Extension briefs for

October and November 2023

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Integrated pest management

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

Thrips management

During October and November, citrus fruit is highly susceptible to damage from citrus thrips. Therefore, orchards should be scouted at least once a week for this pest, 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 five to six weeks after petal fall, then 4% for seven to eight 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 six to eight weeks' thrips control will eliminate natural enemies of false codling moth (FCM), mealybug, and scale insects for a month or more. So, if this degree of control is required, it is best to spray these at petal fall and to 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, and growers should, therefore, 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 exceeding 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 a 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.

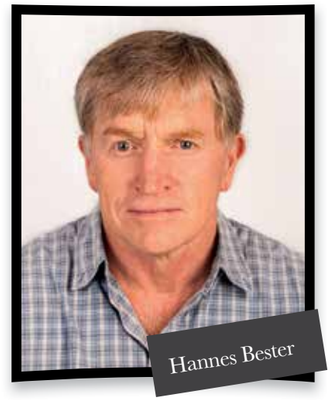
Bollworm

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 enables determining if a spray is necessary. A treatment should be applied when more than 20% of blossom clusters are infested with larvae or mature eggs. Enlarged navel end problems in Navel oranges can be further exacerbated by bollworm attack. In which case 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). 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 warrant a spray. No plant protection products are registered for use against the lemon borer moth. However, there are several pesticides that are registered for other pests on citrus and are effective, including Bt (DiPel), mevinphos and spinetoram (Delegate).



FCM

Importantly, 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, 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 orchard. If not done, this 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 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, which is preferably October, but not later than November. It was suspected that this may be a lot earlier in the warmer northern regions, as temperatures and FCM activity may begin increasing as early as July. However, results from trials conducted in Limpopo to test this, did not show improved efficacy with earlier initiation of mating disruption. 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. The presence of any untreated areas on the farm will negatively affect the efficacy of mating disruption, as it is a population suppression technology, rather than a crop protection technology. It's advisable to apply it on an area-wide basis for optimal efficacy.

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 (GA_3) 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 important 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 to 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 tangor, but not on grapefruit.

Pruning of late cultivars should be done as soon as possible after harvest. All 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 if 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.

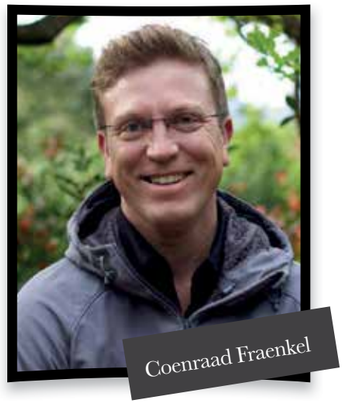

Wayne Mommsen

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 Nelspruit gestuur word vir ontleding. Dis sodat die status van die aalwurmpopulasie in die wortels bepaal kan word. Die resultaat sal dien as ń bestuurshulpmiddel om ń kostedoeltreffende aalwurmbeheerstrategie daar te stel.


Coenraad Fraenkel

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 en met ń behoorlike besproeiing opgevolg te word. Dit sal 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 ń effektiewe benadering nie.

Phytophthora

Phytophthora wortelvrot – die gebruik van fosfonaat-produkte wat sistemies is, is ń 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 (en veral die waarskuwings) voor gebruik deeglik bestudeer word. Indien kraagvrotletsels voorkom, kan ń stamverf of blaarbespuiting aangewend word; drie aanwendings per seisoen met ses tot agt weke intervalle. Vir wortelvrotbeheer word ń blaarbespuiting van ten minste twee of drie blaarbespuitings met ses to agt weke intervalle aanbeveel. Fosfonaat-behandelings behoort jaarliks as 'n standaardtoediening op nie-draende bome toegedien te word. Let asseblief daarop dat sekere fosfonaatprodukte as grondtoedienings vir die beheer van kraag- en wortelvrot geregistreer is.


André Combrink

Fruit and foliar diseases (P. Moyo)

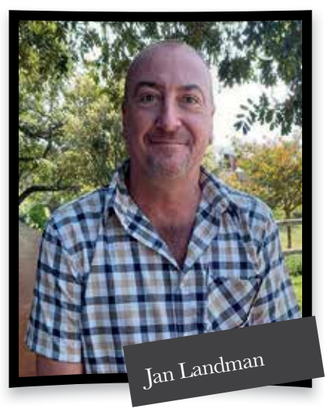
***Alternaria* core rot**

Alternaria core rot, also known as navel-end rot or black rot, affects navel oranges, lemons and mandarin types, causing dark brown to black rot at the stylar end (navel). The disease generally occurs on fruit with poorly formed navels; fruit can develop *Alternaria* core rot without showing any external symptoms until after harvest. Fruit with large navel-end openings is more susceptible to *Alternaria* core rot and physiological disorders such as fruit splitting. Also, fruit splitting or micro-cracks at the stylar end, during early fruit development after petal fall, provide entry points for fungal spores that infect young fruit and form infections. The latter remain dormant until favourable environmental conditions stimulate further fungal growth. Application of 2,4-D, during full bloom reduces the size of the navel as well as that of the 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 infection (CBS) from 80% petal drop (traditionally mid-October). Therefore, it is recommended that CBS fungicide sprays commence from this period and follow through until the end of the susceptibility period (four to five months after petal drop). In cases where fungicide sprays commence later than the date of 80% petal drop, it must be demonstrated that no CBS infection periods occurred during the period between the date of 80% petal drop and date of spray commencement, by using either CRI-PhytRisk or spore trap data. 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.


Natasha Jackson


Jan Landman

Poor control of CBS is attributed greatly to poor spray coverage, and it is therefore very important that spray equipment is properly maintained and calibrated to achieve proper canopy coverage. Cultural practices that reduce the fungal inoculum in the orchards (removal of leaf litter, shredding of pruning debris and removal of sickly trees/orchards if/where possible) are also important in the management of CBS, as they complement its 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 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 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 surfaces where fruit may contact treated surfaces are rinsed off thoroughly with clean water. Do not postpone this cleaning until the next season, as the pressure of preparing for the new season may lead to substandard sanitisation. Time consuming jobs such as cleaning dry tunnel rollers must also 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. This is also the time to do any upgrades, changes, or replacements. Brushes, donuts, and chains are of particular importance to evaluate and replace if necessary.

Fertilisation and irrigation (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, should 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 deep into summer on sandy soils, should have received the bulk of its seasonal N (up to 85%) by the end of November.

After fruit set and physiological fruit drop have occurred, it is important to take note of final fruit set and to re-adjust the fertiliser programme accordingly. A lower set than had been predicted may result in over fertilisation, due to a reduction in fruit acting as carbohydrate and nutrient sinks. There is a risk of applying excessive N, especially, 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 consequently occur, resulting in an 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 $CaNO_3$ as the N source. Apply the $CaNO_3$ 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, KNO_3 foliar sprays can be applied from end October through to beginning December if low leaf K levels is expected. This will help improve fruit size.

Micronutrients: Their 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 bed-swell and balloon phase, during October when the spring flush are still young with thin cuticles expediting uptake. In soils with optimal pH levels, i.e., 5.0 - 6.5, $ZnSO_4$ 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 were 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, is 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. However, over-irrigation can also be detrimental to root activity and nutrient uptake. Accurate irrigation scheduling during this period is therefore, critical, to ensure optimal fruit size.