

Extension briefs for



June and July 2023

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

Integrated pest management

False codling moth (S.D. Moore)

Orchard sanitation must continue diligently during the harvesting period. All fruit remaining on trees after harvest must be removed and destroyed within no more than two weeks after completion of harvesting. This is because false codling moth (FCM) activity does not cease during winter, and any remaining fruit could serve to facilitate this activity. In addition, this winter fruit creates a reservoir of inoculum of FCM for the following spring. Conversely, removal of all fruit after harvest could dramatically reduce FCM levels in the following season. Fruit fly numbers can also build up on unharvested fruit.

Packhouses must continue to implement all aspects of the FCM risk management system (FMS) for fruit destined for the EU, as diligently and accurately as possible. For example, grading of fruit on the packing line must be conducted as stringently as possible. Packhouses should not hesitate to slow down the line speed, to enable more careful scrutiny of fruit. Additionally, a designated inspection table should preferably be installed just before final grading and sizing of fruit. These should be equipped with excellent lighting, and staff appointed to conduct such inspections and grading must have 20/20 vision and should be properly trained and incentivised to do the most reliable and accurate job possible. Also, that the Perishable Products Export Control Board (PPECB) pallet inspections are a critical component of the FCM Management System (FMS), to help filter out infested fruit. Thus, full cooperation

must be given in order for this process to be conducted thoroughly and accurately.

Red scale (T.G. Grout)

Those growers who have experienced red scale problems during the past season should consider applying narrow distillation range horticultural mineral oils, as these comprise the most IPM-compatible treatment option for red scale. The optimal period to apply this treatment is from budswell to budburst (mid-July to mid-August). The concentration to be used is dependent on the grade of the oil to be applied (generally 1.0 – 1.25% medium grade oil). When spraying oil, care must be taken to apply it as a full cover, film wet spray. And trees to be sprayed must not be under any stress. Pruning the trees before spraying will help improve spray coverage of the tree framework where many of the red scale insects survive. Other treatments for red scale would normally be applied in August, September or after petal fall, and will be discussed in later editions of Extension Briefs.

Ant control (T.G. Grout)

Ants are usually indirect pests on citrus and interfere with the behaviour of natural enemies, sometimes protecting and even transporting pest species. The winter months are a good time to control ants before honeydew-producing pests such as aphids increase on the spring growth flush. Trees should also be skirt-pruned to prevent branches from touching the ground later in the season when bearing fruit. A new bait – SAGA – that is effective against both the pugnacious ant and the brown house ant, is available from River Bioscience.

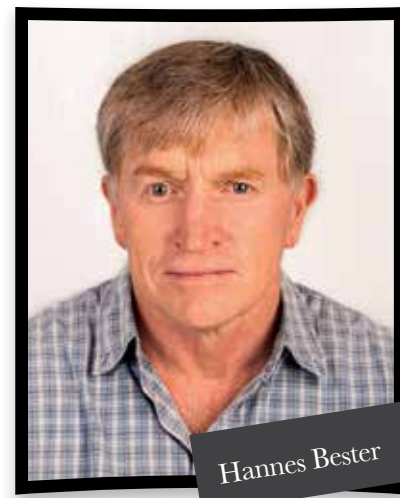
Naoespraktyke (P.J.R. Cronjé)

Vir die voorkoming van naoes fisiologiese afwykings is die korrekte produksiepraktyke – soos bemesting en besproeiing, asook snoei – uiters belangrik. Daar is egter gedurende die oes en pakproses kritiese faktore waarop gelet moet word, wat die voorkoms van skil-defekte, asook algemene vrugkwaliteit kan beïnvloed. Bepaal die optimum plukvenster vir elke kultivar per boord deur h maand voor die beplande oesdatum met rypheidsindeksering (interne kwaliteit en skilkleur) te begin. Daar moet gepoog word om die temperatuurlading op die vrug te beperk, vanaf die plukproses tot in die pakhuis, deur die vrugte se veldhitte so gou as moontlik te verwyder (bv. deur vrugte gouer te stort/doop). Die paklyn het h invloed op skiltoestand, asook die voorkoms van skil-defekte, en dit is belangrik dat noukeurige aandag aan alle bewegende dele – bv. rollers en borsels, asook wakstipe en aanwending – geskenk word.

Ontgroening is h belangrike aspek van die sitrus-naoeshantering en moet optimaal bestuur word. Dis belangrik om te beseft dat daar h interaksie tussen kultivar, vrugrypheid en die effektiwiteit van ontgroening bestaan. As vrugte te vroeg (onvoldoende kleur-ontwikkeling aan boom) in die ontgroeningskamer geplaas word, sal die verlangde kleur nie ontwikkel nie en vrugte neig om h geler of bleker voorkoms te kry. Gedurende ontgroening is daar egter aspekte wat streng beheer moet word, nl. etileenkonsentrasie (1-3 ppm), temperatuur en relatiewe humiditeit (95%+).

Optimum ontgroeningstemperatuur

Satsuma-mandaryne	18 tot 21 °C
Clementine- en Nova-mandaryne	19 tot 22 °C
Nawellmoene	21 tot 23 °C
Ander lemoene	23 tot 24 °C
Pomelo's en suurlemoene	24 tot 25 °C



Hannes Bester



Wayne Mommsen

Ontgroen altyd meer sensitiewe vrugte teen die laagste temperatuur. Die etileen-behandeling is die effektiëfste as vrugte van dieselfde kleur gelykertyd behandel word. Die tydperk van die behandeling moet ook so kort as moontlik wees. Hou die CO₂-vlakke onder 0.3% (3000 dpm) deur die ventilasie sodanig te stel; hoë CO₂-vlakke verlangsamen die ontgroeningsproses deur as kompeterende inhibeerder teen etileen op te tree. h Stadiger ontgroeningstempo sal h verlenging van die tyd in die ontgroeningskamer vereis en 'n verkorte rakleef tyd tot gevolg hê. Vir meer inligting, raadpleeg die *Common Defects*

Associated with Degreening of Citrus deur Krajewski en Pittaway, wat hier bestel kan word: <https://www.citrusres.com/shop/>.

Die koueketting se invloed op vrugkwaliteit is van kardinale belang en sal nie net die voorkoms van skil-defekte beïnvloed nie, maar ook algemene kwaliteitsaspekte soos vrugfermheid en rakleef tyd. Die belangrikste faset van die koueketting is dat dit nie onderbreek mag word nie, m.a.w. as vrugte tot op die verlangde temperatuur verkoel is, mag die temperatuur nie weer styg nie.

Crop and fruit quality management

(P.J.R. Cronjé)

Maturity indexing: Maturity indexing on mid-season to late cultivars should commence. Maturity indexing is done to predict the rate of change in fruit maturity in order to harvest fruit at an optimal maturity. The aim is to define changes or rate of change in acids and sugars, and to build up a database over a number of years. Random sampling of fruit every week from each of 10 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 using a refractometer, the sugar:acid ratio calculated, and fruit colour should be read from a colour chart. These parameters 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.

Degreening and postharvest rind disorders: The two publications, *Common Defects Associated with Degreening of Citrus* by Andy Krajewski and Tim Pittaway, and *Postharvest Rind Disorders of Citrus Fruit* by Paul J. R. Cronjé are a must read for

any grower. Both are available to order from CRI at: www.citrusres.com.

Pickers training and monitoring: 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, fingernails of pickers should be short, and clippers 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 the fruit quality of each picker monitored by an appointed team leader via the sorters.

Pruning: For early and mid-season cultivars, pruning 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; any rootstock regrowth, water shoots and excessive regrowth from main frame shoots on the inside of the tree. Light levels of above 30% of full sunlight are necessary for optimal photosynthesis – at least one “window” cut should be made to allow adequate light distribution and improve bearing wood. Increase in photosynthesis and light distribution will lead to increased fruit size and internal fruit quality (Brix°), better fruit colour development, increase in rind integrity, as well as a more uniform fruit distribution across the tree. Pruning can also be used as a thinning technique: prune more heavily after a light crop if a heavy crop is expected, and when the orchard has a history of alternate bearing. A follow-up pruning of regrowth in the summer is of critical importance. Pruning tools should always be sanitised with 10% Jik solution

when moving from one orchard to another. Another benefit of pruning is that it ensures much more cost-effective spray application.

Flower induction: Citrus trees require a rest period of about six weeks to ensure adequate flower induction. The two mechanisms involved in floral induction in citrus involve (1) low temperature, or (2) controlled water stress, both prevent root activity. In the absence of low-temperature rest, citrus trees should be exposed to controlled water stress for a four- to six-week period during June and July, if possible.

Bemesting/Fertilisation (P.J. Raath and J.G.K. Coetzee)
Blaarontleding/Leaf analysis
The very last opportunity to get leaf analyses done is in June and July. Leaf analysis is still the best diagnostic method to measure the nutritional status of the trees.

Blaar-analise kan egter nie as die enigste norm vir die daarstelling van ‘n bemestingsprogram gebruik word nie, maar moet as ‘n aanvulling tot grond-analises gesien word. Dit is ook nuttig in gevallestudies waar blare vanaf “siek” bome gemonster word, asook vanaf naburige, nie-geaffekteerde bome. Die gesonde/beter bome se blare dien dan as direkte kontrole, sodat die tyd van monsterneming en al die ander veranderlikes, minder krities of nie ter sake is nie. Geen norm word gebruik nie, maar wel die relatiewe verskille tussen die twee monsters.

Grondontledings/Soil analyses Soil analyses should be done every second year on sand soils and every two to three years on clay soils. Preferably during the same time as leaf analyses. A good practice is to take soil samples from the same spot every year to ensure accurate historic dataset development for the soils. Sampling areas can be marked with GPS coordinates. Sections where trees are performing poorly should be sampled separately.

Gereelde grondontledings word in

bestaande boorde benodig om te verseker dat optimale groeitoestande gehandhaaf word. Die belangrikste voordeel van grondontledings in bestaande boorde is dat veranderinge in grondvrugbaarheid bespeur kan word en daar korrekatief opgetree kan word. Dus vóór voedingsprobleme wat boomprestasie benadeel, ontwikkel.

Other analyses If manure or compost is used, it should be analysed to determine the nutrient value and occurrence of unacceptable elements (e.g. heavy metals) in the organic material. The amount of organic material applied is determined by the concentration of nutrients in the compost or manure. The nutrient content of organic material is much lower than inorganic fertilisers, and often in an inappropriate ratio compared to the trees’ nutritional requirement. Therefore, be careful not to apply excessive amounts of nutrients that are out of sync with the trees’ requirement.

Bemesting/Fertilisation Potential yield is used as an indicator for the amount of fertiliser to be applied initially. Use historic yield data to determine a realistic target yield and basis from which the fertilisation requirement is compiled. The fertilisation programme should then be adjusted, using results of both soil and leaf analyses as well as evaluations during the season.

The fertilisation programme for each season starts in July or August of the previous year, depending on the production area. Due to the properties of the specific chemical ion, the properties of the soil and the physiological requirements of the trees, certain basic rules should be adhered to when applying fertilisers to citrus.

Blaarbespuitings word gebruik om tekorte reg te stel, of om die bome fisiologies te manipuleer. Vir manipulasie is dit hoofsaaklik lae biuret-ureum of kaliumnitraat wat gebruik word. Indien nodig, moet beide bespuitings ses tot agt weke voor die 50% blomstadium toegedien word. Dit is gewoonlik in Julie of vroeg Augustus.

Table 1.

Element	Mikrospruite/micro-sprinklers	Druppers/drippers
N	Dien die meeste N gedurende Julie tot September toe. Die aantal toedienings word bepaal deur die totale massa kunsmis wat toegedien moet word en die klei-inhoud van die grond. Die beginsel vir sproeibemesting of hand- en meganiese toediening bly dieselfde.	Die beginsel is soos dié vir mikrospruite maar die massa word verdeel in 'n groot aantal toedienings wat tot Desember strek. Die meeste N moet egter nog steeds in Julie tot September toegedien word, en die toedienings moet nie veel langer as Januarie aanhou nie.
Organiese materiaal	Organiese materiaal soos kompos, kraal- of hoendermis moet nie later as Julie of Augustus toegedien word nie. Vrystelling van N uit organiese materiaal is moeilik om te beheer of voorspel en oormatige N-mineralisasie ná Oktober, sal nadelige gevolge inhou.	Die huidige metode is om die totale massa organiese materiaal te verdeel en gelyke massas bo-op elke drupper te plaas. Dit moet teen die laatste Julie/Augustus gedoen word.
P	Use single or double superphosphate. In higher pH soils it should be applied in a narrow strip of about 5 cm wide in the wetted zone.	Use a water-soluble source like mono ammonium phosphate (MAP). In high pH soil, phosphoric acid can be used, which should be applied in a few instalments over a period (four to five months) from spring onwards.
K	Wanneer sproeibemesting gebruik word, kan korrektiewe bemesting op swaarder gronde teen 100 g K per boom per toediening oor die hele lengte van die siklus toegedien word. Doen dit elke twee tot drie weke totdat die voorgeskrewe aanbeveling toegedien is. Wanneer meganies of met die hand uitgestrooi word, word die aanbevole K in een (leem- tot kleigronde) tot drie (sandgronde)-toedienings gedurende die lente/vroeë somer gemaak.	Dien die aanbevole massa kaliumnitraat, -sulfaat of -chloried toe oor 'n periode van drie tot ses maande gedurende Julie tot Desember.
Ca	Calcium deficiency is only expected on acidic or extremely sandy soils. The most critical time to avoid a deficiency is from August to October. Therefore, lime applications should be done in winter, while gypsum can be applied up to August or September.	Calcium nitrate is the only suitable alternative source besides lime and gypsum that require rain to be washed into the soil. It must be applied from July to September/October, and can be extended to December. Take the nitrate component of the calcium nitrate into account when calculating N fertilisation.
Magnesium	Dolomitiese kalk, magnesiumsulfaat of -hidroksied of -oksied kan in die lente, vroeë somer of herfs toegedien word.	Magnesiumnitraat of -sulfaat word ook oor 'n periode van drie tot ses maande toegedien. Die nitraat word gewoonlik vroeg, en die sulfaat ná Oktober, toegedien.
Sulphur	Sulphur deficiency has the most devastating effect on fruit set. Where a deficiency is present, apply the sulphate (e.g. gypsum) during July to August. On sandy soils, maintenance applications are done during spring or early summer.	Gypsum is applied in the rainy season. Otherwise, magnesium, potassium or ammonium sulphate are S-sources, and the application is timed to fit the requirement of these four elements.

Table 2.

	Element	Timing
N	Low biuret urea to stimulate blossom or improve the quality of the blossom Low biuret urea to supplement the nitrogen supply	July or early August October to February
P	Om die suurinhoud van die vrugte te verminder kan MAP toegedien word. Om die TOV van die vrugte te verhoog kan MKP toegedien word. Dit sal ook dunner en gladder skille tot gevolg hê.	Ses weke ná blomblaarval Ses, vier en twee weke voor oes
K	Potassium nitrate to stimulate blossom or improve the quality of the blossom Potassium sulphate or potassium nitrate to supplement the K supply, if root uptake is insufficient	July or early August August/September for the best results and up to February for maintenance After fruit drop to December
Mg, Zn, Mn, B en Mo	Waar tekorte ondervind word Instandhouding, indien nodig	Julie/Augustus en weer in Oktober Oktober tot Desember
Cu	Only recommended to correct a deficiency	May to July, before flowering



Coenraad Fraenkel



Catherine Savage



MC Pretorius



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

Most packhouses are entering their peak period, but this is not the time to neglect important and basic practices such as sanitation and fungicide application.

Packhouse sanitation The main aims of this practice are to:

1. remove any infected fruit from the packhouse environment
2. sanitise surfaces with appropriate treatments.

These actions will reduce the inoculum (spore) levels, which will reduce the risk for future infections and fungicide resistance development.

Surfaces that should be considered in sanitation:

- **Packline surface:** treat daily with a registered, food-safe sanitising product. It is important that the product does not leave a residue, and is quick and easy to use.
- **Fruit surface:** a fruit disinfectant treatment should be one of the first steps when entering the packhouse. Chlorine (Calcium

Hypochloride) is the most popular active for this step. Remember to strictly manage the chlorine concentration, pH and ORP. Alternatives such as liquid or powder PAA formulations can also be used. In the case of PAA there is no need to adjust the pH, however the PAA concentration levels must be managed carefully, and fruit must be dried timeously (both to prevent rind injury).

- **Floors and walls:** wash weekly with a registered soap and disinfectant product. In these areas, a product that leaves a residue (such as a QAC product) can be used. It is important to remember that a dirty surface can't be sanitised, so the use of a registered soap before sanitation is recommended. The areas to clean include the packhouse, degreening rooms and cold rooms.
- **Degreening rooms and cold rooms:** need to be washed and then – where possible – fumigated with a suitable product that can reach into crevices and folds. Never fumigate when there is fruit in the room, to avoid the risk of residue transfer.
- **Orchard bins and picking bags:** must be washed and sanitised before being used again.

Sources of inoculum (spores):

- **The orchard:** spores naturally occur in the orchards, so orchard sanitation is key, to reduce the inoculum load.
- **Post-degreening fruit:** degreening conditions are hugely favourable for disease development and unfortunately, some sporulating fruit are often tipped into the packhouse system.
- **Waste fruit:** have a process in place to remove this fruit without delay, and to keep the waste in sealed containers.
- **Juice fruit:** this fruit is often treated with fungicides and sits in the packhouse area for some time until it's transported to the juicing plant. Therefore, any decay that occurs on such fruit holds a resistance risk.
- **Small fruit:** this fruit, if not properly graded out, can fall between brushes or gaps between units and lie unseen on drip trays in the packhouse.
- **Retention samples:** shelf-life fruit has also been treated with fungicides and holds a similar resistance risk as juice fruit.

Recommendations that can reduce the risk of infection and/or resistance development:

- Treat all harvested fruit promptly (within 12 – 18 hours), as most fungicides cannot control infections that are older than a day.
- Don't let fruit stand from Friday afternoon to Monday morning without any fungicide protection. In this case it would be prudent to drench the fruit on Friday.
- Degreen fruit for the absolute minimum period of time.
- Do not exceed the volume limit of your packline. This is to avoid accelerated agitation and movement of the fruit, which will result in bruising and injuries, and will reduce the efficacy of sanitation and fungicide treatment. Spread the fruit out evenly, so that none skip the treatments. If fruit moves too quickly through the various control points, the following risks will be observed:
 - The chlorine treatment: poor disinfection, spores surviving

- The fungicide dip tank: loading suboptimal residue, poor infection control
- The wax applicator: poor wax deposition on the fruit; suboptimal residue loading, poor moisture retention, negative impact on quality.
- Limit the time from harvest to packing and the eventual introduction to the cold chain.

Some advice in managing retention fruit:

- Have a dedicated person managing this task.
- Fruit should be evaluated every day, and decayed fruit noted on the carton and removed or isolated.
- This infected/discarded fruit should be placed in a plastic bag immediately and



André Combrink

the bag sealed tightly, to reduce the risk of releasing inoculum (spores) into the packhouse atmosphere.

- Fruit in retention samples have been treated with fungicides, and holds a serious resistance risk if spores are spread into the packhouse.
- Green mould sporulation inhibition is a very important criterion to note, as the loss of sporulation inhibition is indicative of either fungicide resistance or poor fungicide application. To prevent spores spreading from this infected fruit, fruit exhibiting sporulation inhibition should be kept in sealed transparent plastic bags and incubated for another week to rate sporulation inhibition (white mycelium with few to no green spores).
- When the sporulation inhibition rating is concluded, the bagged fruit must be destroyed (with the bag) well away from citrus orchards and packhouses, to prevent spores from entering any production area.
- Do not keep fruit for longer than the shipping period.

Ideally, the retention room should be some distance away from the clean area in the packhouse and should be totally enclosed with controlled access. This room should be cleaned and treated with a suitable soap and sanitiser at least once a month. ▀



Natasha Jackson



Jan Landman