

Extension briefs for



October and November 2022

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

Integrated pest management

(T.G. Grout and S.D. Moore)

Thrips management

During October and November, the different citrus fruits are highly susceptible to damage from citrus thrips and orchards should be scouted for this pest at least once a week, being sure to look under the sepals. Citrus thrips larvae cause more serious damage than adult thrips, so low numbers of adults in the absence of larvae may not require immediate intervention. The intervention threshold for citrus thrips larvae on fruit is 2% for the first four weeks after petal fall, 3% for 5 - 6 weeks after petal fall, then 4% for 7 - 8 weeks after petal fall. These thresholds can be roughly doubled if the population comprises mostly adults. Citrus thrips are genetically predisposed towards developing resistance to pesticides, so avoid spraying two consecutive sprays of the same active ingredient. Treatments that give 6 - 8 weeks thrips' control will eliminate natural enemies of false codling moth (FCM), mealybug and scale insects for at least one month. So, if this degree of control is required, it is best to spray these at petal fall and follow up with softer options when necessary.

Parasitoid releases

Growers planning to augment parasitoids for mealybug (i.e. *Coccidoxenoides perminutus* or *Anagyrus vladimiri*), red scale (i.e. *Aphytis melinus*) or FCM (i.e. *Trichogrammatoidea cryptophlebiae*) control should initiate releases as early in the new season as possible. Augmentative releases of parasitoids are not a corrective option. Therefore, growers should not wait until the pest reaches a problematic level. Research

trials with mealybug and FCM parasitoids indicate that better suppression of the pest is achieved with releases initiated as early as October. However, first ensure that sufficient time has lapsed since application of pesticides that would be detrimental to parasitoids. This information is available from CRI and the biocontrol agent producers/suppliers. Lastly, if releasing parasitoids against mealybug, you need to be sure that the mealybug species is indeed susceptible to the parasitoid being released; for *C. perminutus*, this is only citrus mealybug, whereas for *A. vladimiri*, this is citrus and oleander mealybug.

Preventative sprays for mealybug

Pre-harvest blemish analyses or winter inspections of trees might have indicated that preventative spraying for mealybug is unnecessary. This can be confirmed or refuted by inspecting fruit in October and November for the presence of mealybug. Sprays applied before calyx closure will be more effective than those applied thereafter. An infestation level in excess of approximately 5% at petal fall, or up to 20% six weeks after petal fall, requires immediate chemical intervention. At this later stage, the organophosphates and buprofezin, with which we are so familiar, can no longer be used. However, trial work indicates that some of the newer options, particularly spirotetramat and sulfoxaflor, are at least as effective. Anything short of an absolutely thorough full cover film spray will compromise the effectiveness of a chemical treatment. If citrus mealybug is not the dominant species, then augmentative releases of *Coccidoxenoides perminutus* should be considered unsuitable.

Bollworm

In many regions, it might already have been necessary to treat bollworm during September. However, routine spraying for bollworm is generally not necessary. Monitoring the percentage of blossom clusters infested makes it possible to determine if a spray is necessary. A treatment should be applied when more than 20% of blossom clusters is infested with larvae or mature eggs. Enlarged navel end problems in Navel oranges can be further exacerbated by bollworm attack. In such an instance, a threshold of 11% of clusters infested should be used.

Four biocontrol options are available for the control of bollworm. These are DiPel (Bt), Helicovir, Bolldex and Graboll (all viruses). In order to be effective, these biological products should be applied immediately after egg hatching, but certainly not once larvae are longer than one centimetre in length.

Citrus flower moth

Moths of the citrus flower moth (or lemon borer moth), *Prays citri*, are attracted to lemon blossoms. Growers should inspect these blossoms in spring to determine if they are infested with larvae or pupae. These can be identified by their colouration, which is usually greenish and the association of webbing with pupation. Even if the damage to and loss of blossom are not considered sufficiently severe to justify control measures, no intervention will allow the development of a second generation. It is the moths of this second generation that lay their eggs on the lemon fruitlets. Hatching larvae can potentially cause severe damage. Therefore, it is more effective to control the first generation. Infestation of 5% of blossoms with this first generation will lead to approximately 5% fruit damage, and would thus warrant a spray. No plant protection products are registered for use against the lemon borer moth. However, there are a number of pesticides that are registered for other pests on citrus and are effective, including Bt (DiPel), mevinphos and spinetoram (Delegate).



Hannes Bester



MC Pretorius

False codling moth

NB: As was the case since 2018, all growers intending to export citrus to the EU must implement the FCM Risk Management System (FMS), which includes the FCM Systems Approach.

Effective control of FCM from early in the season is critical. If this is not done, false codling moth (FCM) could escalate to undesirable levels, which will be far more difficult to bring under control. As soon after harvesting as possible, all out-of-season fruit must be removed from trees and destroyed. Within the FMS, it is mandatory that this be completed within 14 days after completion of harvesting the particular orchard. If not done, these fruit can act as a reservoir for FCM and fruit flies, enabling particularly the former, to carry over onto the new crop set in spring. Do not neglect orchard sanitation

early in the season. Infested fruitlets can contribute significantly to the build-up of FCM populations later on and any extra labour required is well worthwhile.

FCM pheromone traps should be hung not later than November. It is imperative that these traps be hung strictly according to the recommendations on the label.

Growers wishing to control FCM with Cryptogran, Cryptex or Gratham (FCM granulovirus) should apply the first treatment no later than the end of November or early in December – applied shortly after the flight peak, which occurs at this time in all production areas. Cryptomax is a new FCM granulovirus formulation, consisting of two distinct virus isolates, thus increasing the probability of good efficacy against multiple FCM populations, and decreasing the possibility of resistance, even though there is already minimal possibility of resistance against insect viruses

If mating disruption (e.g. Isomate, Checkmate, Splat, X-Mate) is being used, there are a few very important principles to be aware of. Firstly, application must be initiated early in the season, before FCM levels begin to rise. In the cooler Cape regions, this is preferably October, but not later than November. However, this may be a lot earlier in the warmer northern regions. It appears that temperatures and FCM activity may begin increasing as early as July, which may then be a more appropriate time to initiate mating disruption in these regions. This approach is currently being tested in Limpopo. Secondly, the product must be applied (or hung) as high as possible in the tree. Lastly, large areas (at least 5 ha, but preferably even larger) must be treated.

Crop and fruit quality management (P.J.R. Cronjé)

Fruit set treatments according to cultivar requirements, need to be applied. Treatments

include the application of gibberellic acid (GA₃) and girdling, especially for parthenocarpic cultivars. General guidelines cannot be given, as fruit set treatments differ by cultivar and orchard. Moisture stress should be avoided during full bloom, fruit set and early fruit growth.

Fruit growth must be optimised during stage 1 of fruit development, with optimal nutrition and irrigation practices. During this phase of fruit development, the rind (flavedo and albedo) is formed. It is essential to ensure optimal uptake of essential nutrients such as Ca and Mg, which play an important role in the structural integrity of cell membranes. In addition, fruit thinning practices need to be applied to reduce inter-fruit competition and optimise fruit growth.

The **acidity** of fruit at harvest is largely determined within the first six weeks of fruit growth and development. Thereafter, only minor modifications to acidity can be achieved. Under conditions of anticipated high-acidity mono-ammonium phosphate (MAP) or mono-potassium phosphate (MKP) can be applied at 1%, i.e. 1 kg per 100 l of water, six weeks after full bloom. Please note that these phosphate sources have not been tested on all citrus cultivars; until now 1% MAP or MKP has reduced acidity on Valencia orange and Temple tanger, but not on grapefruit.

Pruning of late cultivars should be done as soon as possible after harvest. All of the following should be removed during pruning: old, broken and dead shoots/twigs; weak and entangled shoots crossing each other or hanging downwards; as well as any rootstock regrowth. Regrowth on the inside of the tree should be thinned out, cut back or removed. Light levels above 30% are necessary for optimal photosynthesis. Enough windows should be cut to allow adequate light distribution and to improve bearing wood within the tree. This will lead to increased fruit size and internal fruit quality (Brix°), better

fruit colour, increase in rind integrity, as well as a more uniform fruit size distribution. Pruning can be used as a thinning technique: prune more heavily after a light crop when the orchard has a history of alternate bearing. A follow-up prune of regrowth in the summer is of critical importance. Pruning tools should always be sanitised with 10% Jik.

Grondgedraagde siektes

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

Aalwurms

Grond- en wortelmonsters kan nou in die lente getrek word en na die Diagnostiese Sentrum in Mbombela (Nelspruit) gestuur word vir ontleding, sodat die status van die aalwurmpopulasie in die wortels bepaal kan word. Die resultaat sal dien as 'n bestuurshulpmiddel om 'n kostedoeltreffende



Wayne Mommsen



Coenraad Fraenkel

aalwurmbeheerstrategie daar te stel.

Die gebruik van chemiese aalwurmdoders vir die beheer van die sitrusaalwurm word nie aanbeveel alvorens ten minste 30 mm reën geval het nie (Oktober). Elke aalwurmdodertoediening behoort op nat (veldkapasiteit) grond toegedien te word en met 'n behoorlike besproeiing opgevolg te word om daardeur te verseker dat die middels deeglik in die grondprofiel ingewas word. Toedienings behoort slegs volgens etiket-aanbevelings toegedien te word. Afwykings van die geregistreerde dosisse, om kostes te bespaar, is glad nie 'n effektiewe benadering nie.

Phytophthora

Phytophthora wortelvrot: die gebruik van fosfonaatprodukte wat sistemies is, is 'n uiters effektiewe en bekostigbare beheermaatreël wat suksesvol deur produsente gebruik word. Om effektiwiteit te verseker en fitotoksisiteit te voorkom is dit van uiterste belang dat die etiket deeglik bestudeer word, asook die waarskuwings, voordat die produk gebruik word. Indien kraagvrotletsels voorkom kan 'n stamverf of blaarbespuiting aangewend word, drie aanwendings per seisoen met 6 - 8 weke intervalle. Vir wortelvrotbeheer word 'n blaarbespuiting van ten minste twee of drie blaarbespuitings met 6 - 8 weke intervalle aanbeveel. Fosfonaatbehandelings behoort jaarliks as 'n standaardtoediening op nie-draende bome toegedien te word. Let asseblief daarop dat sekere fosfonaat-produkte as grondtoedienings vir die beheer van kraag- en wortelvrot geregistreer is.

Fruit and foliar diseases (P. Moyo)

Alternaria core rot

Alternaria core rot (a.k.a. navel-end rot or black rot) affects navel oranges, lemons and mandarin types, causing dark-brown to black rot at the styler end (navel). The disease generally occurs on fruit with poorly-formed navels, but external symptoms usually show after harvest. Fruit with large navel-end openings is more

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susceptible to *Alternaria* core rot and to physiological disorders such as fruit splitting/micro cracks. When these disorders occur at the stylar end, during early fruit development after petal fall, they provide entry points for fungal spores which infect young fruit and form infections that remain dormant, until favourable environmental conditions stimulate further fungal growth. Application of 2,4-D, during full bloom, reduces the size of the navel and navel-end opening. Fungicides, including difenoconazole and tebuconazole, applied at 50 and 100% petal fall, reduce the incidence of *Alternaria* core rot.

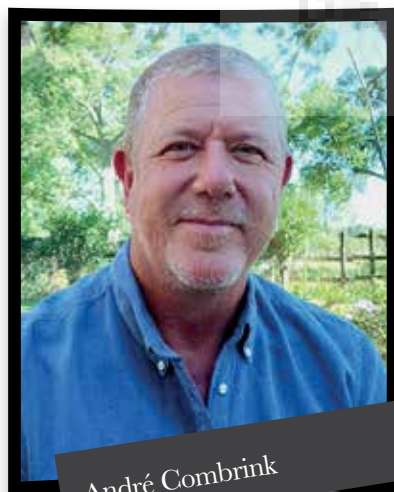
Black spot

Citrus fruit is susceptible to citrus black spot (CBS) infection from 80% petal drop (traditionally mid-October). It's advisable to commence with CBS fungicide sprays from this period, and to follow through until the end of the susceptibility period (4 - 5 months after petal drop). If fungicide sprays commence beyond the date of 80% petal drop, please use either CRI-PhytRisk or spore trap data to demonstrate that no CBS infection periods occurred from the date of 80% petal drop to the date of spray commencement. Fungicides used in the spray programmes must be registered for CBS control and used according to the recommendations specified on the label. The maximum residue level (MRL) restrictions of different fungicide products for different markets, must be adhered to. Poor spray coverage causes poor CBS control, and properly maintained and calibrated spray equipment achieves proper canopy coverage. Cultural practices that reduce the fungal inoculum in the orchards are also important in the management of CBS, as they complement chemical control. Refer to CRI Cutting Edges 351 and 352 for further information regarding the overall management of CBS, and timing of the first CBS sprays.

Postharvest pathology (W. du Plooy, C. Savage and L. Mamba)

By now most of the crop has been harvested, packed and shipped. Now is the time to consider what changes need to be done to improve disease management next season. Here are a few factors to consider:

- **How long did it take from harvest to the first fungicide treatment?** The shorter this period, the younger any infections will be. Therefore, fungicide treatments will be much more effective, resulting in less rotten fruit in the degreening room and/or at the packhouse. A reduction in rotten fruit will reduce the strain on your sanitation protocol and pre-sorters.
- **Was the flow of your drench applicator strong enough?** Were you able to apply at least 250 l per bin per minute? A more



André Combrink



Catherine Savage

effective drench application will curb disease development, leading to fewer rotten fruit arriving at the packhouse and again, less pressure on the sanitation protocol.

- **Is there enough packline facility for sorting and removal of rotten fruit in the very first part of the packline at, or just after tip?**

Most packhouses have insufficient sorting in the beginning of the packline, which allows for rotten fruit to enter the packhouse, contaminating the rest of the line.

- **Consider installing a second sanitation treatment.** This should be a total loss system and it should be situated in the packline after rotten fruit has been removed from the export fruit. This will protect the packline from contamination.
- **Sanitation of dip tank/flooder:** Do you have a pasteurisation protocol (heating overnight)? Heating the solution to 60°C for one hour and letting it cool down overnight will reduce the build-up of bacteria, as well as *Rhizopus* and other pathogen spores in the solution. Coliform counts that seem to skyrocket can often be traced back to poor sanitation of reused water.

- **The end of the season is the time to thoroughly sanitise the entire packhouse from roof beams to the floor.** This should be done only after all fruit (rotten or healthy) has been removed from the packhouse environment. A quaternary ammonium product can be used, after which it should be ensured that the surfaces where contact is made with fruit are rinsed off with clean water. Do not postpone this cleaning until next season, as the pressure of preparing for the new season always leads to unsatisfactory sanitisation. Time consuming jobs such as cleaning dry tunnel rollers, must be done during this time. Cleaned machinery and equipment can be covered with plastic to protect them from dust during the off-season.

- **An examination of all the equipment should be done right after the season ends when problems are still fresh in the packhouse manager's mind.** Any upgrades, changes or replacements must

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be done now. Brushes, donuts and chains are of particular importance to evaluate and replace if necessary.

Fertilisation and irrigation

(V. White and P. Raath)

During this time of the year, following sufficient nitrogen (N) fertilisation, a healthy anthesis has been established and emphasis should be put on fruit set and phase one of fruit growth. Phase one is characterised by intensive cell division in the developing fruitlets and ultimately sets the trend for desirable fruit size. After full-bloom cellular division starts and the developing ovaries need carbohydrates and N for protein biosynthesis. It is also important to take note of vegetative growth, fruit set and leaf colour as indicators of the effectiveness of the current fertilisation programme and to re-evaluate and adjust if necessary.

Macronutrients

During this period the tree has a high demand for nitrogen (N), calcium (Ca) and potassium (K) in relation to phosphorus (P) and magnesium (Mg). Though the demand of P and Mg is always fairly constant, By now P, and if corrective Mg was required, must have been applied especially on heavier textured micro-irrigated soils. On lighter textured soils, drip irrigated soils, application can be divided into a few instalments throughout the season. Most N should have been applied, with the last instalment due during Oct/Nov. Even fertigated orchards, where N is applied on sandy soils deep into summer, should have received the bulk of its seasonal N (up to 85%) by the end of November.

After fruit set and physiological fruit drop has occurred it is important to take note of final fruit set and re-adjust the fertiliser programme accordingly. If a lower set has occurred than predicted, over-fertilisation might occur due to less fruit that acts as carbohydrate and nutrient sinks. There is a particular risk of applying excessive N,



Natasha Jackson



Jan Landman

which can lead to reduced fruit quality and rind colour. During phase one of fruit development, Ca plays a central role in cell division, which ultimately affects fruit size and rind integrity. Since Ca is exclusively taken up with the transpiration stream, any factors affecting transpiration (i.e. overcast days, cold conditions, or sudden heat waves that cause stomatal closure) will reduce Ca uptake. On the other hand, excessive transpiration rates (i.e. constant warm weather with low humidity) can result in preferential transport of Ca to the leaves, instead of the fruit. Despite sufficient Ca in the soil, insufficient Ca supply during phase one can therefore occur and result in increased incidence of creasing and/or fruit splitting. If periods of reduced uptake are suspected/expected, an attempt to increase Ca uptake can be made by using CaNO₃ as the N source. Apply the CaNO₃ as soil application and not as foliar application. Apply

the CaNO₃ as soil application and not as foliar application. Due to various antagonisms between Ca and other nutrients, do not apply large, once-off instalments of K or Mg during this stage. Most of the season's K should, however, be applied during this period; and 100% of the annual requirement should be applied by end November on heavy soils, while up to 60% of the annual requirement should have been applied on sandy soils. In addition, KNO₃ foliar sprays can be applied from end October through to beginning December if low-leaf K levels are expected. This will help improve fruit size.

Micronutrients:

Micronutrient availability is a function of soil pH and should be applied as foliar treatments on alkaline soils. Zinc (Zn), manganese (Mn) and boron (B) can be applied between bud-swell and balloon phase or during October when the spring flush is still young with thin cuticles expediting uptake. In soils with optimal pH levels, i.e. 5.0 - 6.5, ZnSO₄ can be applied to the soil to raise the levels to 10 mg/kg. Since there tends to be a poor correlation between soil Zn and Mn concentration and uptake by the tree, foliar applications of Zn and Mn are commonly recommended. If Mn containing fungicides was used, foliar application should not be necessary. Boron deficiency is common on acid sandy soils where foliar application just before, during flowering or during October are advised.

Irrigation:

During phase one of fruit development any factor that might reduce cell division can have irreversible effects on fruit size. Therefore, care should be taken not to induce any stress through poor irrigation management. During Oct/Nov a 30% depletion of plant available water (PAW) between irrigation cycles is recommended. Over-irrigation, however, can also be detrimental to root activity and nutrient uptake. Accurate irrigation scheduling during this period is therefore critical to ensure optimal fruit size. 🍷

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Peter Wood
+27 82 463 2036
peterwood@agrofresh.com

Hannes Snijman
+27 83 709 6464
hsnijman@agrofresh.com

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