Extension Briefs for February & March 2016

J.J. BESTER & M.C. PRETORIUS *Citrus Research International*

INTEGRATED PEST MANAGEMENT

Mealybug S.D. MOORE

Growers should be scouting for mealybug regularly, by inspecting underneath calyces and thereby determining percentage of fruit infested. The most effective way of doing this is to break the fruit off from the calyx. Both the fruit and the underside of the calyx should then be inspected. 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. Trial results have demonstrated that buprofezin (Applaud) is by far the most effective corrective option for mealybug control. It is imperative that any application of buprofezin be targeted against the younger stages of mealybug, i.e. eggs, crawlers and second instars. Where buprofezin cannot be used, methomyl and chlorpyrifos can be used if preharvest intervals allow.

This is also a good time to determine which species of mealybug are present. This is important, as it appears that the biocontrol complexes of oleander mealybug and longtailed 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 species in a particular orchard. The phytosanitary status of certain species must also be borne in mind.

False codling moth S.D. MOORE

Effective false codling moth (FCM) control begins in November or even October with diligent orchard sanitation and the application of a registered control treatment. Follow up treatments should be applied as often as necessary, bearing in mind that there is zero tolerance for FCM by certain markets, making the decision a phytosanitary one rather than an economic one. It is also imperative to refrain from using broad-spectrum long-residual pesticides (most often used for thrips control) as early as possible in the season. Naturally occurring egg parasitoids can be extremely effective in reducing FCM levels and one should therefore conserve them.

Granulovirus products (Cryptogran, Cryptex and Gratham), Delegate and Broadband are the only pesticide sprays for FCM, which are permitted in all markets. The granuloviruses and Broadband can be used up until the day of harvesting, whereas Delegate has a 7-day withholding period. A virus

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Some Oranges are Sweeter than Others . . .
CONTINUED FROM PAGE 34

season Navels, with Cambria and Glen Ora Late being found to be the most FCM tolerant of the late season Navels. Consideration of FCM susceptibility in evaluation of new varieties would then also assist with the management of FCM.

Acknowledgments

The authors would like to thank all the growers in the Sunday's River Valley who kindly allowed for the collection of fruit from their orchards. We gratefully acknowledge River Bioscience and John Opoku-Debrah for the supply of FCM, and Zongezile Zondi of CRI for conducting the internal quality tests. The assistance of Candice Coombes, Tanya Pretorius and Diane Smith with executing the experiments is much appreciated, as well as Dr Julie Coetzee for her assistance with the statistical analysis. CRI, the Andrew Mellon Foundation and Rhodes University are acknowledged for financial support.

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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. Note that due to high levels of UV irradiation in the Clanwilliam and Piketberg magisterial districts of the Western Cape and in the Northern Cape, problems may be experienced with the efficacy of virus applied in these areas during February and March. The use of Cryptogran should therefore ideally be used in these areas before the beginning of December and again after March. This problem does not exist in the rest of the country and therefore the caution is limited to the above-mentioned areas. Note that although the simultaneous use of a granulovirus and copper has traditionally been discouraged, due to the potentially detrimental effect of copper on the virus, a recent study completed by Rhodes University indicates that if a tank mixture of the two compounds is sprayed within a few hours of mixing, there will be no reduction in the efficacy of the virus.

Delegate is registered as a double-application, 8 and 4 weeks before harvest. However, even a single application will have a good effect. However, note that the registered rate of Delegate for FCM is 20 g per 100 L water, as a high volume spray. Application at reduced rates (e.g. 10 or 12 g as registered against thrips and bollworm) will not be effective. Coragen (Rynaxypyr) also has a 7-day withholding period for most markets, bar Japan and Norway, where 90% petal drop applies, albeit only for Mandarins in the case of Japan. Coragen is recommended to be applied once or twice, from as early as 16 weeks before harvest and never at more than 8500 L per hectare. Runner is registered to be applied not more than twice in a season and has a withholding period of 30 days for all markets except Taiwan. Bear in mind that the use of triflumuron (Alsystin) and teflubenzuron (Nomolt) is restricted to not later than 90% petal fall for several important markets, making them relatively ineffective for protection of the in-season crop. Also note that the withholding period for fenpropathrin (Meothrin), which is 28 days for most markets, is 185 days for certain markets and cultivars. Cypermethrin (other than alpha- and zeta-cypermethrin) is not allowed on fruit destined for the USA market, but is permitted in other markets with a withholding period of 28 days.

Broadband is registered to be sprayed no fewer than three times in a season. It is suggested that if growers wish to use this product, that they should only do so within an integrated programme, as the efficacy of the product alone may not be sufficient. Note that Broadband is currently the only entomopathogenic fungus registered for use on citrus.

In addition to the insecticides, there are two mating disruption products – Isomate and Checkmate – 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.

Early maturing mandarins, such as Satsumas, which will be harvested during March, should be strongly considered for a registered spray treatment for FCM during February, i.e. approximately four weeks before harvest. An effective treatment at this time should reduce post-harvest risks associated with FCM.

Bud mite T.G. GROUT

The period February to May is the optimal time for bud mite sprays and Mitigate (fenpyroximate) can be used during this period at 150 ml per 100 L water. The preharvest interval for most countries is 28 days but for Canada and for citrus types other than mandarins going to South Korea the preharvest interval is 150 days, or no applications after the end of October. Orchards with fruit going to markets that do not have an MRL can be sprayed immediately after removing all fruit in winter. In trials with Mitigate, this product was found to have similar efficacy to Acarol against bud mite so although a spray after harvest is not at the optimal time it will still have more impact against this pest than other unregistered options. Mitigate will also suppress citrus red mite when sprayed during autumn for bud mite and CRI research has shown that it is also effective against citrus grey mite.

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) previously known as *Bactrocera invadens* (B. i.) which is now present in the northern and north eastern parts of South Africa.

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 *B. dorsalis* per Production Unit Code (PUC) is a require-

ment 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). Monitoring of *B. dorsalis* is conducted using bucket type traps such as Chempac Bucket trap, Moroccan trap and Lynfield trap baited with Methyl Eugenol (ME). Each PUC should have at least one ME baited trap for monitoring of *B. dorsalis.* Monitoring of *B. dorsalis* should be carried out throughout the year. Trapping guidelines for surveillance of *B. dorsalis* in fruit production areas should be followed. Guidelines are available at http://www.daff.gov.za under Plant Health Division or at http://www.citrusres.com/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. Trapping density should be between 2 and 5 traps per 100 ha in areas where *B. dorsalis* is considered present or where *B. dorsalis* specimens 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 *B. dorsalis* 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 should be adhered to. For Medfly, the threshold in a Capilure baited trap is 4 males per week. For Natal fly, the threshold in a Capilure baited trap is 2 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. If trap thresholds are exceeded, control actions must be increased.

Fruit fly control practices should be initiated 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 methods is recommended: weekly bait sprays (mixture of protein hydrolysate and malathion/trichlorfon, GF-120) and M3 bait stations. For the use of malathion in bait sprays, the pre-harvest interval is now back to 7 days for citrus. For Medfly and Natal fly, Last Call FF is also available as an additional control method. In areas affected by *B. dorsalis,* the Male Annihilation Technique (MAT) must be used to control *B. dorsalis* males in addition to normal baiting. In MAT, *B. dorsalis* males are targeted using ME and killed by an insecticide incorporated with ME. With high levels of male kills, the number of matings and therefore viable offsprings are reduced. 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. 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.

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. The contacts at DAFF are RemovalPermits@daff.gov.za, Mashangoane Mabelebele (MashangoaneM@daff.gov.za) 012-309 8735 and Gloria Phahlamohlaka (GloriaPh@daff.gov.za).

GRONDGEDRAAGDE SIEKTES

JAN 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 en met die 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 winterreëns begin. Residu-weerhoudingstydperke moet in ag geneem word. Dit is belangrik om 'n aalwurmbeheer**program** te volg aangesien 'n **enkele aalwumdodertoediening** nie effektief genoeg is nie en het geen noemenswaardige onderdrukking van die aalwurmpopulasies op die langduur nie. Meermalige toedienings twee maande uit mekaar verseker dat die larfies 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 t**oegedien 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 aalwurmdoder behoort deur drupbesproeiingsstelsels toegedien te word nie. Indien toedienings in boorde met druptoediening gedoen moet word behoort die middels as 'n bandplasing (half meter aan beide kante van die drupperlyn) oor die drupperlyn gedoen te word. Dit kan wel deur mikro-besproeiingstelsels toegedien word.

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

HORTICULTURE

Fruit production and quality

O.P.J. STANDER, P.J.R. CRONJE

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 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 ten representative trees should start 4 to 6 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 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 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.

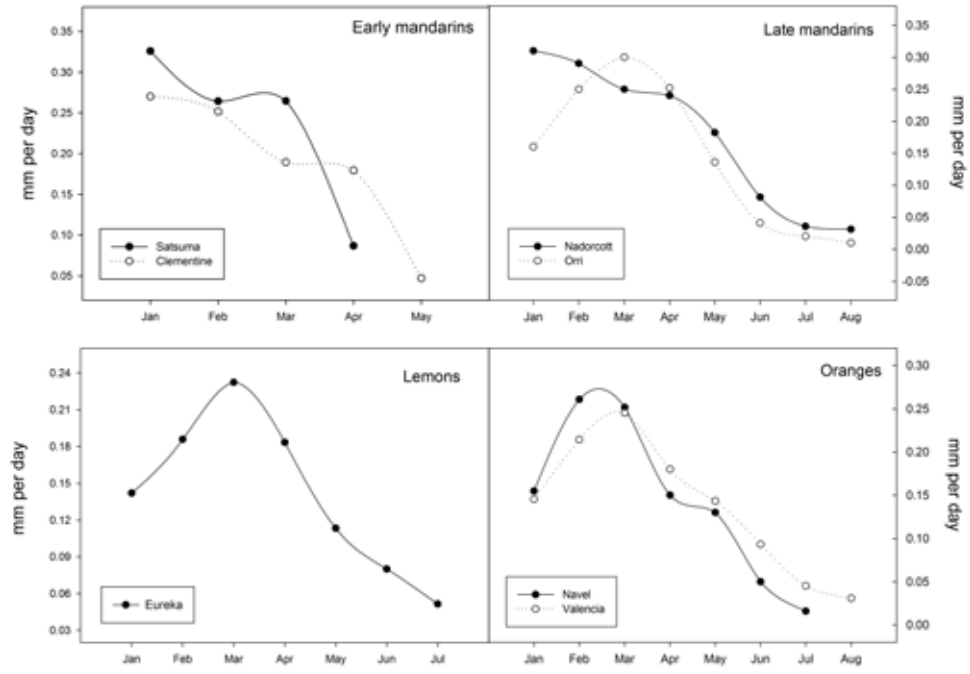


Figure 1. *Historical fruit growth rates (mm per day) of different citrus cultivars in the Western Cape region.*

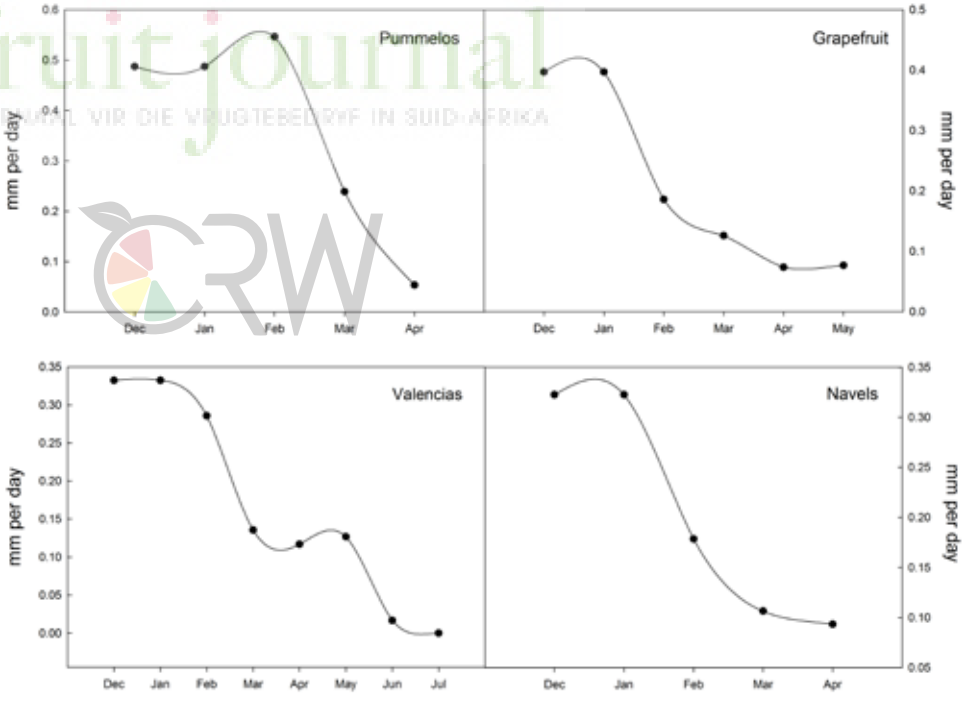


Figure 2. *Historical fruit growth rates (mm per day) of different citrus cultivars in Limpopo.*

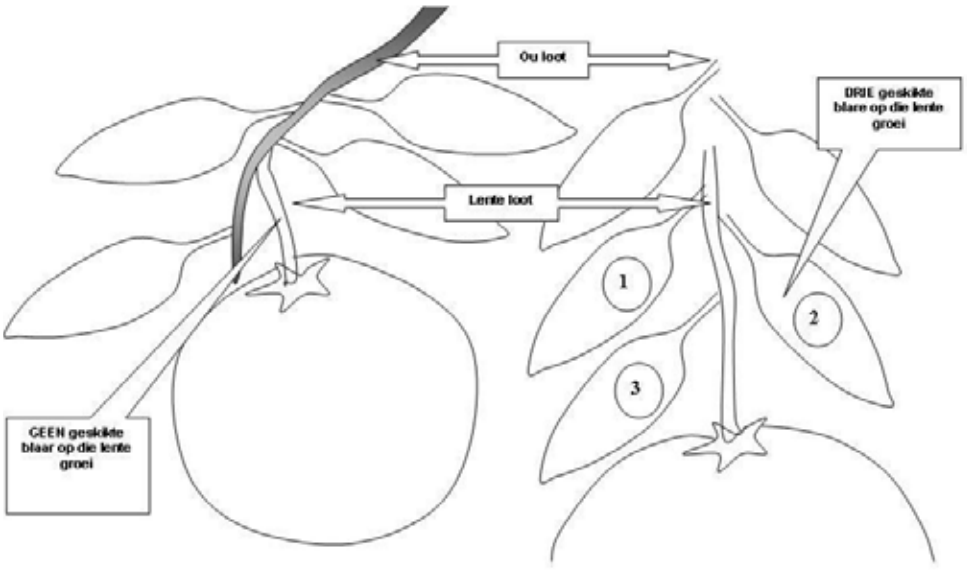
GEINTEGREERDE BEMESTING

T. VAHRMEIJER

Blaar- en grondontledings

By sitrus word blaar- en grondmonsters gedurende Februarie en Mei geneem maar die periode kan tot Julie verleng word. Daar moet net in gedagte gehou word dat wanneer monsters in Julie geneem word, is die tyd beperk om resultate betyds terug te kry om bemestinaanbevelings te maak vir bemesting wat in Julie/Augustus begin word.

Geen ontleding, hoe gesofistikeerd ookal, kan die kwaliteit van die monster verbeter nie. Bestee dus tyd, energie en aandag aan die



Figuur 3. *Voorstelling van die soort blaar wat vir blaarontleding geneem moet word.*

monsternemingsproses. Op grond van die resultate van dié monsters word baie geld aan kunsmis bestee, terwyl die oes ook benadeel kan word. Monster elke jaar dieselfde groep bome (Indeksbome) en hou by dieselfde prosedure en tyd. Soos by enige monster moet dit die eenheid wat gemonster word, in alle opsigte verteenwoordig.

Leaf analyses

Leaf analyses are an indicator of the nutritional status of the trees. During the research into this method a relationship was established between the concentration of the nutrient elements in the leaves and production. This relationship was developed for almost every nutrient element. For some like chloride and sodium only the maximum tolerable concentration was determined.

Let ook op die volgende spesifieke vereistes.

- Verdeel die boorde in monster eenhede, verkieslik nie groter as 5 ha nie.
- Kies twee of vier INDEKS-RYE wat die monster-eenheid in alle opsigte verteenwoordig en merk die rye.
- Gebruik elke jaar dieselfde indeksrye om blaar- en grondmonsters te neem.
- Pluk sowat 50 tot 75 blare per monster deur aan die linker- en regterkant (son- en skadukant) tussen heup- en kophoogte, blare te gepluk.
- Pluk blare van agter 'n vrug, wat op dieselfde takkie as die vrug, en in die lente gevorm is (Figuur 3).
- Pluk die blaarmonsters gedurende Februarie tot Mei.
- Plaas die blare in 'n skoon plastiek sakkie, druk die lug uit en knoop toe.
- Merk die monsters deur 'n etiket op die sakkie te plak of aan die sakkie te bind.

Ensure that the correct leaf is picked from the trees in the index rows or blocks. The correct leaf is one that was formed during the previous spring and situated behind a fruit on the same twig as the fruit. Collect 50 to 100 leaves per sample. Take the soil sample at the same index trees. Collect 15 to 20 subsamples, mix and submit 500 g of the composite samples for analyses.

If the soil was sampled, prepared and fertilized properly before planting, it is not necessary to take leaf samples from non-bearing trees. However it is never too early to monitor the nutritional status.

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. Met 'n grondontleding word gepoog om binne sekondes of minute 'n massa van die voedingstowwe uit die grond te ekstraheer, wat die bome in 8 - 10 maande sal opneem. Elke metode wat gebruik word, het dus net waarde indien dit gekalibreer is en presies so uitgevoer word, soos wat dit in die kalibrasie gebruik is.

Neem van grondmonsters vir bemestingsadvies - Die grondmonsters word in dieselfde indeksrye as die blaarmonsters soos volg geneem.

Monsterneming by mikrospuite

- Neem 'n submonster vanaf die oppervlak (verwyder slegs die blare, maar geen grond nie) tot 30 cm diep onder die blaarkap. Gebruik 'n graaf of monsterboor.
- Neem sowat 15 tot 20 submonsters by die bome in die indeksrye. Plaas dit in 'n plastiekemmer, meng deeglik en neem ±400 g en verpak vir versending na die laboratorium.
- Merk die monster met die boordnaam (u verwysing) of boordkode plus u besonderhede.

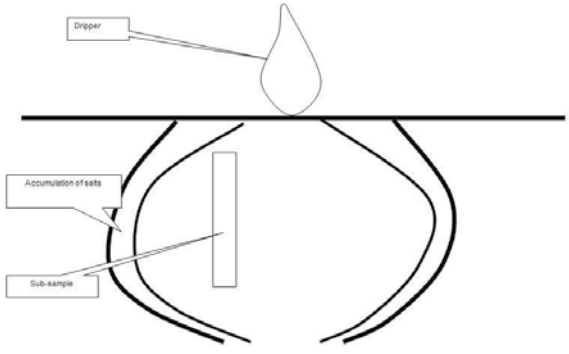


Figure 4. *Taking soil samples.*

Soil sampling at drippers

(Figure 4)

- Remove the top 5 cm of soil plus debris.
- Take the sub-sample from 5 to 30 cm deep.

• Take the sample between the dripper and the perimeter of the wetted zone. If the wetted zones of two adjacent drippers overlap, take the sub-sample between the two drippers.

• Collect 15 to 20 sub-samples at the index trees. Put the sub-samples in a plastic bucket, mix properly and retain ± 500 g for sending to the laboratory.

• Mark the samples with your name and that of the orchard plus all relevant information on a label and stick or tie it to the outside of the container.

Dit word sterk aanbeveel dat 'n submonster, 30 tot 60 cm diep, elke twee tot drie jaar geneem word om die grond-pH en opbouing van soute in die wortelsone te monitor.

POST HARVEST PATHOLOGY – WASTE PREVENTION CHECKLIST

K.H. LESAR & ARNO ERASMUS

Sanitation: NB: For reducing fungal spore load, as well as keeping FCM and fruit fly under control – remove all fallen fruit and decayed fruit from the orchard. Bury or macerate fallen fruit and allow to dry in the sun away *from the orchards.*

Remove dead wood from all citrus trees to reduce the spore load of the latent citrus pathogens.

Good fruit fly control: Use traps and bait regularly.

FCM: Apply pre-harvest treatments according to trap counts and fruit drop data.

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

DO NOT PACK ANY FALLEN FRUIT THAT COULD BE INFECTED, OR ANY FRUIT TOUCHING THE GROUND. THESE FRUIT SHOULD BE REMOVED FROM THE ORCHARD A DAY OR TWO BEFORE HARVEST.

Swaar reënval – *Phytophthora* bruinvrot waarskuwing!!!! *Phytophthora* bruinvrot word versprei wanneer *Phytophthora nicotianae* of *P. citrophthora* spore tydens reën vanaf besmette grond op vrugte spat. Infeksie vind plaas en die vrug vrot na 'n tydperk van 4-6 dae. Dit gebeur dus dat geinfekteerde vrugte gepluk en gepak kan word en

tydens versending bruinvrot kan ontwikkel. ŉ Enkele vrot vrug kan die hele karton vrugte besmet. Die swam penetreer die skil binne drie ure, dus is dit belangrik dat bruinvrot voorkomend in die boord, voor pluk, behandel word.

Prevent injuries: Test for injuries. "Indigo-Carmine" should be used for this purpose. Test both in the orchard and the packhouse. **NB: Ensure that proper picking practices are adopted. There are far too many injuries every season, resulting in unnecessary high waste levels.**

Let Wel: Sorg dat gepaste plukpraktyke toegepas word. Plukbeserings veroorsaak elke seisoen onnodig hoë vlakke van bederf.

Apply packhouse fungicides with care and proper management: Check the mixing / application rates.

Packhouse sanitation:

- Never allow any fruit, and more importantly any fungicide-treated fruit, to lie around in the packhouse and develop spores.
- Constantly monitor concentrations of sanitisers in dump tanks, descaler water, rinses, etc.
- Spray the packhouse with sanitisers regularly and immediately after finding a single mouldy fruit.
- Spray trailers/picking bins with a suitable sanitiser before they leave for the orchard.
- Transport cartons to the ports as soon as possible and prevent packed fruit standing on the packhouse floor where it is hot. Green mould develops faster at 10°C than at 4.5°C.
- Store retention samples for each consignment and check regularly for waste and other developing factors.

The control of post-harvest diseases on export citrus using the post-harvest fungicide thiabendazole

There seems to be a general reduction in the use of thiabendazole within the SA citrus industry. This is particularly alarming since latent pathogen infections have been observed in abundance during recent citrus production seasons.

Why use thiabendazole (TBZ)?

TBZ was the first fungicide registered (1960s) for the control of the Penicillium moulds and the latent pathogens, Diplodia stem-end rot, Phomopsis stem-end rot and Anthracnose on citrus fruit. TBZ and benomyl belong to the benzimidazole group of fungicides.

The benzimidazoles are distinguished from other traditional fungicides in that they control diseases both by contact and systemic action.

Due to the extensive pre-harvest application of benomyl for the control of citrus black spot and the post-harvest application of TBZ for control of Penicillium, populations of Penicillium that were resistant to the benzimidazoles developed rapidly. There is therefore an unfortunate perception in the industry that TBZ is of no value in controlling important post-harvest pathogens.

However, TBZ is still effective in controlling the latent pathogens on citrus: Diplodia stem-end rot, Phomopsis stem-end rot and Anthracnose. All export citrus should therefore be treated with TBZ.

Application of TBZ in the wax to fruit also reduces the risk of some physiological rind conditions developing on sensitive cultivars during storage and export, e.g. chilling injury, pitting etc.

Guidelines for reducing the risk of chilling injury on grapefruit exported under extended cold sterilisation conditions:

Citrus in general is known to be sensitive to cold damage (chilling injury) during shipping and storage, but certain cultivars, with light or yellowish pigmentation (some soft citrus cultivars, lemons and grapefruit varieties), are particularly prone to chilling injury, especially when exposed to "cold sterilisation" temperatures. It is especially the yellow pigmented citrus cultivars viz. lemons, Satsumas, Marsh grapefruit, and even the yellow areas of Star Ruby and Rose grapefruit which are the most sensitive, as they do not contain sufficient levels of carotenoids which act as anti-oxidants that protect the fruit against chilling injury. The extended cold sterilisation treatment, as recently adopted by China (24d at -0.6°C), is particularly problematic. It is generally accepted that it is not feasible to export lemons under these conditions. Though grapefruit is also highly sensitive to chilling injury, the application of TBZ can reduce the risk of chilling injury.

Picking window

The South African grapefruit season, in the traditional production areas, extends from the middle of March to the end of June. The picking window for grapefruit is often manipulated in an attempt to access markets early or to extend the season. However, harvesting grapefruit too early in the season, when the fruit rind is still "immature" and also at or beyond the end of the season when the fruit is well coloured and "very mature", is when grapefruit is most sensitive to cold injury. It is a major risk to export such sensitive fruit to markets where cold sterilisation is a requirement.

Thorough maturity indexing is essential to determine the ideal harvesting window. Commencing 5 weeks before anticipated harvest, pick samples of grapefruit (20-25 fruit). Mark the representative trees (data trees from different rootstocks, selections, tree ages or microclimates). Evaluate and record average fruit colour and full internal quality assessments. Repeat every week until optimal har-

vest date, ensuring that the samples are drawn similarly for comparison. Plot the results on a graph to determine whether the season is early or late compared to the previous year, thereby determining the optimal picking window for the specific cultivar.

Commencement of export packing of grapefruit to "cold steri" markets should start 14 days later, as the rinds will still be too cold sensitive at the beginning of the normal optimal picking window. Harvesting of grapefruit for "cold-steri" markets should also not be extended beyond the end of the optimal picking window.

Post-harvest wilt conditioning

Conditioning (wilting) trials where Marsh grapefruit (exported to Japan) was "conditioned" for 2, 4 and 6 days at 16°C and 20°C prior to cold treatment, showed a dramatic reduction in the incidence of chilling injury relative to the non-conditioned control fruit. Unfortunately extending the time between packing and introduction into the cold chain can also increase the incidence of post-harvest rind pitting and decay in sensitive fruit. Nonetheless, wilting at ambient for 7 days is part of the standard handling procedure for grapefruit exported to Japan and should be implemented by anybody wishing to risk exporting grapefruit under an extended cold treatment regime.

The role of TBZ

It is known that inclusion of thiabendazole (TBZ) in citrus wax applied to grapefruit can significantly reduce the incidence of chilling injury. Inclusion of TBZ is also a good standard packhouse procedure and should be used if anybody wishes to risk exporting grapefruit under these extended cold sterilisation conditions.

Pre-cooling and storage

A critical factor affecting the extent of chilling injury of grapefruit, is the duration of exposure to temperatures below 4.5°C. This exposure period is cumulative and can occur during pre-cooling (the period prior to loading during which the temperature of the fruit is reduced to the cold sterilisation level), the cold sterilisation treatment itself and post-shipping storage. Pre-cooling for 3d is a compulsory component of the disinfestation treatment, but any other pre-loading storage at temperatures below 4.5°C should be avoided. Storage of grapefruit after shipping should be at an "intermediate storage temperature" of 7 to 8°C and should be kept to the minimum necessary duration.

The role of waxes

The main purpose of a wax emulsion is to:

- Protect fruit against moisture loss, which results in **longer shelf life** and **less weight loss** of the fruit.
- To provide shine to the fruit at the point of sale. It is important to note that this shine needs to be sustained throughout the chain of distribution (some waxes break down more rapidly than others).
- Provide a **barrier of protection against chilling injury and fungi.**

The type of wax that you choose and the way in which you apply the wax will have a significant influence on the above points.

Choosing the right wax: The "lighter" waxes (e.g. lower solids or carnauba based waxes) offer less resistance to gas transfer (respiration) than "heavier" waxes (e.g. shellac or high solids polyethylene based waxes). Thus light wax emulsions will protect fruit with sensitive rinds far better than a heavier wax emulsion and will also allow for better colour development. On the other hand lighter waxes break down more quickly, and are therefore not suitable for long storage programs, especially cold sterilisation programs.

Research has indicated that "heavy waxes" that slow down breathing (respiration) and retain a high level of CO2 (10%+) on the surface of the fruit, reduce the incidence of CI. Unfortunately the use of heavy waxes may increase the incidence of post-harvest rind pitting on sensitive fruit. Nonetheless, the high risk of chilling injury on grapefruit under conditions of extended sterilisation, make it appropriate to consider preferentially using such waxes when exporting to markets that require such extended cold treatment.

Wax application Uneven waxing, under-waxing and over-waxing all have a deleterious effect on fruit quality. The wax barrier need not be thick, and in fact a very thin barrier provides enough of an integral film to prevent most of the moisture loss without interfering with the respiration process. NB: Adhere to the wax manufacturer's recommended application rate – ADHERE TO THE PRODUCT LABEL INSTRUCTIONS.

Please note

- Fruit should be dry before waxing. Where possible the packhouse should use a hot water bath for fungicide application as this helps the drying of fruit before waxing.
- Fruit must move evenly through the waxing unit and flow of fruit entering the packing line must be consistent.
- When fruit leaves the waxing unit, all parts of the fruit needs to be covered with a film of wax. Examine fruit after the waxing unit regularly.
- Brushes in the wax applicator must be in good condition and should rotate at a speed of about 90 rpm. The last brush in the wax applicator should always be wet, so as not to remove wax from the fruit.

Over application

- Inhibits the breathing (respiration) of the fruit.
- The movement of oxygen and CO_2 on the surface of the fruit is inhibited resulting in poor colour development and off-flavours caused by the process of an aerobic fermentation.
- Inhibits colour break.
- Encourages rind disorders on sensitive fruit.
- Unnecessary expense!!

Under application

- Excessive weight loss and shrinkage of fruit.
- Poor shelf life / storage.
- Susceptibility to chilling injury.