

INTEGRATED PEST MANAGEMENT

T G GROUT, S D MOORE & A MANRAKHAN

Phytosanitary pests

All the recommendations made in the Extension Briefs for February and March also apply to this period. Monitoring numbers of fruit flies and false codling moth (FCM) is critical. Remember that for Medfly, the threshold in a Capilure baited trap is 4 males per week whilst 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 these thresholds are exceeded, control actions must be increased. Surveillance monitoring of the Oriental fruit fly (OFF), *Bactrocera dorsalis* previously recognised as *Bactrocera invadens* per Production Unit Code (PUC) is a requirement for phytosanitary registration of citrus for export to special markets. Surveillance monitoring using traps baited with methyl eugenol should be carried out weekly. Trap details and trap servicing should be recorded as per trapping guidelines (<http://www.citrusres.com/market-access>). The Oriental fruit fly is considered present in some areas of the following provinces: Limpopo, Mpumalanga, North-West, KwaZulu-Natal and Gauteng. Where

the Oriental fruit fly is present, growers should manage the pest by applying protein bait sprays or bait stations in combination with methyl-eugenol based Male Annihilation Technique (MAT) (e.g. Invader-b-Lok, B.i. Toolkit, Static Spinosad ME, Last call B.i.). Growers should take measures to ensure that fruit moved out of affected production areas are not infested with the Oriental fruit fly. Growers in an affected area should apply for a removal permit if fruit is to be moved out of the area. In areas where the Oriental fruit fly is absent, growers should continue monitoring and if suspect specimens are found, this should be reported immediately to the relevant authorities as per trapping guidelines (<http://www.citrusres.com/market-access>). This is important in order to enable timely implementation of monitoring and control actions.

Growers are strongly urged to conduct sanitation of split, stung or infested fruit in the trees, or fallen fruit on the ground, at least once a week. Additionally, growers should be diligent about weekly monitoring of fruit drop under 5-10 data trees in each orchard, particularly those most susceptible to FCM. This entails careful dissection of fruit and inspection for FCM larvae, tunnelling and frass (amongst

all other causes of fruit drop). Although this should be done weekly from around December, it is particularly important in the last few weeks leading up to harvest as this is a very good indicator of the post-harvest risk posed by fruit harvested from the orchard. This could play a key role in deciding whether fruit is suitable for certain sensitive markets or not. Consequently, packhouses are strongly urged to insist on receiving such data from delivering growers, in line with Cutting Edge no. 192. Packhouses should also implement inspections for FCM as proposed within the Systems Approach communicated in Cutting Edge 155 of April 2013. However, one small change has been recommended. Instead of destructively sampling (cutting) all fruit within a sample, it is now only deemed necessary to cut those fruit that show any sign of suspicious marks whatsoever, no matter how small. This includes any Navel oranges showing even a slight sign of navel-end splitting. In order to compensate for the small percentage of fruit that might be missed without dissecting all fruit, it is recommended to increase initial sample size from 200 to 300 fruit and total potential sample size from 600 to 900 fruit. Consult Cutting Edge no. 155 for a full understanding.

CONTINUED FROM PAGE 33 the pH of normal water to around 3

- Much lower residue levels were loaded in the IMZ pH 3 treatments compared to the pH 8 treatments

The IMZ sensitive isolate was effectively controlled at a residue level of 0.5 ppm loaded in a pH 3 solution

- IMZ is more curative than protective when applied with a dip treatment
- The resistant isolate could never be 100% controlled even at more than double the MRL

- Cold storage can cause a significant reduction of green mould infections

A word of caution: Don't increase the pH of your IMZ sulphate solution to 8, remember this is the story of a journey and later we discover that pH 8 is not the way to go, as it is too high and easily causes exceedance of the 5 ppm MRL. Always follow the recommendations given to you by CRI and always read the chemical labels.

Most of this work was published in a scientific article (see below), please contact

Arno Erasmus at arno@cri.co.za if you are interested in reading it.

The two publications mentioned in this article:

SMILANICK, J.L., MANSOUR, M.F., MARGOSAN, D.A., GABLER, F.M., GOODWIN, W.R., 2005. Influence of pH and NaHCO₃ on effectiveness of imazalil to inhibit germination of *Penicillium digitatum* and to control postharvest green mold on citrus fruit. *Plant Dis.* 89, 640-648.

ERASMUS, A., LENNOX, C.L., JORDAAN, H., SMILANICK, J.L., LESAR, K., FOURIE, P.H., 2011. Imazalil residue loading and green mould control in citrus packhouses. *Post-harvest Biol. Technol.* 62, 193-203.

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 and 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. If fruit blemish is analysed at the packhouse, samples can be taken at a convenient point before the fruit are graded. Samples should be randomly selected and the number of samples should ensure that a true picture is obtained of the situation in a particular orchard. Having taken the sample, it is important to record separately 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.

CROP & FRUIT QUALITY MANAGEMENT

P.J.R CRONJÉ & O.P.J. STANDER

GENERAL Stage II of fruit development is coming to an end, with stage III commencing. During stage III, little or no increase in fruit size occurs and fruit start to mature i.e. increase in juice content, total soluble solids (Brix°) and reduction of titratable acidity (TA). With the temperature drop in autumn, change in fruit colour is also expected. GA3 (ProGibb®) and Nitrogen applications later than 5 months prior to harvest would have resulted in retarded colour development and

this effect would be pronounced if high autumn temperatures occur.

MATURITY INDEXING. In order to predict the rate of change in fruit maturity, maturity indexing on early and mid-season cultivars should commence, to harvest fruit at a maturity that would maintain acceptable commercial shelf life. Random sampling of fruit every week from each of 10 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 by a refractometer, the sugar:acid ratio calculated and fruit colour should be read from a colour chart. It is important to maintain a good record-keeping of abovementioned maturity indicators over a number of years, in order to predict harvest dates and identify and manipulate possible problems with internal and external quality parameters.

PICKERS TRAINING AND MONITORING. It is important that growers ensure pickers are trained to harvest citrus fruit and are 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 should at all times be free of leaves, shoots or sand and kept dry throughout. To avoid lesions on fruit, finger nails of pickers should be short and scissors and ladders handled correctly i.e. no long stems and limited contact between ladders and fruit. Picking of low-hanging fruit as well as collecting of dropped fruit should be avoided. At each bin, two sorters should be stationed wearing gloves and fruit quality of each picker monitored via the sorters, by an appointed team leader.

PRUNING OF EARLY CULTIVARS. (Satsuma, Clementine) should be done during this period as soon as possible after harvest. Prune

more heavily after a light crop and if a heavy crop is expected and 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.

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.

GRONDGEDRAAGDE SIEKTES

M C PRETORIUS & JAN VAN NIEKERK

Phytophthora en aalwurmbeheer

Dit is nou 'n goeie tyd van die jaar vir die winterreënvalgebiede soos die Wes-Kaap om *Phytophthora* en aalwurmontledings te doen. Beheerprogramme moet 'n aanvang neem na die eerste goeie winterreëns. Beheermaatreëls moet 'n program van minstens twee maar verkieslik drie toedienings (twee maande uitmekaar) insluit. Let op residu-weerhoudingstydperke van veral aalwurmdoders en lees die ETIKETTE van die verskillende produkte!!!

Phytophthora beheer

WORTEL EN KRAAGVROT *Phytophthora* wortel en kraagvrot beheerprogramme in die Wes-Kaap kan in die herfs begin. Ridomil wortelsone behandeling (2.1 ml/m²) en fosfaat blaarbespuitings kan gebruik word om wortel en kraagvrot effektief te beheer. Drie fosfaat toedienings 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. Produsente het oor die algemeen 'n probleem om te weet wanneer boorde onder vogstremming is en wanneer nie. Bo en behalwe

droogte en hitte kan bergwindtoestande 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 fitotoksiteit.

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 teen die tyd wat die vrugte hul bestemming bereik.

In die somerreënvalgebiede word bruinvrot op sitrus hoofsaaklik veroorsaak deur die patoogeen *Phytophthora nicotianae* var. *parasitica* en affekteer dit meestal die 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. In die winterreënvalgebiede kom *Phytophthora citrophthora* ook voor. Hierdie patoogeen versprei hoër op in die boom en kan vrugte tot bo in 'n sitrusboom besmet. Daar word dus aanbeveel dat die totale blaar oppervlak in hierdie streke gespuit sal word. Bruinvrot ontwikkel slegs wanneer die klimaatstoestande gunstig is vir die patoogeen (*Phytophthora*) om te infekteer en te ontwikkel. Indien dit dus 'n droë najaar is en geen of slegs ligte reënuitjies voorkom, is voorkomende bespuitings nie nodig nie. Indien dit egter 'n nat winter of na-jaar is, moet bome gespuit word. Kontak swamdoders soos Koper (200 g/100 ℓ) of mancozeb (200 g/100 ℓ) kan gespuit word om bruinvrot te beheer. Daar is egter beperkinge tov mancozeb binne sekere markte. Beide hierdie produkte is slegs kontakmiddels en die moontlikheid dat dit afgewas kan word deur reën en besproeiing is moont-

lik. Daar is ook 'n gevaar dat indien die kopertoedienings en proteïen vrugtevlieglokase te na aan mekaar toegedien word fitotoksiteit (stippeling) op die skille kan voorkom. Hierdie gevaar is hoër tydens kleurbreek. **Sistemiese fosfonaat swammiddels is uiters effektief vir die beheer van bruinvrot, Fighter en Brilliant is geregistreer vir die gebruik teen bruinvrot. Die fosfonate is ook effektief teen bruinvrot indien dit in 'n wortelvrot program gebruik word as 'n blaarbespuiting. Geeneen van die fosfonaat stamaanwendings is effektief teen bruinvrot nie.**

WATERBESTUUR/WATER MANAGEMENT

J T VAHRMEIJER

BESPROEIINGSKEDULERING/IRRIGATION SCHEDULING Mature citrus trees require between 7 000 and 10 000 m³ water per hectare per year. Water is lost through evaporation, run-off, leaching and transpiration. Transpiration and in some instances leaching are 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, 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.

Evaporasie kan verminder word deur te verseker dat druplyne bo-op riewe vasgemaak is om te verhoed dat water teen die kante van riewe afloop. Sodoende word die oppervlakte verminder waarvan water kan verdamp. Die grondoppervlak 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 besproeiingswater nie hoër is as die infiltrasietempo van die grond nie. Die periode van besproeiing moet ge-

noegsaam wees om die wortelsone tot veldkapasiteit te benat sonder om die wortelsone te versadig en sodoende oormaat dreinerings 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, called the management allowable depletion.

Grondvogssensors wat die grondwaterinhoud meet, is waarskynlik 'n beter aanduiding vir "wanneer" en "hoeveel" besproei moet word as die gebruik van gewasfaktore of die sogenaamde kalendermetode, waar besproeiing op 'n voorafbepaalde tyd plaasvind, bv. elke Dinsdag en Vrydag.

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 to -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 commence already 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. Irrigation is scheduled ac-

Break new ground in pest control

CRYPTONEM™

Die Joernaal vir die Vrugtebedryf in Suid-Afrika



Photo by Dr Jeanne De Waal

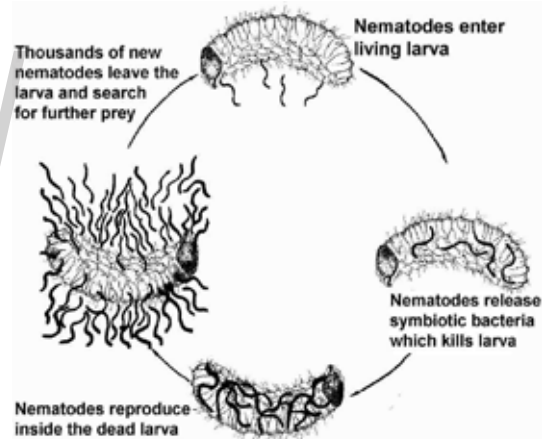


Photo by E-Nema

Cryptonem is a powdered, biological pest control agent that contains entomopathogenic nematodes (EPNs) of the species *Heterorhabditis bacteriophora*. These EPNs are naturally occurring, lethal pathogens of insects, actively hunting for insect larvae and pupae in the soil and killing them within 2-3 days. Target pests include, false codling moth (*Thaumatotibia leucotreta*), banded fruit weevil (*Phlyctinus callosus*) and

other weevil species, codling moth (*Cydia pomonella*) and sciarid flies (*Lycoriella* sp. and *Bradysia* sp.). The nematodes will reproduce inside the larvae and eventually exit the cadaver and spread throughout the soil for further infestation of insects. Cryptonem can be applied through irrigation systems or with conventional spraying equipment.



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cording to the readings of the shallow tensiometer. The deeper placed tensiometer monitors over and under-irrigation. If the deeper placed tensiometer continuously gives a low reading then over-irrigation is indicated. However, if it gives increasingly higher readings, in spite of irrigation, it indicates under-irrigation.

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 gronde 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 wortelzone 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

K H LESAR, A ERASMUS & P H FOURIE

THE ORIGIN OF DECAY All the post-harvest citrus diseases are present in the orchard. Around 1% of the fruit harvested will have established green mould infections; this needs to be dealt with swiftly by the packhouse. The packhouse needs to convey the importance of the following practices to the orchard management.

- Sanitation to minimise the inoculum (spore) load in the orchard
- Establish protocols to minimise wounding of fruit during harvesting. Prevention of wounds will dramatically reduce the inci-

dence of infections.

- Treat the fruit within 24 hours from 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 applying of wax is a short process. Every single process needs to be managed diligently to reduce the risk of waste.

CHLORINE TREATMENT

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

FUNGICIDE DIP TANK

- The imazalil concentration should be managed continuously by means of titration and maintained at 500 ppm.
- The pH level of imazalil sulphate solution should be kept stable to ensure consistency in terms of residue loading. An automatic dosing system for pH is recommended. - pH 3 will result in lower residue levels (around 0.5 ppm), but can still give excellent curative control if exposure time is 60 – 90 seconds and fruit is treated within 24 hours of infection. - pH 6 will result in higher residue levels (around 1-2 ppm), but the exposure time needs to be limited to 45 seconds to prevent MRL exceedance.
- The solution should be pasteurised every evening by increasing the temperature to 60°C 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 dip application provides excellent curative control.

- Wax containers / tanks should be agitated continuously (i.e. 24 hours a day) to ensure that thiabendazole and imazalil stay in solution and do not precipitate; if not, it will precipitate and lead to MRL exceedance. Containers should also be tightly sealed to prevent the wax formulation from destruction. - Do not use air bubbles as agitation measure for this purpose as it breaks the wax formulation down.
- 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 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.

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

- No sporulating green or blue mould fruit should be visibly present anywhere near the packhouse. - Remove and discard any waste fruit in closed containers from the packhouse as soon as possible - 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 and the shelf life and quality needs to be maintained. The packed export crop needs to be moved from the packhouse into the cold chain as soon as possible, thereby reducing the risk of loss of quality and waste.