



Citrus tristeza virus (CTV) **cross-protection of soft citrus** **– current status**

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Pre-immunisation for cross-protection

All citrus cultivars in the Southern African Citrus Improvement Scheme are freed from viruses by shoot-tip grafting. The abundance of the most effective aphid vector, *Toxoptera citricida* (Kirk.) will result in virus-free trees becoming naturally infected with various strains of *Citrus tristeza virus* (CTV) including virulent strains. It is therefore necessary to protect the virus-free plants from severe CTV strains by deliberately infecting them with mild strains. The interaction of mild CTV sources with regard to cross-protection is specific with regard to biological activity and therefore, mild CTV sources should be identified specifically for each citrus type.

Before virus-free budwood is included in the Citrus Foundation Block (CFB) for multiplication, the different citrus cultivars are pre-immunised with a specifically approved mild CTV source. From the pre-immunised budwood, mother trees are established in a psylla and black spot protected screen house from where budwood is multiplied for commercial nurseries. All the mother trees at the CFB are re-indexed annually to establish whether the pre-immunised source still contains mild CTV source.

The background to the problems encountered with the pre-immunisation of soft citrus types as well as the current status of the pre-immunisation of these cultivars, which include Satsuma, Clementine and Mandarin, are provided below.

Background on difficulties in pre-immunising soft citrus

Initially the GFMS 12 CTV source was used to pre-immunise all citrus cultivars (including soft citrus). A trial at Addo Research Station (ARC-ITSC) was conducted to identify a suitable CTV source for Clementine. It was found that 5-year-old 'Marisol' Clementine trees with GFMS 12 or LMS 6 (derived from 'Mexican' lime) CTV sources produced the best, averaging 17%

better than trees that were planted virus-free. The LMS 6 source was preferred for pre-immunisation since it contained the 'Seedling Yellows' component of CTV, which the GFMS 12 source lacked and consequently in the late 1990s LMS 6 replaced GFMS 12 for cross protection of soft citrus cultivars.

During re-indexing from 2003 to 2006, it was found that some Clementine and Mandarin mother trees at the CFB were free of CTV, despite having previously been pre-immunised with the LMS 6 mild CTV source. This caused some concern since the budwood that was multiplied from these mother trees and supplied to the commercial nurseries was virus-free and therefore the trees would be unprotected against natural CTV infection with severe strains by aphids. This also resulted in delays in the release of soft citrus type budwood after shoot tip grafting: when budwood from virus-free new cultivars is multiplied from positively pre-immunised plants, the progeny tested negative with ELISA, which meant that the budwood could not be released and pre-immunisation had to be repeated.

Current status

At the 5th Meeting of the southern African Citrus Improvement Scheme Advisory Committee in August 2006, it was recommended that another CTV source that is compatible with soft citrus types should be investigated. Currently, a glasshouse trial is being conducted to evaluate additional CTV sources. This will take a year before a field trial can be initiated which in turn will take at least 8 years for conclusive results. Therefore, it was agreed at the 6th meeting of the Advisory Committee that the GFMS 12 CTV source should be re-introduced as the pre-immunising source until a new suitable CTV source for soft citrus has been identified; with the understanding that a severe CTV strain is present in the GFMS 12 source and that it may become dominant under certain climatic or horticultural conditions. This is, however, a better option than planting the trees virus-free.

It is necessary to inform growers and nurseries of this situation so that they can be particularly vigilant in their aphid control programmes. Protective insecticidal sprays during growth phases of these trees are recommended. This will reduce aphid population, the rate of natural infection of trees with severe CTV strains and



Cutting Edge

RESEARCH NEWS FROM CITRUS RESEARCH INTERNATIONAL

May 2009

No 85

therewith prolong the commercial lifespan of these orchards.

Aphid control

Aphids are attracted to new growth and will only need to be controlled on mature trees when the growth flushes occur. On young trees with almost constant growth, control measures will have to be applied more frequently. Four aphid species occur on citrus in South Africa but *Toxoptera citricida* mentioned above is the most common. This aphid is known as the black aphid here but is called the brown aphid in the USA. It is easily controlled with many plant protection products used to protect new growth from other pests, such as psylla and thrips (excluding baits). For non-bearing trees, systemic products applied to the stem or soil will be the most effective means of controlling aphids. Products that can be used in this way include Confidor, Mospilan, Citrimet, Temik and Rogor. These products can also be used on bearing trees but long pre-harvest intervals are associated with all options except Citrimet. Aphids on bearing trees can be sprayed with Aphox or Phosdrin without much disruption of natural enemies. Organophosphates used for the control of thrips or mealybug will also control aphids, as will endosulfan and Lannate. However, pre-harvest intervals may again limit their usage between November and harvest.

These comments on plant protection products apply to all aphids except the cotton aphid *Aphis gossypii*, which sometimes occurs in citrus, particularly if vegetables are grown in the area. This aphid is dark grey as an adult but the immature life stages start off light green. It is not an efficient vector of viruses but can still transmit them to a degree. It is usually resistant to organophosphates and may be tolerant to carbamates as well, which would mean that both Aphox and Phosdrin sprays, Citrimet stem treatments and Temik and Rogor soil treatments are ineffective.



***Citrus tristeza virus (CTV)* kruisbeskerming van sagtesitrus – huidige status**

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Pre-immunisasie vir kruisbeskerming

Alle sitruskultivars in die Suidelike Afrikaanse Sitrusverbeteringskema word deur groeipunt-enting van virusse vrygemaak. Die algemene voorkoms van die mees effektiewe plantluisvektor, *Toxoptera citricida* (Kirk.), het tot gevolg dat virusvrye bome natuurlik deur verskeie rasse van *Citrus tristeza virus* (CTV) geïnfekteer word, insluitende virulente rasse. Dit is dus noodsaaklik dat virusvrye plante teen strawwe CTV rasse beskerm moet word deur hulle opsetlik met ligte rasse te infekteer. Die interaksie van ligte CTV bronne met betrekking tot kruisbeskerming is spesifiek met betrekking tot biologiese aktiwiteit, gevolglik moet ligte CTV bronne spesifiek vir elke sitrustipe geïdentifiseer word.

Voordat virusvrye enthout vir vermeerdering by die Sitrus Grondvesblok (SGB) ingesluit word, word die verskillende sitruskultivars met 'n spesifiek goedgekeurde ligte CTV bron vooraf gepre-immuniseer. Vanaf die vooraf gepre-immuniseerde enthout, word moederbome in 'n sitrus bladvloei en swartvlek beskermdde tonnel gevestig, vanwaar enthout vir kommersiële kwekerie vermeerder word. Alle moederbome in die SGB word jaarliks weer geïndekseer ten einde vas te stel of die vooraf gepre-immuniseerde enthout bron steeds die ligte CTV bron bevat.

Die agtergrond tot die probleme wat teëgekomp word met die pre-immunisasie van sagtesitrus-tipes, asook die huidige status van pre-immunisasie van hierdie kultivars, wat satsuma, clementine en mandaryne insluit, word hieronder verskaf.

Agtergrond oor struikelblokke in pre-immunisasie van sagtesitrus

Aanvanklik is die GFMS 12 CTV bron gebruik om alle sitruskultivars (insluitende sagtesitrus) te pre-immuniseer. 'n Proef is by Addo Navorsingsstasie (LNR-ITSG) uitgevoer ten

einde 'n geskikte CTV bron vir Clementine te identifiseer. Daar is gevind dat 5-jaar-oue 'Marisol' Clementine bome met GFMS 12 of LMS 6 (afkomstig van 'Meksikaanse' lemmetjie) CTV bronne die beste geproduseer het, met 'n gemiddelde van 17% beter as bome wat virusvry geplant is. Die LMS 6 bron is vir pre-immunisasie verkies aangesien dit die 'Saailing Vergeling' komponent van CTV bevat, wat in die GFMS 12 bron ontbreek. LMS 6 het gevolglik in die laat 1990s GFMS 12 vir kruisbeskerming van sagtesitruskultivars vervang.

Gedurende die her-indeksering vanaf 2003 tot 2006, is gevind dat sommige Clementine en Mandaryn moederbome in die SGB vry van CTV was, ten spyte daarvan dat hulle vooraf met die LMS 6 ligte CTV bron gepre-immuniseer is. Dit het kommer gewek aangesien die enthout, wat vanaf hierdie moederbome vermeerder is en aan kommersiële kwekerie verskaf is, virusvry was en gevolglik sou die bome onbeskermd teen natuurlike CTV infeksie deur plantluiste met strawwe rasse wees. Dit het ook tot vertraging in die vrystelling van sagtesitrus-tipe enthout, ná groeipunt-enting, gelei: wanneer enthout van virusbevryde nuwe kultivars van vooraf gepre-immuniseerde plante vermeerder word, het die vermeerderings negatief met ELISA getoets, wat beteken het dat die enthout nie vrygestel kon word nie, en pre-immunisasie herhaal moes word.

Huidige status

Tydens die 5de Vergadering van die Suidelike Afrikaanse Sitrusverbeteringskema Advieskomitee in Augustus 2006, is voorgestel dat 'n ander CTV bron wat met sagtesitrus-tipes verenigbaar is, ondersoek word. Tans word 'n glashuisproef uitgevoer ten einde bykomende CTV bronne te evalueer. Dit sal 'n jaar neem voordat 'n veldproef kan begin, wat op sy beurt ten minste 8 jaar sal neem om oortuigende resultate te lewer. Daar is dus by die 6de Vergadering van die Advieskomitee besluit dat die GFMS 12 CTV bron her-ingestel word as die pre-immunisasie bron totdat 'n nuwe geskikte CTV bron vir sagtesitrus geïdentifiseer word, met die wete dat 'n ernstige CTV ras in die GFMS 12 bron teenwoordig is, en dit onder sekere klimaatstoestande of tuinboukundige toestande dominant kan word. Dit is egter 'n beter opsie as om die bome virusvry te plant.



Dit is nodig om produsente en kwekerie oor hierdie situasie in te lig sodat hulle veral versigtig in hul plantluis beheerprogramme kan wees. Beskermende insekdoderbespuitings word gedurende groeifases van bome aanbeveel. Dit sal die plantluisbevolking verminder, asook die tempo van natuurlike infeksie van bome met ernstige CTV rasse, en daardeur die kommersiële lewensduurte van boorde te verleng.

Plantluisbeheer

Plantluis word deur nuwe groei aangetrek en moet slegs op volwasse bome beheer word wanneer die groeistuwings voorkom. Op jong bome, met amper konstante groei, moet beheermaatreëls meer gereeld toegepas word. Vier plantluis spesies kom op sitrus in Suid-Afrika voor, maar *Toxoptera citricida* wat bo genoem is, is die algemeenste. Dié plantluis staan hier as die swart plantluis bekend, maar word in die V.S.A. die bruin plantluis genoem. Dit word maklik met baie plantbeskermende produkte beheer wat gebruik word om nuwe groei teen ander peste soos psilla en blaaspootjies (uitsluitend lokase) te beskerm. Vir nie-draende bome, sal sistemiese produkte wat aan die stam of grond toegedien word, die mees effektiewe manier wees om plantluis te beheer. Produkte wat op die manier gebruik kan word, sluit Confidor, Mospilan, Citrimet, Temik en Rogor in. Hierdie produkte kan ook op draende

bome gebruik word, maar lang voor-oes intervale word met alle opsies geassosieer, uitsluitend Citrimet. Plantluis op draende bome kan met Aphox of Phosdrin gespuit word, sonder hewige steuring van natuurlike vyande. Organofosfate wat vir die beheer van plantluis of wolluis gebruik word, sal ook plantluis beheer, so ook endosulfan en Lannate. Voor-oes intervale sal egter hul gebruik tussen November en oes beperk.

Hierdie opmerkings oor plantbeskermingsprodukte is op alle plantluis van toepassing, behalwe die katoen plantluis, *Aphis gossypii*, wat soms in sitrus voorkom, veral indien groente in die omgewing verbou word. Hierdie plantluis is donkergrys as volwassene maar die onvolwasse lewensfasies begin liggroen. Dit is nie 'n doeltreffende vektor van virusse nie, maar kan hul steeds in 'n mate oordra. Dit is normaalweg weerstandbiedend teen organofosfate en kan ook teen karbamate bestand wees, wat sal beteken dat beide Aphox en Phosdrin spuite, Citrimet stambehandelings en Temik en Rogor grondbehandelings ondoeltreffend sal wees.