EXTENSION BRIEFS:
for February and March

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INTEGRATED PEST MANAGEMENT

Mealybug S.D. MOORE

Growers should be scouting for mealybug regularly, by inspecting underneath calyces and thereby determining percentages 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 methomyl, chlorpyrifos, sulfoxaflor (Closer) and fenpyroximate (Lesson). Ensure that preharvest intervals are complied with is critical.

The species of mealybug present should also be determined, as it appears that the biocontrol complexes of oleander mealybug and long-tailed mealybug, in particular, might not be as effective as those of citrus mealybug. Therefore, treatments can be applied more readily when either of these species is identified as the dominant one. The phytosanitary status of certain species must also be borne in mind.

Finally, a mealybug infestation can also attract a carob moth infestation. Therefore, if the fruit is to be exported to a market which 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 reduce it 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.

The following sprayable insecticides are registered and available for use against FCM: the granulovirus products (Cryptogran, Cryptex and Gratham), Methoxyfenozide (Runner, Walker, Sprinter, Chaser), 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. 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. It's recommended that Warlock is reapplied 7-10 weeks after the first application. These products are therefore suitable for a final application against FCM before harvest, which ideally should not be applied later than 3-5 weeks before harvesting begins. Such a practice is strongly recommended. Other chemical options are triflumuron (Alsystin), teflubenzuron (Nomolt), fenpropathrin (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 should, therefore be used with discernment.

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 intervals for both Europe and Canada have changed to 28 days. The only exception to this is for citrus types other than mandarins going to South Korea, for which the preharvest interval currently remains 150 days, or no applications after the end of October. 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 as well, 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 the magisterial districts of Amajuba, uMgungundlovu, uMzinyathi, uThukela and Zululand). *Ceratitis rosa* was recently split into two species: *Ceratitis rosa* and *Ceratitis quilicii* (Cape fly). Both species are present in South Africa. The status of citrus for *C. quilicii* would still have to be confirmed.

Fruit fly management consists of two components: monitoring and control. Monitoring of Medfly and Natal fly should be carried out using Capilure and Questlure baited Sensus traps. Monitoring of Oriental fruit fly should be conducted using bucket type traps such as Chempac Bucket trap, McPhail type trap and Lynfield trap baited with Methyl Eugenol (ME). The Biolure fruit fly containing ammonium acetate, trimethylamine hydrochloride and putrescine is also recommended for monitoring all fruit fly pest species. 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 (USA, Japan, South Korea, China and the European Union - 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 at http://www.daff.gov.za under Plant Health / Exporting from SA/ Phytosanitary registrations for special export markets, or at http://www.citrusres.com/downloads/market-access. Trap details and trap servicing should be recorded as per trapping guidelines.

All trapping results should be supplied to Early Warning Systems (e-mail: janhendrikv@daff.gov.za) at the end of each export season. Density of methyl eugenol baited traps should be between two and five traps per 100 ha in areas where Oriental fruit fly is considered present, or where specimens of the pest fruit fly were detected. 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. Traps are used to determine the presence/ absence of a fruit fly pest and to indicate whether the control strategy is adequate. 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: 013 759 8000) or to DAFF (Jan Hendrik Venter: 012 319 6384). Trap thresholds have currently been set for specific trapping systems. Trap thresholds should be adhered to. For Medfly, the threshold in a Capilure baited trap is four males per week. For Natal fly, the threshold in a Capilure baited trap is two males per week. When using Questlure in a Sensus trap, the threshold is one female fly per trap per week, for both Medfly and Natal fly. For the Oriental fruit fly, the threshold in a methyl eugenol baited trap set by DAFF is three flies per trap per week. If trap thresholds are exceeded, control actions must be increased.

Fruit fly control practices should be initiated at least two months before the earliest expected harvest date. 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 practices should be implemented even earlier, in line with the ripening and harvesting of the other fruit types. Fruit fly baiting and good orchard sanitation form the core of fruit fly control practices. For fruit fly baiting, the use of either one or a combination of the following registered methods is recommended: bait sprays (either mixture of protein hydrolysate and malathion/ trichlorfon or a mixture of HymLure and cyantraniliprole or GF-120), M3 fruit fly bait station and Magnet MED. For the use of malathion in bait sprays, the pre-harvest interval is seven days for citrus to all markets (including EU) except Canada (14 days) and Switzerland (28 days).

The pre-harvest interval when using GF-120 is one day for all markets. The pre-harvest interval with cyantraniliprole (ExirelTM 100SE) is one day for all markets, except for CODEX A countries and Taiwan. When using bait stations such as M3, fruit fly bait station or Magnet MED, there is no pre-harvest interval. Precautions must be taken when using bait sprays on specific citrus cultivars when fruit is at certain maturity stages. Ground-based spray application of GF-120 should be avoided on Nadorcott at the green and colour break stages, due to possible phytotoxicity on fruit. Ground-based spray application of GF-120 is, however safe to use when Nadorcott fruit is at the fully coloured ripe stage. In areas affected by the Oriental fruit fly, the Male Annihilation Technique (MAT) must be used. A number of male annihilation methods such as wooden fibre blocks impregnated with ME and malathion (e.g. ready to use Invader-b-Lok, Chempac ME liquid for combination with malathion 500 EC with the mixture impregnated into wooden blocks), as well as SPLAT technology containing ME and spinosad such as STATIC Spinosad ME have been registered for *B. dorsalis* control in South Africa. All fruit fly control products should be applied correctly and instructions provided on 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* quarantine areas, a removal permit is required for movement of fruit outside those areas. Applications for removal permits should be made through DAFF 30 days before fruit need to be moved out of B. dorsalis quarantine areas, or 30 days before the expiry of the permit. The contacts at DAFF are RemovalPermits@daff.gov.za, Mashangoane Mabelebele, Gloria Malepa and Lazarus Mokwena. The telephone numbers for the above contact persons are: 012 309 8735/ 8791/ 8794. The removal permit will be issued within two working days following application, provided all the relevant documents and information are attached.

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 fitotoksisiteit op gevoelige sitruskultivars tydens hoë temperature wat gedurende Februarie / Maart kan voorkom, moet die gebruik van fosfonaatblaarbespuiting *streng volgens die etiket geskied* (geen sagtesitrus kultivars behoort weens hul gevoelige skille gedurende hierdie tyd van die jaar met hierdie produkte gespuit te word nie). Hoë dag temperature, 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 Wortelvrot beheerprogram (blaarbespuiting) sal bruinvrot ook effektief kan beheer.

Bruinvrot ontwikkel slegs wanneer die klimaatstoestande gunstig is vir die patogeen *(Phytophthora)* om te infekteer en te ontwikkel. *Indien dit dus 'n droë najaar is en geen of slegs ligte reënbuie voorkom, is voorkomende fosfonaatblaarbespuitings nie nodig nie.* Indien dit egter 'n 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 weerhoudings tydperk en waarskuwings) gespuit word om bruinvrot te beheer. Bo en behalwe droogte en hitte kan 'n oormaat vogtige toestande (baie reën) ook bome onder tydelike verwelkte toestande plaas wat 'n gevaar inhou vir blaarbespuitings. Bome moet dus nie tydens of kort na sulke toestande gespuit word nie. Laastens beïnvloed drag ook 'n boom se gevoeligheid vir droogtespanning. Hoe hoër die drag, hoe gevoeliger is die boom vir uitdroging en hoe groter is die risiko vir fitotoksisiteit.

Sitrusaalwurm

Wortelmonsters kan enige tyd van die jaar getrek word om die status van die sitrusaalwurmpopulasies in boorde te bepaal. Wyfietellings word gebruik om te bepaal of die toediening van 'n aalwurmdoder geregverdig is. Die drempelwaarde voordat 'n aalwurmdoder oorweeg word is 1000 wyfies/ 10 g wortels. Daar word aanbeveel dat aalwurmdodertoedienings in 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 die winterreëns begin. Residu-weerhoudingstydperke moet ook in ag geneem word. En dis belangrik om 'n aalwurmbeheerprogram te volg aangesien 'n *enkele aalwurmdodertoediening* nie effektief genoeg is nie, en geen noemenswaardige onderdrukking van die aalwurmpopulasies op die langduur het nie. Meermalige toedienings twee maande uit mekaar verseker dat die larfies wat uitbroei gedood word voordat hulle volwasse wyfies 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 doders word dus belemmer indien hulle nie

behoorlik deur die wortelsone versprei word nie. Geen aalwurm-doder behoort deur drupbesproeiingsstelsels toegedien te word nie. Indien toedienings in boorde met druptoediening gedoen moet word, behoort die middels as ŉ bandplasing (half meter aan beide kante van die drupperlyn) oor die drupperlyn gedoen te word. Dit kan wel deur mikro-besproeiingstelsels toegedien word.

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

CITRICULTURE

Fruit production and quality

O.P.J. STANDER, 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 break-down 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, and fruit size and 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 ten representative trees should start four to six weeks before the expected harvest date. Titratable acidity is determined by titration with sodium hydroxide, whereas 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. Then, trends will become apparent, harvest dates can be estimated and problem

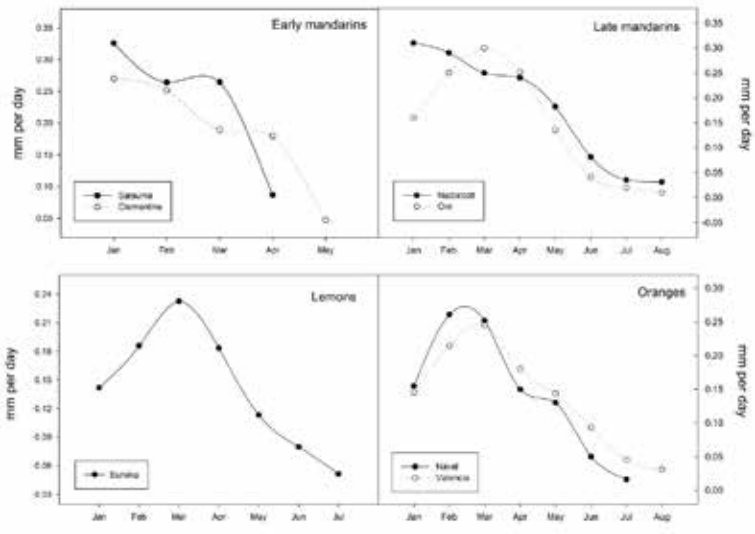


Figure 1. *Historical fruit growth rates (mm per day) of different citrus cultivars in the Western Cape region.*

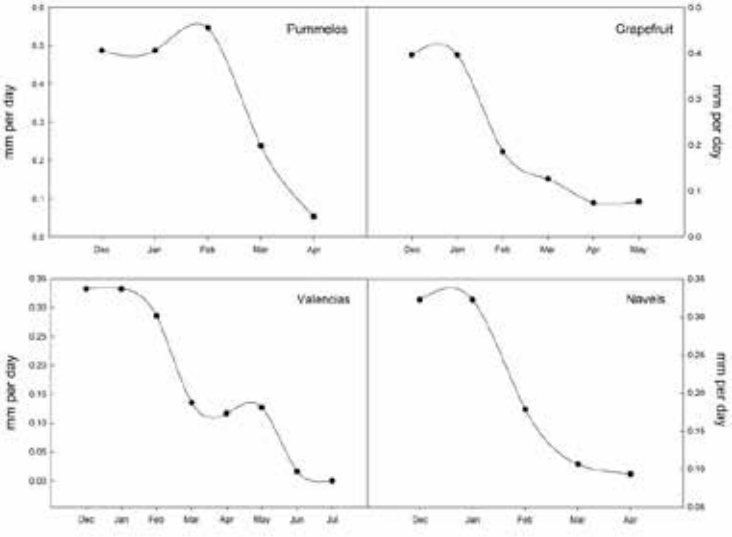
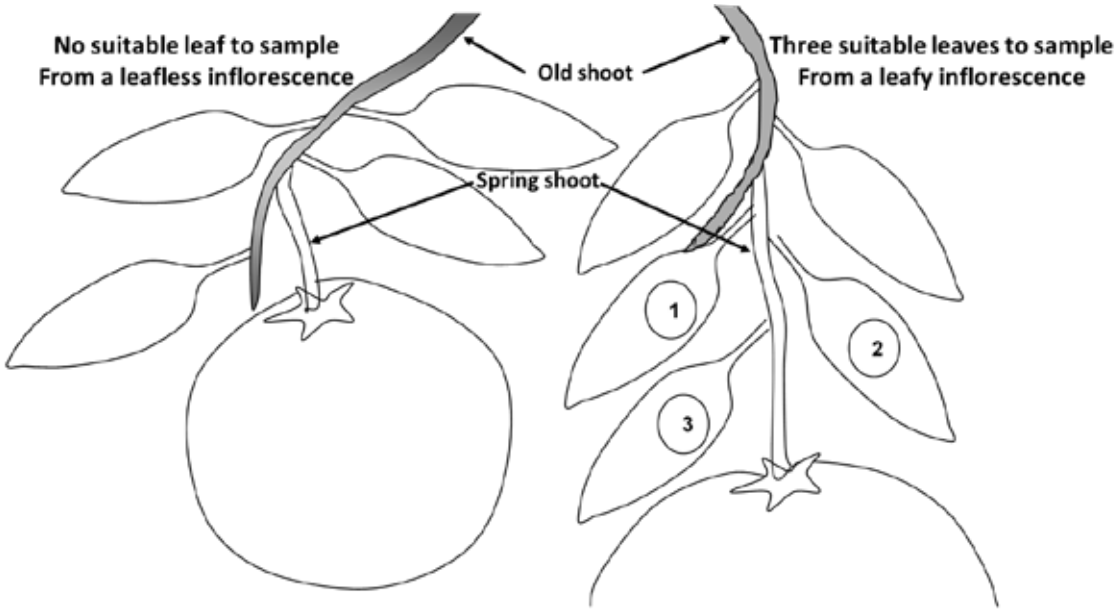


Figure 2. *Historical fruit growth rates (mm per day) of different citrus cultivars in Limpopo.*



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

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 size. Fruit thinning plays a critical role in fruit size (see Cutting Edge no. 32: Fruit size improvement); and correct pruning practices are the most effective way to manipulate the number of fruit per canopy volume,as wel as the eventual fruit size. For more information, refer to 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 & T. VAHRMEIJER

Neem van blaar- en grondmonsters Die periode van Februarie tot Junie moet gebruik word vir jaarlikse blaar- en grondontledings. Blaarmonsters behoort jaarliks geneem te word, terwyl grond elke drie jaar gemonster kan word. 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. *Standardiseering van die monsternemingsprosedure is dus belangrik.*

Monster blare elke jaar:
1) Rondom 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 monsternemings-eenhede 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.

- slegs blare agter 'n vrug, wat in die lente 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 50 en 70 blare, plaas hulle in 'n skoon plastieksakkie, druk die lug uit en knoop die sakkie toe. Merk die monster deeglik – moet nie direk op die sakkie skryf nie, aangesien selfs permanente ink 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) taken half-way 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 occurence of soil acidity or salinity is suspected, an additional sample must be taken from the 30 – 60 cm layer.

Use either an auger or spade to take the samples over the full top 30 cm. Then, 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 met die besluitnemingsproses oor 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 ekstraksiemetodes en maniere waarop resultate uitgedruk word. Interpretasie van grondontledings moet dus met inbegrip van die ekstraksiemetodes gedoen word.

POST HARVEST PATHOLOGY – PRE-PACKING POINTERS

C. SAVAGE, W. DU PLOOY & K.H. LESAR

Orchard sanitation: Sanitation just before the start of the picking season is of critical importance. For reducing fungal spore load, as well as keeping FCM and fruit fly under control, remove all fallen and decayed fruit (including in the trees) from the orchard. Bury or macerate fruit and allow it to dry in the sun, away from the orchards and packhouses.

Skirt trees for sour rot and brown rot control: Ensure that trees are adequately skirted, preventing low hanging fruit, especially in heavily laden trees, thereby reducing the risk of *Phytophthora* brown rot infection during the rainfall season. 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. Injuries are the number one cause of postharvest decay.

Packhouse sanitation: Before any fruit is brought to the packhouse in the 2019 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.

- 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 2019 season is being sourced and negotiated. Decide on a chemical program for the coming season that is in line with decay control and export market regulations.

Make use of the CRI Postharvest Factsheets that are provided at the Postharvest Workshops during January and February every year. If using a new product, ensure that it's safe to do so (possible phytotoxixity; MRL restrictions) and that it's applied correctly.

In light of the increased cold-temperature shipping and FMS protocols it's important that packhouses use thiabendazole (TBZ) for all fruit being exported. Application of TBZ in the wax provides protection against chilling injury and – importantly – helps control latent pathogen infections.