will be used during the upcoming season are being sourced and negotiated. Decide on a chemical program that is in line with decay control and export market regulations. Make use of the CRI Postharvest Factsheets that are available online at www.citrusres.com under the member downloads. If using a new product, ensure that it is safe to do so (possible phytotoxicity; MRL restrictions) and that it is applied correctly. Also keep in mind the cleaning protocol that must be followed if you need to strip the line of residues that have been used but are no longer allowed. See Cutting Edge No. 314 published by CRI, available on www.citrusres.com.

In light of the increased cold-temperature shipping and FMS protocols it is important that packhouses use thiabendazole (TBZ) for all fruit being exported. TBZ applied in the wax provides protection against chilling injury and is also very important to help control latent pathogen infections. A high solid wax (20 - 22%) will also aid in preventing chilling injury. 🍊

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