EXTENSION BRIEFS
FEB/MARCH 2007

HENNIE LE ROUX & HANNES BESTER
Citrus Research International

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, chlorpyrifos or methomyl are possible options.

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 February. 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 is the only spray option for FCM permitted in all markets at this stage. A Cryptogran 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 Cryptogran 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 from those communicated in the Cutting Edge issues 26 and 27 in 2005. 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 LOAD & FRUIT QUALITY MANAGEMENT

(J.S. VERREYNNE, G.H. BARRY)

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 aalwurm 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.*

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 en tydelike vogstremming kan veroorsaak dat fosfonate swart kolletjies 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 'n nat najaar is moet die bome met of 'n fosfonaat, koper of mancozeb gespuit word om bruinvrot te beheer. Laasgenoemde twee middels is slegs voorkomend terwyl die fosfonate ook 'n korrektiewe werking het. Produsente het oor die algemeen 'n probleem om te weet wanneer hulle boorde onder vogstremming is en wanneer nie. Maak seker alvorens 'n bespuiting oorweeg word om enige fitotoksiese reaksie te voorkom.

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 fitotoksisiteit. Bly dus weg van fosfonate op Satsumas en ander sagtesitruskultivars wat gestres word om die interne kwaliteit te verhoog.

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 'n aalwurmdoder geregverdig is. Die drempelwaarde voordat 'n aalwurmdoder oorweeg word is 1000 wyfies/10 g wortels. Daar word aanbeveel dat aalwurmdodertoedienings in 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 nodig om 'n aalwurmbeheerprogram te volg. 'n Enkele aalwumdodertoediening is glad nie effektief 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 doders word dus belemmer indien hulle nie behoorlik deur die wortelsone versprei word nie.

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

GEÏNTEGREERDE BEMESTING

(J.G.K. COETZEE)

Bemestingsprogramme kan deesdae in drie hoofgroepe verdeel word. Aan die een kant is daar die ou benadering waar kunsmis gebruik word om die chemiese samestelling van die grond reg te stel en in die behoefte van die bome te voorsien. Aan die ander kant is daar die organiese benadering wat deesdae baie aandag geniet. Tussen hierdie twee pole is geïntegreerde bemesting wat van albei kante gebruik maak.

Elkeen van hierdie benaderings het voor- en nadele en dit is noodsaaklik om objektief daarna te kyk. In die volgende paragrawe word van die belangrikste voor- en nadele van die organiese en chemiese benaderings uitgelig.

Organic fertilisation

Advantages:

- Creates a heterogeneous microbial population that will suppress the development of a particular group that could be detrimental to the trees.
- Increases the presence of microbes that can fix nitrogen from the atmosphere as well as from inorganic sources and those that can release fixed elements like P and K. The fixed inorganic N is therefore protected against leaching.
- When mycorrhiza are present, the surface area of the roots can be expanded several times and absorption of P is enhanced.
- Improves the cation exchange (CEC) and water holding capa--city (WHC) of the soil to minimise losses through leaching.
- Improves the structure of the soil.
- Supply organic acids and other compounds that can stimulate root growth.

Disadvantages:

- Huge volumes are required to benefit from an increase in the CEC and WHC. To increase the carbon content of the soil by 0,2%, 4000 kg carbon is required per ha 15 cm deep. This could relate to more than 10 tons compost per ha.
- Annual applications are required to maintain the carbon level.
- Fixation of nitrogen also has a downside. If the fixation occurs when the plants need nitrogen, the plants will suffer, not the microbes.
- Microbes also release nitrogen and in most cases the release is not synchronised with the requirements of the trees. This process is governed by climate and the fruit producer has no control over it. This is the single most important disadvantage and is responsible for crop failures throughout the country.

Omdat die vrystelling van stikstof uit die organiese material in die grond, afhanklik is van temperatuur en vog, geskied dit enige tyd. Ondervinding leer egter dat die sterkste vrylating gewoonlik na Desember kom. Dit is egter ook die tyd dat die meeste vrugte soorte sensitief is vir ekstra stikstof. Die kwaliteit van sitrusvrugte word benadeel deur te veel stikstof vanaf Desember tot Julie. Die kwaliteit van ander vrugte soos mangos, avokado en neute word ook benadeel indien te veel stikstof in die rypwordingsfase teenwoordig is. Ongelukkig is die proses nie beheerbaar nie en loop ons die gevaar dat die kwaliteit kort-kort benadeel sal word.

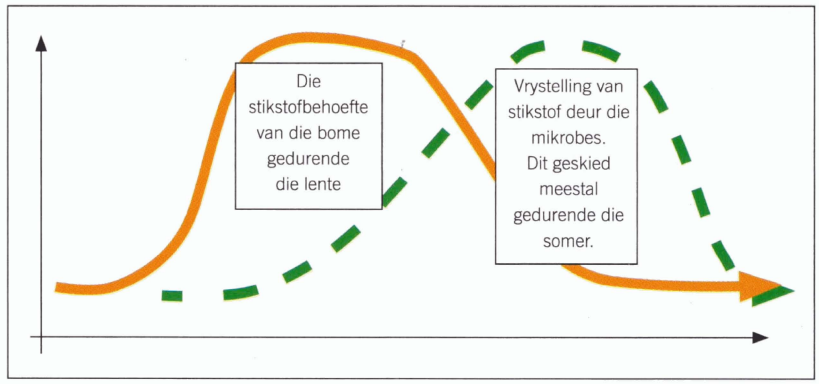
Chemiese bemesting

Voordele:

- Eenvoudig om 'n spesifieke tekort of wanbalans reg te stel. Toedienings van net een element is nodig.
- Die toegediende voedingselemente is meestal dadelik beskikbaar en min of geen verwerking is nodig nie.
- Die produkte is gewoonlik ook goedkoper as dieselfde massa voedingselemente in die organiese vorm.
- Hantering, vervoer en berging is goedkoper.
- Produkte is redelik algemeen beskikbaar.

Nadele:

- Die effektiwiteit van chemiese kunsmis is altyd minder as 100%



en by fosfate kan dit veel laer as 50% wees.

- Oordosering kan maklik plaasvind wat die bome beskadig en die omgewing besoedel.
- Verliese deur vervlugtiging, loging en vaslegging kan aansienlik wees wat die koste van chemiese bemesting verhoog.
- Indien eensydig met die klem op enkele elemente bemes word, ontwikkel wanbalanse wat ook die grond permanent kan beskadig.
- Soms word geen reaksie op toedienings van veral P en K verkry nie.

Wat is dus die antwoord?

Waarskynlik sal geïntegreerde bemesting meer sukses behaal as organiese of chemiese bemesting opsigself. Geïntegreerde bemesting benut die voordele van beide die organiese en chemiese benadering. Van die organiese voordele wat wel saam met die chemiese benadering benut kan word, is onder andere die volgende.

- Indien mikorrhiza gevestig kan word, kan die groot reserwes P in die grond benut word. Dit geld ook vir die vrystelling van K. Ons het egter nog nie die resep nie, tensy groot massa kompos toegedien word.
- Verbetering en instandhouding van die struktuur sal 'n groot bydrae tot die ekonomiese lewe van 'n boord kan maak.
- Stimulasie van die wortels met organiese sure gedurende kritieke tye kan die produksie verbeter.

Unfortunately most of these requirements and possible applications need basic research. The market is currently swamped with all sorts of microbial cultures, extracts and magical formulas and it is difficult to distinguish between 'snake oils' and those products with real potential.

However, whatever you do, remember trees and in fact all plants do not require organic material for optimal growth and production. Organic matter can, however, be used as another tool, like fertilizers and pesticides to manage problems in growing economic crops. Be careful not to accumulate too much organic nitrogen in the soil, especially soils containing more than 15% clay and more so for those in cool and moderate climates. Accumulation of organic nitrogen can be monitored as follows.

- Nitrogen balance sheet. Calculate the mass N removed by the crop and compare with the applied N. If the recovery by the crop is more than 90%, especially over 100% then the trees get nitrogen from an unknown and uncontrollable source. More often than not, from the organic pool.
- Compare the year on year leaf levels in relation to the application rate and crop size. An increase in leaf N without an increase in application rate or decrease in crop, is indicative of N from the organic pool.
- Analyse the soil to determine the total N, organic C and C:N ratio.

The nitrogen content of citrus trees can effectively be monitored by leaf analyses. The most appropriate time to do this is during February to May and even to July. Ensure that the correct leaf is sampled. If in doubt, contact Ilze at CAL on 012-305 5003.

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 is high.

Skirt sprays for brown rot control: Verwys na " *Grondgedraagde-siektes* " *(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 onreëlmatige 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 sanitisers in dump tanks, descaler water, rinses, etc.
- Spray the packhouse out with sanitisers 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 pathogens, *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

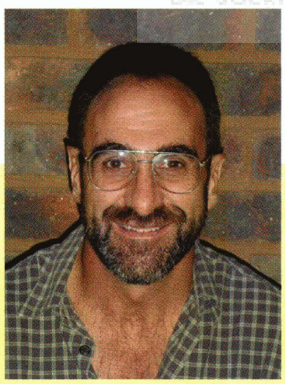
The South African grapefruit season, in the traditional production areas, extends from the middle of March to the end of June. The picking window for grapefruit is often manipulated in an attempt to access markets early or to extend the season. However,

Roy Fine of Afrifresh / Sunpride (right), visiting growers in Peru in Oct, to discuss co-operation in information and marketing. With them on the left is well-known consultant, Oscar Delgardo.

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.



Gerhard Pietersen re-appointed

Gerhard Pietersen, a researcher employed by Citrus Research International, has been re-appointed for a second term as an Extra-ordinary professor to the Department of Microbiology and Plant Pathology, University of Pretoria, in recognition of his services to the South African community in the field of plant virology.

Gerhard has a research programme at UP focusing on graft-transmissible diseases of citrus and viruses of grapevine.

The most important diseases studied by his group include citrus tristeza virus, the grapevine leafroll disease complex, and greening of citrus.

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 3 days 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.