Extension briefs for April and May

INTEGRATED PEST MANAGEMENT

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Phytosanitary pests

All the recommendations made in the extension briefs for February and March also apply to this period. Fruit fly control in citrus areas is critical due to phytosanitary concern associated with fruit fly pests. Fruit fly good agricultural practices are mandatory for export of citrus, excluding lemons and limes to EU under the Citrus Fruit Fly Management System (Citrus FFMS). Fruit fly control should be initiated in mid-summer. In areas with historically high fruit fly numbers, control should have been initiated as early as December, particularly in those areas with mixed deciduous or mango and citrus cultivation. Control actions for fruit flies include the use of registered protein bait sprays and/or bait stations and orchard sanitation. Where Oriental fruit fly (OFF) is present, growers should also apply registered methyl eugenol-based Male Annihilation Technique (MAT) (e.g. Invader-b-Lok, a block impregnated with Chempac ME lure and malathion, or Static Spinosad ME). Monitoring the number of fruit flies and false codling moth (FCM) is also critical. Remember that for Medfly, the threshold in a Capilure baited trap is four males per week whilst for Natal or Cape fly, the threshold in a Capilure baited trap is two males per week. The OFF, *Bactrocera dorsalis,* is present in Limpopo, Mpumalanga, North-West and Gauteng provinces, as well as in KwaZulu-Natal province, except in the magisterial districts of Amajuba, uMgungundlovu, uMzinyathi, uThukela and Zululand. OFF is declared absent from the Western Cape, Eastern Cape, Northern Cape and Free State provinces. Surveillance monitoring of OFF using methyl eugenol baited traps is a requirement for phytosanitary registration of citrus, for export to special markets. Trap details and trap servicing should be recorded as per trapping guidelines (http://www.citrusres.com/downloads/market-access). In areas where OFF is absent, growers should continue monitoring and the detection of suspect specimens should be reported to the relevant authorities immediately. In areas where OFF is present, the threshold in a methyl eugenol baited trap is three flies per trap per week. When using Questlure in a Sensus trap, the threshold is one female fly per trap per week, irrespective of fly species. If thresholds are exceeded, control actions must be increased. Growers in an area where OFF is present should apply for a removal permit if fruit is to be moved out of the area.

At least once a week growers must conduct sanitation of split, stung or infested fruit in the trees, or fallen fruit on the ground. Additionally, growers should continue to monitor infestation of fallen fruit under data trees in each orchard each week. This is a mandatory practice for the last 12 weeks before harvest, for participation in the FCM Risk Management System (FMS). The exact number of data trees required is determined by the orchard size, as calculated by PhytClean. A final spray for FCM is recommended a minimum of four weeks before harvest. During harvesting, pre-sorting of any potentially infested fruit must be conducted in the orchard. Under the FMS and FFMS for citrus, packhouses must conduct inspections for FCM and fruit fly infestation on samples from all orchards on delivery to the packhouse (this excludes lemons and limes). Changes have been made to the details of the requirements for these inspections within the FMS and packhouses must familiarise themselves with these. This includes the compulsory training, competency evaluation and retention of such records of all personnel conducting such inspections. On the pack line, all fruit with blemishes that could be associated with FCM or fruit fly must be graded out. Sorting tables must be very well lit to facilitate optimal sorting. As with packhouse delivery inspections, only trained and competency evaluated personnel may conduct this sorting and grading process.

Blemish factor analysis

The analysis of fruit blemish factors on the tree just prior to harvest or once fruit have been harvested, provides the grower with an evaluation, in commercial terms, of all control programmes implemented during the season. It also assists with pest management decisions for the season to follow. With the trend towards selective picking and a variable degree of culling occurring in the orchard, it is more accurate to conduct the final analysis of fruit blemish factors before picking starts. Care must be taken to include fruit from inside the tree and all blemish factors or pest infestations should be recorded, whether they are sufficient to cull the fruit from export quality or not. Having taken the sample, it is important to separately record each pest or other blemish factor that is severe enough to downgrade a fruit in its own right. With this procedure a particular fruit in the sample may be shown to have more than one factor that can cause it to be culled from export.



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CROP AND FRUIT QUALITY MANAGEMENT

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General:

Stage II of fruit development is ending, with stage III commencing with little or no increase in fruit size, as the fruit matures, i.e. increase in juice content, total soluble solids (Brix°) and reduction of titratable acidity (TA). Lower autumn temperatures will affect rind colour, but GA_3 (Progibb®) and Nitrogen applications later than five months prior to harvest would have resulted in retarded colour development.

Maturity indexing:

Commence maturity indexing on early and mid-season cultivars in order to harvest at optimal maturity and facilitate an adequate shelf life. Weekly samples from ten representative trees should start four to six weeks before the expected harvest date. Titratable acidity is determined by titration with sodium hydroxide, sugar content (Brix°) is determined by a refractometer, the sugar:acid ratio calculated and fruit colour should be read from a colour chart. Results should be recorded and used in comparison with previous seasons, in order to identify and manipulate possible problems with internal and external quality parameters.

Pickers training and monitoring:

Training of pickers is important and the workers should be familiarised with important protocols during picking and handling of fruit. Picking bags should always be carried on the side of the waist to avoid crushing of fruit between the body and the ladders, bins or trees. Picking bags must be free of leaves, shoots or sand and kept dry throughout. To avoid lesions on fruit, finger nails of pickers should be short and clippers and ladders handled correctly, i.e. no long stems and limited contact between ladders and fruit. Low-hanging fruit very close to the ground, or touching the ground, or dropped fruit should be removed a day or two prior to harvesting an orchard, to lower the risk of sour rot and brown rot development in export cartons. At each bin, sorters wearing gloves should be stationed to monitor fruit quality.

Pruning:

In the case of early cultivars (satsuma, clementine) it should be done during this period, as soon as possible after harvest. Prune more heavily after a light crop, if a heavy crop is expected, as well as when the orchard has a history of alternate bearing. Old twigs and dead shoots should also be removed to limit wind damage of the next season's crop. Pruning should be effective to ensure sufficient light distribution and spray penetration into the centre of the canopy.

Postharvest foliar urea application:

A foliar application (low biuret urea at 1%) can be applied on early cultivars (satsuma, clementine), as soon after harvest as possible.

CITRUS BLACK SPOT DISEASE MANAGEMENT

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General:

At this stage, most growers should have completed all their scheduled preharvest sprays for citrus black spot (CBS). Since CBS symptoms only appear on mature fruit, absence of preharvest symptoms is not necessarily indicative of successful CBS control. It is advisable to assess the CBS risk of orchards to exclude export from high-risk orchards to CBS sensitive markets. Here are suggested criteria:

- **CBS history of orchard:**

Older orchards tend to have more CBS, but various factors (including cultivar susceptibility, topography, orchard condition, canopy density and efficacy of spray deposition) can influence

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the disease pressure. If monitoring records were kept, growers would be able to identify orchards with a higher CBS incidence. Orchards where CBS disease incidence was high in the previous two seasons can be expected to have a higher inoculum pressure in the past season.

• **Inoculum management:**
Monthly removal of all fallen leaves from late winter through the fruit susceptibility period has been shown to be as effective as full CBS spray programmes. Conversely, pruning debris that is left in the orchard will contribute to the inoculum pressure. It is unclear to what extent shredding of pruning debris will limit ascospore production on leaves, but growers are advised to at least shred their pruning to a very fine particle size (< 5 cm²); the smaller, the better. Likewise, removal of all out-of-season fruit is important to limit pycnidiospore inoculum.

• **Prevailing weather conditions:**
The CBS pathogen can only infect fruit if warm and wet conditions are experienced during the fruit susceptibility period (four to five months after fruit set). A comparison of suitability of weather conditions for CBS experienced in the past season with previous seasons will be indicative of the relative risk. Growers are also encouraged to register on CRI-PhytRisk (www.cri-phytrisk.co.za) to compare the CBS infection forecasts for the season with the spray programme that they followed. If all infection periods were protected, the CBS risk should be lower. This is assuming that sprays were effectively applied during weather conditions suitable for spraying (this can also be observed from CRI-PhytRisk) and effective fungicide coverage and deposition was achieved.

GRONDGEDRAAGDE SIEKTES

M.C. PRETORIUS AND JAN VAN NIEKERK

***Phytophthora* en aalwurmbeheer**
Winterreënvalgebiede soos die Wes-Kaap moet nou *Phytophthora* en aalwurmontledings laat doen. Beheerprogramme moet begin na die eerste goeie winterreëns. Beheermaatreëls moet 'n program van twee, maar verkieslik drie toedienings (twee maande uitmekaar) insluit. Let op residu-weerhoudingstydperke van aalwurmdoders, en lees die *etikette* van die verskillende produkte!

Wortel en kraagvrot
Phytophthora wortel- en kraagvrotbeheerprogramme in die Wes-Kaap kan in die herfs begin. Ridomil wortelsone-behandeling (2.1 mℓ/m²) en fosfonaatblaarbespuitings kan gebruik word. Drie fosfonaattoedienings, twee maande uitmekaar, behoort gedoen te word. Let op weerhoudingstydperke.
Baie belangrik: Lees die etikette van die verskillende produkte deeglik, veral die waarskuwings!
Vermy die gebruik van die fosfonate indien toestande voorkom wat bome onder enige vorm van stremming plaas. Bo en behalwe droogte en hitte kan bergwindtoestande bome ook onder tydelik 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.

Bruinvrot
Herfsreëns kan lei tot ernstige na-oesbederfverliese deur *Phytophthora* bruinvrot. 'n Enkele vrug, wat besmet is met bruinvrot, kan tydens verskeping die res van die vrugte in 'n uitvoerkarton laat bederf.

In die somerreënvalgebiede word bruinvrot veroorsaak deur die patogeen *Phytophthora nicotianae*, en affekteer dit vrugte op die onderste 1.5 m van die boom naaste aan die grondoppervlak. Dit behoort dus redelik veilig te wees om slegs hierdie onderste band vrugte te spuit in boorde waar die *Phytophthora*-insidensie nie hoog is nie. *Phytophthora citrophthora* kom ook in die winterreënvalgebiede voor. Hierdie patogeen versprei hoër op in die boom en kan vrugte tot bo in 'n sitrusboom besmet. Die totale blaaroppervlak in hierdie streke moet gespuit word. Bruinvrot ontwikkel slegs wanneer die klimaatstoestande gunstig is vir die patogeen *(Phytophthora)* om te infekteer en te ontwikkel. Indien dit 'n droë najaar is en daar kom geen of ligte reënbuitjies voor nie, is voorkomende bespuitings nie nodig nie. Indien dit 'n nat winter of najaar is, moet bome gespuit word. Kontakswamdoders soos Koper (200 g/100 ℓ) of mancozeb (200 g/100 ℓ) kan gespuit word om bruinvrot te beheer. Daar is egter beperkinge t.o.v. mancozeb vir sekere markte. Beide hierdie produkte is slegs kontakmiddels en hulle kan deur reën en besproeiing afgewas word. Daar is ook 'n gevaar dat indien die

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kopertoedienings en proteïen-vrugtevlieglokase te na aan mekaar toegedien word, fitotoksisiteit ("stippeling") op die skille kan voorkom. Hierdie gevaar is hoër tydens kleurbreek. *Sistemiese fosfonaat-swammiddels is uiters effektief vir die beheer van bruinvrot: verskeie fosfonate is geregistreer vir die gebruik teen bruinvrot. Raadpleeg etikette waar nodig om te bepaal watter produkte hiervoor geregistreer is. Die fosfonate is ook effektief teen bruinvrot, indien dit in 'n wortelvrotprogram gebruik word as 'n blaarbespuiting. Geen van die fosfonaat-stamaanwendings is effektief teen bruinvrot nie.*

WATERBESTUUR / WATER MANAGEMENT

P. RAATH

Besproeiingskedulering / Irrigation scheduling

Mature citrus trees require between 7 000 and 10 000 m^3 water per hectare per year. Water is lost through evaporation, run-off, leaching and transpiration. Transpiration, and in some instances leaching, is beneficial to the trees and therefore not viewed as a loss. However, non-beneficial losses should be kept to a minimum. Evaporation is largely determined by climatic factors such as radiation, temperature, relative humidity and wind. Run-off is determined by infiltration rate, slope and application rate. Non-beneficial leaching occurs when water penetrates to below the root zone.

Verdamping kan verminder word deur te verseker dat druplyne bo-op riwwe vasgemaak is om te verhoed dat water teen die kante van riwwe afloop. Sodoende word die oppervlakte vermin-der waarvan water kan verdamp. Die grond-oppervlak kan ook met organiese materiaal bedek word om verdamping te verminder. Afloop kan verder beperk word deur seker te maak dat die toedieningstempo van die be-sproeiingswater nie hoër is as die infiltrasietempo van die grond nie. Die periode van besproeiing moet genoegsaam wees om die wortelsone tot veldkapasiteit te benat sonder om die wortel-sone te versadig, en sodoende oormaat dreine-ring of afloop te veroorsaak. Die instandhouding van besproeiingstoerusting is belangrik om te verseker dat die toerusting in 'n goeie toestand is en dat daar geen lekkasies is nie.

The difference between field capacity and the actual soil water content is called the "soil water depletion". Irrigation timing and the amount of water to be applied are determined by monitoring or estimating soil water depletion and applying water when the depletion reaches a pre-selected level. This is called the management allowable depletion.

Grondvogsensors wat die grondwaterinhoud meet is 'n beter aanduiding vir "wanneer" en "hoe-veel" besproei moet word, eerder as die gebruik van gewasfaktore of die sogenaamde kalender-metode, waar besproeiing op 'n voorafbepaalde tyd, bv. weekliks Dinsdae en Vrydae plaasvind.

Tensiometers

Tensiometers are installed in pairs. The ceramic cup of the first tensiometer must be in the root zone and the second cup should be below the root zone. For most soils the reading should be between -5 and -20 kPa at field water capacity. No tensiometer should remain on zero or even at -5 kPa for too long, as this is an indication of water-saturated conditions. As the soil dries out, the tension slowly increases (readings become more negative) until a certain inflection point is reached. This point is characteristic of the soil and lies between -30 and -70 kPa. The tension increases rapidly after the inflection point has been reached.

For sandy soils, irrigation should probably com-mence at a tension of -30 kPa and in a clay soil at -40 to -50 kPa. However, it is important to note that these values are characteristic of the soil and should be determined for each irrigation block.

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Irrigation is scheduled according to the readings of the shallow tensiometer. The deeper placed tensiometer monitors over and under-irrigation. A continued low reading on the deeper placed tensiometer indicates over-irrigation. However, increasingly higher readings, in spite of irrigation, indicate under-irrigation.

Kapasitans "probes"

Kapasitans "probes" meet op verskillende dieptes die relatiewe waterinhoud van die grond. Hierdie metings geskied op 'n kontinue basis (elke 30 of 60 min). Die sagteware maak voorsiening dat 'n versadigingspunt, 'n hervulpunt en droë punt gekies kan word. Indien die grafiek daal tot by die hervulpunt kan met besproeiing begin word. In grond met 'n hoë klei-inhoud is dit moeiliker om die verandering in die waterinhoud van die grond waar te neem.

Profielput

'n Profielput in die wortelsone van die bome kan weekliks of selfs twee-weekliks gegrawe word. Die waterinhoud van die grond word dan visueel waargeneem en die besproeiingskedulering word daarvolgens beplan. Die voordeel van hierdie metode is dat probleemareas geïdentifiseer en geïnspekteer kan word.

POSTHARVEST PATHOLOGY - WASTE PREVENTION CHECKLIST

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The origin of decay

All the postharvest citrus diseases are present in the orchard. Around 1% of the harvested fruit will have established green mould infections, which needs to be dealt with swiftly by the packhouse.

The packhouse needs to convey the importance of the following practices to orchard management:

- Sanitation to minimise the inoculum (spore) load in the orchard.
- Establishing protocols to minimise wounding of fruit during harvesting. Prevention of wounds will dramatically reduce the incidence of infections.
- Optimising FCM and fruit fly control to minimise wounds and risk of decay.
- Treat the fruit within 24 hours of harvesting. This will enable the postharvest fungicide(s) to curatively control established infections.

The packhouse can make or break it

The time taken from the tipping of fruit to wax application is short, and every single process must be managed diligently to reduce the risk of waste.

Chlorine treatment

- Measure ORP – it should be ±800 mV.
- If ORP is too low, adjust pH and concentration.
- pH should be 6.5 - 7.5.
- Concentration should be 75 - 100 ppm (active chlorine) or 100 - 200 ppm (total chlorine).
  - o The concentration needs to be monitored continuously; an automatic dosing system is highly recommended.

Pre-packhouse drench

- The 2020 CRI factsheets list all the possible options for the pre-packhouse drench and need to be consulted *(http://www.citrusres.com/postharvest-recommendations-factsheets-2020)*.
- It is imperative to have adequate water flow in order to have all the fruit in all the bins thoroughly drenched – drenches must deliver at least 500 L drench mixture/bin/min.
- Pre-suspend fungicides in warm water and add to the tank while agitating, remembering to use the order SC > EC > SL, then fill the tank to the correct level.
- Exposure time 1 - 3 min.
- Replace mixture after 150 bins (1000 L tank), or 200 bins (2000 L tank), or 300 bins (3000 L tank).
- Constant agitation – the system must be in operation for at least 15 min before use.

Fungicide dip tank and In-line drench

- The fungicide of choice for use in the aqueous applications for 2020 is imazalil sulphate for all markets. Updated recommendations for the 2021 season for export to the EU will be made available through the course of the year.
- The imazalil sulphate concentration should be managed continuously by means of titration and maintained at 500 ppm.
- The pH level of imazalil solution should be kept stable to ensure consistency in terms of residue loading. An automatic dosing system for pH is recommended.
  - o pH 3 will result in lower residue levels (around 1 ppm), but can still give excellent curative control if exposure time is

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60 - 90 seconds and fruit is treated within 24 hours of infection.

o pH 6 will result in higher residue levels (around 2 - 3 ppm), but the exposure time needs to be limited to 45 seconds to prevent MRL exceedance.

• The CRI factsheets list all possible options for the fungicide bath or in-line drench, and need to be consulted *(http://www.citrusres.com/postharvest-recommendations-factsheets-2020)*.

• If not replaced on a daily basis, the fungicide solution should be pasteurised every evening by increasing the temperature to no less than 60°C, keeping it there for 35 minutes, and then letting the solution cool down overnight.

Wax application

• Fruit should be dry before entering the wax applicator – wet fruit will hamper the efficacy of this treatment.

• It is highly recommended to apply imazalil in the dip tank and thereafter in the wax. The wax application will ensure good protective control and sporulation inhibition of green mould, while the aqueous application provides excellent curative control.

• Wax containers/tanks containing fungicides should be gently agitated continuously (i.e. 24 hours a day), to ensure that thiabendazole and imazalil stay in solution and do not precipitate. Precipitated chemicals will result in MRL exceedance from wax lower down in the container, while the top layers will not have enough residue to give the desired protection. Containers should also be tightly sealed to prevent the wax formulation from deteriorating.

o Do not use air bubbles as an agitation measure, as they break down the wax formulation due to liberation of the volatiles and oxidation of the solvent system.

o Do not over-agitate the wax, as this also eliminates the volatiles, which are an integral part of the wax during film formation after application.

• Ensure that fruit is totally and uniformly covered in wax; if not, contact your wax suppliers for support.

• Ensure that wind from the drying tunnel is not blowing back onto the wax applicator. This will cause wax to dry on the last brushes, causing hardening of the bristles. Hardened bristles are ineffective in wax application and could cause injury to the fruit rind.

Cold chain

• Fruit should be placed under cold storage as soon as possible.

• Maintaining the cold chain will reduce the incidence of green mould infections and physiological rind disorders.

• Never break the cold chain.

Sanitation

• Packhouse sanitation is all about keeping inoculum (spore) levels as close to zero as possible.

• No fruit should be present on the floor. No waste fruit should be standing around (even in bins), but should be removed immediately.

o Remove and discard any waste fruit in closed containers from the packhouse, as soon as possible.

o Do not allow fruit destined for the juice factory to be anywhere near your packhouse.

• Sanitation is an effective way of preventing fungicide resistance from developing.

Remember

Fresh citrus fruit is a high-risk, perishable commodity. The fruit is alive, therefore it's respiring, and the shelf life and quality need to be maintained. The packed export crop must be moved from the packhouse into the cold chain as soon as possible, thereby reducing the risk of loss of quality and waste. Always handle fruit postharvest according to the Time and Temperature Protocols for Citrus: refer to Cutting Edge No. 99.

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