EXTENSION BRIEFS
MARCH/APRIL 2008

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INTEGRATED PEST MANAGEMENT

Mealybug (S.D. MOORE)

Growers should be scouting for mealybug regularly, by inspecting underneath calyces and thereby determining percentage of fruit infested. The most effective way of doing this is to break the fruit off from the calyx. Both the fruit and the underside of the calyx should then be inspected. Where mealybug is under good biocontrol, infestation should peak during December in the northern production areas and during January in the Cape production areas. If mealybug infestation does not decline during January and February, respectively, suppression with a chemical treatment is advisable on early maturing cultivars. Trial results have demonstrated that buprofezin (Applaud) is by far the most effective corrective option for mealybug control but this cannot currently be used on fruit destined for Europe. It is imperative that any application of buprofezin be targeted against the younger stages of mealybug, i.e. eggs, crawlers and second instars. Where buprofezin cannot be used, methidathion is probably the most effective option. Methomyl and chlorpyrifos can also be used. Mevinphos (at 50 ml per 100 L water) also has some effect. However, this is not a registered option.

This is also a good time to determine which species of mealybug are present. This is important, as it appears that the biocontrol complexes of oleander mealybug and longtailed mealybug, in particular, might not be as effective as those of citrus mealybug. Therefore, treatments can be applied more readily when either of these species is identified as the dominant species in a particular orchard. The phytosanitary status of certain species must also be borne in mind.

False codling moth (S.D. MOORE)

Effective false codling moth (FCM) control begins in November with diligent orchard sanitation and the application of a registered control treatment, if and where necessary. For growers in black spot-free areas who are accredited for export of fruit to the USA, it is prudent and possibly mandatory to apply a second treatment during late January or Feb-

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CONTINUED FROM PAGE 35 ruary. Growers in other areas can determine the extent of an FCM problem through weekly monitoring of traps, routine inspection of abscised fruit and the historical status of FCM levels in orchards. This will help in determining whether a follow-up treatment for FCM is necessary at this time of year. The use of the mating disruption product, Isomate, can also be considered as a stand-alone treatment or in conjunction with one or more spray treatments.

Bear in mind that the use of triflumuron (Alsystin) and teflubenzuron (Nomolt) is restricted to not later than 90% petal fall for most major markets and is therefore relatively ineffective for protection of the in-season crop. Also note that the withholding period for fenpropathrin (Meothrin) for many markets, including most EU countries, is 185 days. Cypermethrin is not allowed on fruit destined for the USA market, but is permitted in other markets with a withholding period of 28 days. This means that Cryptogran and Cryptex (two distinctly different virus products) are the only spray options for FCM permitted in all markets at this stage. A virus application should be timed against (or shortly after) a peak in FCM activity, determined by the use of a Lorelei pheromone trap. Note that due to high levels of UV irradiation in the Clanwilliam and Piketberg magisterial districts of the Western Cape and in the Northern Cape, problems may be experienced with the efficacy of virus applied in these areas during February and March. The use of Cryptogran is therefore not recommended in these areas until the end of March. This problem does not exist in the rest of the country and therefore the caution is limited to the above-mentioned areas.

Early maturing mandarins, such as Satsumas, which will be harvested during March, should be strongly considered for a registered spray treatment during February i.e. approximately four weeks before harvest. An effective treatment at this time should reduce post-harvest risks associated with FCM.

Bud mite (T.G. GROUT)

The period February to May is the optimal time for bud mite sprays. Bromopropylate is the more efficacious of the two available options to consider for fruit going to all markets except the USA, but take note of the 21-day pre-harvest interval. The other registered option for the USA is lime sulphur at 1.25*l*/100*l* water. More than one abamectin application during summer for citrus thrips will suppress bud mite populations but the level of control may not be adequate for lemons.

Fruit fly (T.G. GROUT)

Fruit fly monitoring and management practices should be initiated two months before the earliest expected harvest date. Recommendations remain unchanged and are as follows. Fruit flies should be controlled by use of weekly protein hydrolysate bait sprays, the use of GF120, M3 bait stations or Last Call FF. Traps must be used to indicate whether the control strategy is adequate. Growers have the option of monitoring male flies in Sensus traps with Capilure and using a threshold of 4 flies per week per trap, or using Questlure in a Sensus trap and using a threshold of 1 female fly per week per trap. If these thresholds are exceeded, additional control measures will be required.

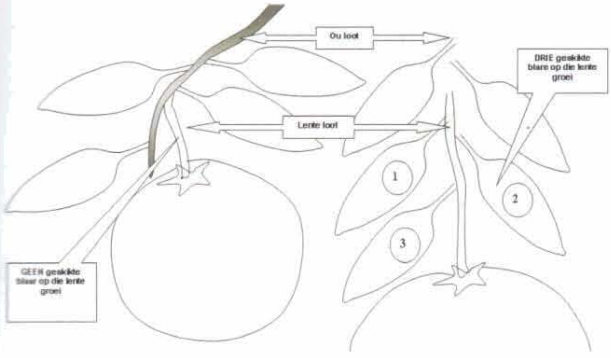
CROP AND FRUIT QUALITY MANAGEMENT (J.S. VERREYNNE)

Internal quality: If properly timed, regulated deficit irrigation can result in an increased total soluble solids (TSS) and an increase or no response in titratable acidity. Deficit irrigation retards the breakdown of acid and can result in a more favourable solids:acid ratio at harvest, especially in cultivars where there is a sudden drop in acid before harvest. It is mainly aimed at early cultivars like Satsuma, but other early maturing cultivars with low internal quality could benefit. No water stress should be imposed during the initial growth phase of the fruit, i.e., during and after flowering, but only during the final maturation phase, i.e., the last two months prior to harvest (January for Satsuma). Less water is applied and at longer intervals. Therefore, irrigation is continued but at a reduced level. Trees should be irrigated lightly two weeks prior to harvest. In high rainfall areas, regulated deficit irrigation may not be successful. The deficit should be imposed slowly, so that the trees can adjust without symptoms of drought. Severe water stress can have adverse effects on tree health and fruit quality. High nitrogen is antagonistic to the effect of deficit irrigation. Management of this technique is much easier when trees are planted on ridges. Additionally, regulated deficit irrigation imposed the last two months prior to harvest also enhances the rate of colour development. Selective harvest of outside fruit and delaying harvest of inside fruit will result in a higher proportion of fruit with higher TSS and better colour.

Maturity indexing on early cultivars like Satsuma should commence. Maturity indexing is done to predict the rate of change in fruit maturity in order to harvest fruit at a maturity that would maintain acceptable commercial shelf life. The aim is to define changes or rate of change in acids and sugars and to build up a data base over a number of years for comparison. Random sampling of fruit every week from each of ten 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 using a refractometer, the sugar:acid ratio calculated and fruit colour should be read from a colour chart. All the parameters mentioned above 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.

GRONDGEDRAAGDE SIEKTES (M.C. PRETORIUS)

Grond en wortelmonsters behoort elke drie jaar geneem te word om sodoende die sitrusaalwurm en phytophthora *status in sitrusboorde te bepaal. Resultate sal dien as `n bestuurshulpmiddel wat beplanning vir die toediening van produkte om die patogene effektief te beheer, vergemaklik.*



Figuur 1. Voorstelling van die soort blaar wat geneem moet word.

Phytophthora bruinvrot

Weens die gevaar van fitotoksisiteit op gevoelige sitruskultivars tydens hoë temperature, wat gedurende Februarie / Maart kan voorkom, moet die gebruik van fosfonaatblaarbespuiting streng volgens die etiket *geskied.* Hoë dagtemperature, tydelike vogstremming en warm bergwinde kan veroorsaak dat fosfonate swart stippeltjies soortgelyk aan koperskade op vrugte veroorsaak. Bome moet daarom nie gespuit word as toestande nie optimaal is nie.

Bruinvrot ontwikkel slegs wanneer die klimaatstoestande gunstig is vir die patogeen *(Phytophthora)* om te infekteer en te ontwikkel. *Indien dit dus ń droë najaar is en geen of slegs ligte reënbuitjies voorkom, is voorkomende fosfonaatblaarbespuitings nie nodig nie.* Indien dit egter ń nat na-jaar is kan bome met of ń fosfonaat, koper of mancozeb gespuit word om bruinvrot te beheer. Laasgenoemde twee middels is slegs voorkomend terwyl die fosfonate ook ń korrektiewe werking het. Produsente het oor die algemeen ń probleem om te weet wanneer hulle boorde onder vogstremming is en wanneer nie. Maak seker alvorens ń bespuiting oorweeg word om enige fitotoksiese reaksie te voorkom.

Bo en behalwe droogte en hitte kan 'n oormaat vogtige toestande (baie reën) ook bome onder tydelike verwelkte toestande plaas wat ń gevaar inhou vir blaarbespuitings. Bome moet dus nie tydens of kort na sulke toestande gespuit word nie. Laastens beïnvloed drag ook ń boom se gevoeligheid vir droogtespanning. Hoe hoër die drag, hoe gevoeliger is die boom vir uitdroging en hoe groter is die risiko vir fitotoksisiteit.

Die registrasie van Fighter is slegs opgeskort vir gebruik op sagte sitruskultivars, dit kan nog steeds gebruik word op ander sitruskultivars vir die beheer van Phytophthora *bruinvrot.*

Sitrusaalwurm

Wortelmonsters kan enige tyd van die jaar getrek word om die status van die sitrusaalwurmpopulasies in boorde te bepaal. Wyfietellings word gebruik om te bepaal of die toediening van ń aalwurmdoder geregverdig is. Die drempelwaarde voordat ń aalwurmdoder oorweeg word is 1 000 wyfies / 10 g wortels. Daar word aanbeveel dat aalwurmdodertoedienings 'n aanvang neem tydens die begin van die reënseisoen. Dit sou daarom die regte tyd wees vir produsente in die Wes-Kaap om hulle aalwurmmonsters in Maart te trek sodat hulle weet watter boorde om te behandel wanneer winterreëns begin. Residu-weerhoudingstydperke moet in ag geneem word. Dit is belangrik om ń aalwurmbeheerprogram te volg aangesien ń enkele aalwumdodertoediening glad nie effektief is nie en het geen effek op aalwurmpopulasies nie.

Tydens die toediening van aalwurmdoders is dit *uiters belangrik dat ten minste 40 mm besproeiing toegedien* word nadat produkte toegedien is om te verseker dat die middels in die grondprofiel ingewas word. Met die uitsondering van Temik, loog die meeste ander aalwurmdoders baie stadig. Die effektiwiteit van die dodders word dus belemmer indien hulle nie behoorlik deur die wortelsone versprei word nie. Geen aalwurmdoder behoort deur drupbesproeiingstelsels toegedien te word nie. Indien toedienings in so ń geval gedoen moet word behoort die middels as 'n bandplasing (half meter aan beide kante van die drupperlyn) oor die drupperlyn gedoen te word. Dit kan wel deur mikrobesproeiingstelsels toegedien word.

Indien beplan word om ń boord te verwyder behoort ń aalwurmmonster geneem te word voordat die boord verwyder word sodat bepaal kan word of sitrusaalwurms teenwoordig is. Dit dien as ń bestuursriglyn tydens ń herplantstrategie.

GEÏNTEGREERDE BEMESTING (J.G.K. COETZEE)

Blaar- en grondontledings

By sitrus word blaar- en grondmonsters gedurende Februarie tot Mei geneem maar die periode kan tot Julie verleng word. Die enigste probleem met monsters wat in Julie geneem word, is die beperkte tyd om die resultate betyds te verskaf sodat met bemesting in Julie / Augustus begin kan word.

Geen ontleding hoe gesofistikeerd ookal, kan die kwaliteit van die monster verbeter nie. Bestee dus tyd, energie en aandag aan die monster. Op grond van die resultate van dié monsters word baie geld aan kunsmis bestee, terwyl die oes ook benadeel kan word. Monster elke jaar dieselfde groep bome (Indeksbome) en hou by dieselfde prosedure en tyd. Soos by enige monster moet dit die eenheid wat gemonster word, in alle opsigte verteenwoordig.

Leaf analyses

Leaf analyses are an indicator of the nutritional status of the trees. During the research into this method a relationship was established between the concentration of the nutrient elements in the leaves and production. This relationship was developed for almost every nutrient element. For some like chloride and sodium only the maximum tolerable concentration was determined.

Let ook op die volgende spesifieke vereistes:

- Verdeel die boorde in monster-eenhede. 'n Monster-eenheid is 'n groep bome van dieselfde kultivar, onderstam, soort besproeiing, ouderdom en wat op dieselfde soort grond staan.
- 'n Monster-eenheid moet verkieslik nie groter as 5 ha wees nie.
- Kies twee of vier rye wat die monster-eenheid in alle opsigte verteenwoordig en merk die rye. Hierdie rye is die indeksrye waar die blaar-, grond- en vrugtemonsters geneem moet word. Rye word bo diagonale roetes deur die boord verkies omdat dit makliker monster en dit jaar na jaar weer

VERVOLG OP BLADSY 38

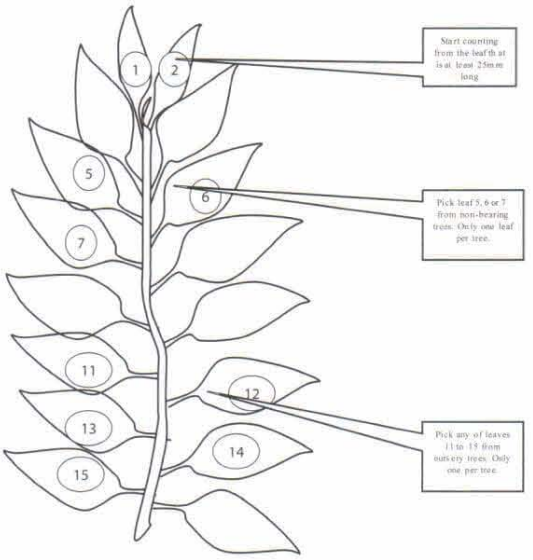


Figure 2. Illustration of the type of leaf to be sampled from non-bearing and nursery trees.

VERVOLG VAN BLADSY 37 herhaal kan word. Sodoende word die veranderings as gevolg van bemesting en nie die variasie in die boord gemeet nie.

- Gebruik elke jaar dieselfde indeksrye.
- Wanneer die monsters geneem word, word tussen twee indeksrye ingestap en blare aan die linker- en regterkant (son- en skadukant) tussen heup- en kophoogte, gepluk.
- Pluk sowat 50 tot 75 blare per monster.
- Pluk blare van agter 'n vrug, wat op dieselfde takkie as die vrug en in die lente gevorm is (Figuur 1).
- Die blare moet 5 tot 9 maande oud wees.
- Pluk die blaarmonsters gedurende Februarie tot Mei. Blaarmonsters wat gedurende Junie en Julie gepluk is, is ook bruikbaar maar laat min tyd om gereed te maak vir die nuwe bemestingseisoen.
- Plaas die blare in 'n skoon plastieksakkie, druk die lug uit en knoop toe. Indien die blare waterdruppels op het, moet dit eers met sneespapier droog gemaak word.
- Merk die monsters deur 'n etiket op die sakkie te plak of aan die sakkie te bind. Moenie die etiket binne in die sakkie saam met die blare sit nie. Die etiket moet die boordnaam of –nommer (u verwysing) en u besonderhede bevat.
- Hou die monsters koel maar moet dit nie vries nie. Versend dit so gou moontlik na die laboratorium. Indien die blare nie waterdruppels op gehad het nie, nie in die son gelê het nie en koel gehou is, kan dit na een maand nog bruikbaar wees.

Ensure that the correct leaf is picked from the trees in the index rows or blocks. The correct leaf is one that was formed during the previous spring and situated behind a fruit on the same twig as the fruit. Collect 50 to 100 leaves per sample. Take the soil sample at the same index trees. Collect 15 to 20 subsamples, mix

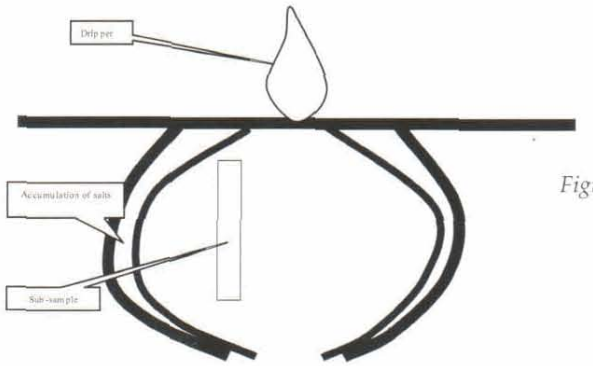


Figure 3. Soil sampling at drippers.

and submit 500 g of the composite samples for analyses.

If the soil was sampled, prepared and fertilised properly before planting, it is not necessary to take leaf samples from non-bearing trees. *However it is never too early to monitor the nutritional status.*

Leaf samples can also be taken from nursery trees.

When sampling non-bearing trees, the same procedure regarding index trees, packaging and forwarding is applicable. Take 50 to 75 leaves per sample, one per plant, of leaf numbers 5 to 7 from the tip (Figure 2).

When sampling nursery stock pick leaf numbers 11 to 15. Pick 50 to 75 leaves per sample, one leaf per plant (Figure 2).

Grondmonsters

Grondontledings verskaf inligting wat help om te besluit watter stappe geneem kan word om tekorte, wanbalanse en oormate in die voedingstatus van die bome reg te stel. Met 'n grondontleding word gepoog om binne sekondes of minute 'n massa van die voedingstowwe uit die grond te ekstraheer, wat die bome in 8 - 10 maande sal opneem. Elke metode wat gebruik word, het dus net waarde indien dit gekalibreer is en presies so uitgevoer word, soos wat dit in die kalibrasie gebruik is.

Neem van grondmonsters vir bemestingsadvies

Die grondmonsters word in dieselfde indeksrye as die blaarmonsters geneem. Let egter op die volgende spesifieke vereistes:

Monsterneming by mikrospuite

- Neem 'n submonster vanaf die oppervlak (verwyder slegs die blare, maar geen grond nie) tot 30 cm diep. Gebruik 'n graaf of monsterboor.
- Neem die submonsters waar bemes en besproei word, gewoonlik onder die druplyn van die bome.
- Neem sowat 15 tot 20 submonsters by die bome in die indeksrye. Plaas die submonsters in 'n plastiekemmer, meng deeglik en neem ±500 g en verpak vir versending na die laboratorium.
- Merk die monster met die boordnaam (u verwysing) of boordkode plus u besonderhede.

Soil sampling at drippers (Figure 3).

- Remove the top 5 cm of soil plus debris.
- Take the sub-sample from 5 to 30 cm deep.
- Take the sample between the dripper and the perimeter of the wetted zone. If the wetted zones of two adjacent drippers overlap, take the sub-sample between the two drippers.
- Collect 15 to 20 sub-samples at the index trees. Put the sub-samples in a plastic bucket, mix properly and retain ± 500 g for sending to the laboratory.
- Mark the samples with your name and that of the orchard plus all relevant information on a label and stick or tie it to the outside of the container.

POST HARVEST PATHOLOGY

WASTE PREVENTION CHECKLIST (K.H. LESAR)

Sanitation: NB: For keeping spore load, as well as FCM and fruit fly under control – remove all fallen fruit and decayed fruit *from the orchard.* Bury or macerate and allow to dry in the sun.

Good fruit fly control: Use traps and bait regularly.

FCM: Apply pre-harvest sprays where trap counts and fruit drop due to FCM are high.

Skirt sprays for brown rot control: Verwys na "Grondgedraagdesiektes" (Soilborne Diseases) deur M.C. Pretorius hierbo.

Prevent injuries: Test for injuries. "Indigo-Carmine" can be used for this purpose. Test both in the orchard and the packhouse.

NB: Ensure proper picking practices are adopted. There were far too many injuries last season, resulting in abnormal waste levels.

Let Wel: Sorg dat gepaste plukpraktyke toegepas word. Te veel plukbeserings het verlede seisoen onreelmatige vlakke van bederf veroorsaak.

Apply packhouse fungicides with care: Check the mixing / application rates.

Packhouse sanitation:

- Never allow any fruit to lie around in the packhouse and develop spores.
- Constantly monitor concentrations of sanitizers in dump tanks, de-scaler water, rinses, etc.
- Spray the packhouse out with sanitizers regularly and immediately after finding a single mouldy fruit.
- Spray out trailers before they leave for the orchard.
- Rail cartons as soon as possible and prevent packed fruit standing on packhouse floor where it is hot. Green mould develops faster at 10°C than at 4.5°C.
- Store retention samples for each consignment and check regularly for waste and other developing factors.

The control of post-harvest diseases on export citrus using the post-harvest fungicide thiabendazole

There seems to be a general reduction in the use of thiabendazole within the SA citrus industry. This is particularly alarming since latent pathogen infections have been observed in abundance during recent citrus production seasons.

Why use thiabendazole (TBZ)?

TBZ was the first fungicide registered (1960s) for the control of the Penicillium moulds and the latent path- CONTINUED ON PAGE 40

CONTINUED FROM PAGE 39 ogens, Diplodia stem end rot and Anthracnose on citrus fruit. TBZ and benomyl belong to the benzimidazole group of fungicides.

The benzimidazoles are distinguished from other traditional fungicides in that they control diseases both by contact and systemic action.

Due to the extensive pre-harvest application of benomyl for the control of citrus black spot and the post-harvest application of TBZ for control of the Penicillium moulds, populations of Penicillium moulds that were resistant to the benzimidazoles developed rapidly. There is therefore an unfortunate perception in the industry that TBZ is of no value in controlling important post-harvest pathogens.

However, TBZ is still effective in controlling the latent pathogens on citrus: Diplodia stem end rot and Anthracnose. All export citrus should therefore be treated with TBZ.

Some guidelines for reducing the risk of chilling injury on grapefruit exported under extended cold sterilisation conditions:

Citrus in general is known to be sensitive to cold damage (chilling injury) during shipping and storage, but certain cultivars (some soft citrus cultivars, lemons and grapefruit varieties), are particularly prone to chilling injury, especially when exposed to "cold sterilisation" temperatures. It is especially the yellow pigmented citrus cultivars viz. lemons, Marsh grapefruit, and even the yellow areas of Star Ruby and Rose grapefruit which are the most sensitive, as they do not contain the carotenoids which act as anti-oxidants that protect the fruit against chilling injury.

The extended cold sterilisation treatment, as recently adopted by China (24d at -0.6°C), is particularly problematic. It is generally accepted that it is not feasible to export lemons under these conditions. However, whereas grapefruit is also highly sensitive to chilling injury, there are some practices, as summarised in this document, that can be followed to reduce the risk of chilling injury.

Picking window The South African grapefruit season, in the traditional production areas, extends from the middle of March to the end of June. The picking window for grapefruit is often manipulated in an attempt to access markets early or to extend the season. However, harvesting grapefruit too early in the season, when the fruit rind is still "immature" and also at or beyond the end of the season when the fruit is well-coloured and "very mature", is when grapefruit is most sensitive to cold injury. It is a major risk to export such sensitive fruit to markets where cold sterilisation is a requirement.

Thorough maturity indexing is essential to determine the ideal harvesting window. Commencing 5 weeks before anticipated harvest, pick samples of grapefruit (20-25 fruit). Mark the representative trees (data trees from different rootstocks, selections, tree ages or microclimates). Evaluate and record average fruit colour and full internal quality assessments. Repeat every week until optimal harvest date, ensuring that the samples are drawn similarly for comparison. Plot the results on a graph to determine whether the season is early or late compared to the previous year, thereby determining the optimal picking window for the specific cultivar. Commencement of export packing of grapefruit to "cold steri" markets should start 14 days later, as the rinds will still be too cold sensitive at the beginning of the normal optimal picking window. Harvesting of grapefruit for such "cold-steri" markets should also not be extended beyond the end of the optimal picking window.

Post-harvest wilt conditioning Conditioning (wilting) trials where Marsh grapefruit (exported to Japan) was "conditioned" for 2, 4 and 6 days at 16°C and 20°C prior to cold treatment, showed a dramatic reduction in the incidence of chilling injury relative to the non-conditioned control fruit. Unfortunately extending the time between packing and introduction into the cold chain can also increase the incidence of post-harvest rind pitting and decay in sensitive fruit. Nonetheless, wilting at ambient for 7 days is part of the standard handling procedure for grapefruit exported to Japan and should be implemented by anybody wishing to risk exporting grapefruit under an extended cold treatment regime.

Post-harvest shock conditioning Although not developed to the point of being a practical standard recommendation, exploratory trials have indicated that various shock treatments may also be useful in conditioning grapefruit such that sensitivity to chilling injury is reduced. In these trials Marsh grapefruit was shock treated by exposure to a high temperature (35°C) or a high level of CO^2 (10%) for 3 days prior to cold treatment (-0.6°C for 22 days). The incidence of chilling injury was dramatically reduced relative to control fruit that was conditioned through wilting at ambient temperatures for 3d, but the incidence of decay was increased by the high temperature treatment.

The role of waxes Research has indicated that heavy waxes that slow breathing (respiration) down and retain a high level of CO^2 (10%+) on the surface of the fruit, reduce the incidence of CI. Unfortunately the use of heavy waxes may increase the incidence of post-harvest rind pitting in sensitive fruit. Nonetheless, the high risk of chilling injury on grapefruit under conditions of extended sterilisation, make it appropriate to consider preferentially using such waxes when exporting to markets that require such extended cold treatment.

The role of TBZ It is known that inclusion of thiabendazole (TBZ) in citrus wax applied to grapefruit can significantly reduce the incidence of chilling injury. Inclusion of TBZ is also a good standard packhouse procedure and should be used if anybody wishes to risk exporting grapefruit under these extended cold sterilisation conditions.

Pre-cooling and Storage A critical factor affecting the extent of chilling injury of grapefruit, is the duration of exposure to temperatures below 4.5°C. This exposure period is cumulative and can occur during pre-cooling (the period prior to loading during which the temperature of the fruit is reduced to the cold sterilisation level), the cold sterilisation treatment itself and post-shipping storage. Pre-cooling for 3d is a compulsory component of the disinfestation treatment, but any other pre-loading storage at temperatures below 4.5°C should be avoided. Storage of grapefruit after shipping should be at an "intermediate storage temperature" of 7 to 8°C and should be kept to the minimum necessary duration.