12th CRI Research SYMPOSIUM

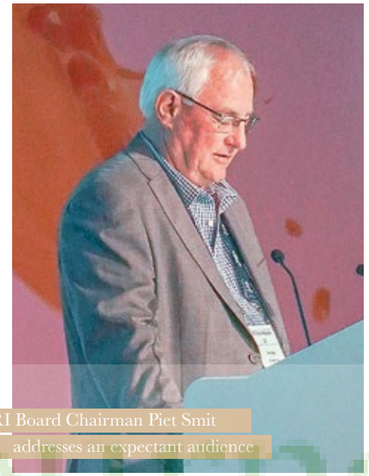
This year the Citrus Research Symposium drew 850 delegates, comprising various local and international industry stakeholders. By **Coenraad Fraenkel**

Once again, the biannual CRI Citrus Research Symposium was hosted at Champagne Sports Resort from 18–21 August 2024. It kicked off with an introductory session by world-class speakers, focusing on the impact of research on market access, market retention and market optimisation. Also under the spotlight were the current EU phytosanitary regulatory environment, and lessons learned in HLB management in California.

Highlights from the various sessions

HLB and biosecurity

- Dr Marcelo de Miranda (Fundecitrus – Brazil) presented the status of Asian Citrus Psyllid (ACP) control in Brazil – ACP spreads the bacteria that causes the feared Huanglongbing (HLB) disease. Unprecedented peaks in ACP numbers were recently observed and attributed in part, to loss of chemical control due to insecticide resistance and loss of certain active ingredients. Orchards that adopted an appropriate rotation of insecticides showed better reduction in ACP populations. Interestingly, "hot" psyllids carrying the HLB bacteria were more active. Thus, HLB also spread faster. The integration of various control measures is important for effective ACP management – importantly, the coordination of insecticide sprays on an area-wide basis.
- Tshepang Makitla gave feedback on the area-wide management project of the African Citrus Greening vector, *Trioza erytreae*, in Buffeljagsrivier and the efficacy of reducing greening inoculum by the removal of infected trees, for example. Currently, growers mainly rely on chemical methods to control *T. erytreae*.
- Dr Evans Mauda from CRI presented on the complexity of the identification of *Trioza* and *Diaphorina* species in SA, due to the vast psyllid diversity. CRI monitors psylla in citrus orchards, at border locations and in neighbouring countries, as early warnings for the presence of the HLB vector, *Diaphorina citri* (ACP), which has not yet been found in Southern Africa. However, some indigenous *Diaphorina* species have a very close morphology to *D. citri*, and must be differentiated by expert entomologists or through molecular methods. The diversity in *Trioza* species, some resembling *T. erytreae*, the African Greening vector, is also being studied.
- CRI tests the trapped psylloids for the presence of the bacteria that cause HLB or African Greening. However, a complex of Liberibacter species occur in indigenous bush in Southern Africa – many of them subspecies of *Liberibacter africanus*, the African Greening pathogen. These subspecies may cause false positive results in tests for the HLB Liberibacters. Dr Glynnis Cook presented on this research and the integrated PCR assay approach that is currently used to be able to distinguish the different pathogens.
- The top 10 biosecurity threats to the Southern African citrus industry were identified. Dr Elma Carstens gave an overview of these threats, and highlighted the importance of not bringing illegal citrus plant material/fruit into Southern Africa.
- HLB has been reported in Ethiopia and Kenya and ACP, *Diaphorina citri*, its primary vector, is reported in Kenya, Tanzania, Ethiopia, Nigeria and Benin. Surveys are being conducted in various African countries to track the movement of HLB and ACP with the aim of establishing regular and sustained monitoring. Wayne Kirkman gave an update on the status of these activities.
- Dr Paul Fourie concluded the Citrus Biosecurity session with a reality check: is SA ready for the HLB threat? SA has a comprehensive HLB Action Plan, which has been adopted by government and relevant stakeholders. A CRI scenario planning exercise tested the feasibility of the Action Plan and found that control measures in urban areas would not be feasible. The Plan will be updated to focus response actions on containment in urban areas, and eradication and containment – on an area-wide basis – in commercial citrus production areas.



CRI Board Chairman Piet Smit addresses an expectant audience

Dr Vaughan Hattingh (right) presents Dr Tim Grout with the CRI Technical Merit Award

Integrated pest management (IPM): false codling moth (FCM)

- Volatiles from the fruit of different cultivars that attract FCM are being identified to improve management strategies.
- The simultaneous release of sterile moths in an SIT programme and FCM egg parasitoids, is a viable strategy.
- A vision system and software are being developed to measure turgidity and flaccidness of larvae surviving cold treatment as a predictor of possible continued survival or imminent death.
- There is room for improvement in Packhouse Delivery Inspections (PDI).
- The identification of various bat species feeding on FCM in the far northern parts of SA is being investigated.
- An earlier initiation of FCM mating disruption in the warm northern citrus production areas should be considered to suppress the first FCM generation and to protect late maturing Valencias.
- A practical demonstration was given on the possible use of canines for postharvest detection of FCM-infested fruit.

Shannon Goodchild receives the Student/Poster Award from Dr Tim Grout

IPM: Fruit fly

- No fruit fly risk in commercial export grade lemon and no/low FF risk in commercial export grade oranges.
- Protein baits are used to mitigate fruit fly risk. Response to protein baits is more effective when applied in mid-upper canopy and at high density.
- Adherence to existing trap thresholds in citrus is strongly associated with a low risk of fruit fly infestation. These thresholds could be used to demarcate areas of low fruit fly prevalence in citrus environments.
- The Western, Eastern and Northern Cape can be listed as pest-free areas for Natal Fly.
- The systems approach was found to be effective in the management of fruit fly and can be proposed for other markets.
- Cold treatments provide support to shipping options in the systems approach for fruit fly.
- An interruption reaching 4°C above the upper threshold for a cold treatment for Medfly at 0.9 °C, does not result in large numbers of survivors that would warrant the cold treatment being extended.

IPM: other pests

- There is a large number and diversity of predatory mites even in sprayed orchards. These should be conserved to maximise their control of thrips and pest mites.
- The biology, behaviour, biocontrol and monitoring of the fruit piercing moth have been investigated to assist in developing management strategies.
- Augmentative parasitoid releases of *Aphytis melinus* did not improve the control of red scale, most likely due to the extreme efficacy of the naturally occurring *Aphytis africanus*.
- Biocontrol of mealybug is mostly effective, but can be undermined by ants, hyperparasitism or mealybug species composition.
- Various postharvest treatments for mealybug were explored. From this study the most effective treatment was sulphur dioxide fumigation at a dosage of 1 100 ppm for 24 hours, which resulted in a 99.61% mortality.

Citriculture: production and quality

- To reduce the incidence of oleocellosis at harvest, monitoring the Rind Oil Release Pressure (RORP) is required. The 3 kg threshold indicates that less fruit will develop symptoms of oleocellosis. But careful handling and drier soils should always be the two things to keep in mind, specifically for orchards under shade netting.
- The use of uniconazole at the colour break of Nadorcott was investigated. The increase in carotenoid synthesis and chlorophyll degradation could result in earlier harvests in regions or growing seasons with warm evening temperatures during autumn and winter.
- A novel technique to quantify fruit firmness indicated possible trends when compared to other maturity indicators, like rind disorders and weight loss. Thus, if required by industry, it might be developed to help indicate citrus fruit rind quality.
- No differences were observed in plant physiological measurements, yield, or quality, indicating that all treatments were well-watered and that low-flow drip irrigation is an effective and viable option for citrus irrigation.
- A method to normalise crop water productivity across regions was proposed to allow fair comparisons across regions with different annual rainfall and evaporative demands.
- Large variation in nutrient use efficiency (NUE) was found between orchards, even for similar irrigation-fertilisation practices. NUE is determined by the N-fertilisation rate and yield. If the NUE is higher than the regional norm, fertilisation rates need to be evaluated.

Citriculture: rind condition and cold chain

- A longer period of degreening of citrus fruit does not improve the effective colouring of citrus rinds – improvements to the process might reduce the cost of degreening.
- Improved pallet designs significantly outperformed original designs in mechanical performance, without increasing costs.
- Computational fluid dynamic models with experiments to validate them, together with the development of digital twins, could help improve the cooling dynamics and minimise the loss of fruit quality.
- The stability of a stacked pallet is key, and the stack configuration significantly impacts the carton.

Citriculture: cultivar and rootstock evaluation

- Dr Kim Bowman of the USDA, Fort Pierce, Florida, provided feedback on the performance of various rootstocks in their breeding programme, as well as the focus on HLB tolerance.
- The results of the EEAOC (Tucuman) rootstocks for lemon production in warm inland production regions were shared.
- Grapefruit production in the semi-desert production area was evaluated on various rootstocks.
- Prof Jude Grosser (University of Florida, CREC Lake Alfred) provided information on their rootstock and cultivar breeding programme, including opportunities and challenges posed by HLB.

Luke Cousin (right) with his Best Presenter Award, presented by Dr Tim Grout

An eye-catching citrus display

Disease management: graft transmissible disease and the Citrus Improvement Scheme (CIS)

- An overview was shared of current international research efforts aimed at combating HLB. These ranged from high-risk, innovative "blue-sky" projects to practical tools that can be used in orchards.
- Shoot tip grafting has been used by the Citrus Improvement Scheme (CIS) for many years. But recent upgrades to the glasshouse facilities and the installation of additional lighting has improved symptom expression during indexing. This will increase the future release of new cultivars.
- A combined viroid treatment has an early effect on yield and tree size reduction. This is the second field trial that indicates that Carizzo citrange is sensitive to viroids.
- Super-infection exclusion might provide a level of symptom modulation, but not complete protection. Other factors might have improved the grapefruit production since the application of cross-protection.
- Data for Citrus Liberibacter screening from African Citrus triozid (ACT) for various trapping regions of SA (2020-24) was presented. *Liberibacter asiaticus* (CLas) has not been detected in SA, but *Liberibacter africanus* (CLaf) is widely distributed in SA.

Disease management: post harvest

- An integrated approach is required to ensure and manage optimum fruit quality and shelf life. This includes optimal picking windows, timely and optimal fungicide treatments, optimal fruit washing, wax application, fruit grading, cold storage and packaging designs.
- On all fruit types good control of Phytophthora brown rot was obtained when treated with the sanitisers E402 and clove oil at 24 or 48 hours post inoculation. Combination treatments had more control over time vs. individual treatments.
- Ortho-phenyl phenol and pyrimethanil applied at lower concentrations with potassium sorbate formulations significantly increased sour rot control, compared to when these synthetics were applied alone at registered dosages.
- Potassium sorbate-based postharvest product can increase sour rot control when added to the drench as an additional active or when added to the Imazalil-fungicide bath with Thiabendazole (TBZ).
- Green mould disease caused by *Pencillium digitatum* is responsible for substantial losses in the industry. It is currently treated with the use of Imazalil fungicide. However, mandarins have varying results. Currently underway is a study whereby compounds are extracted from the mandarin rind to gain better understanding of the reasons.
- Available actives are effective against green mould control. But we are at risk with low residues. Thus, a focus on precision applications is necessary.
- *Cladosporium* and *Ulocladium*, fungi associated with stem-end moulds, enjoy wet conditions. The fungi associated with stem end moulds are not equally sensitive to postharvest fungicides. Various trials are underway investigating the combination of products to be used, the application period and intervals, as well as the effect of fruit respiration (e.g., degreening).

Disease management: fruit, foliar and CBS

- CBS control should not rely on one management strategy but rather be focused on an integrated approach, where fungicide sprays are used in conjunction with inoculum management practices such as leaf litter removal.
- A risk matrix to determine *Phyllosticta citricarpa* risk in orchards will be a valuable tool for CBS risk identification.
- Bioactive compounds with antifungal activity against *P. citricarpa* could lead to the development of environmentally friendly, natural fungicides and assist with cultivating citrus fruit without synthetic fungicides.
- Pre-harvest application of specific fungicides, as well as cultural practices to reduce inoculum sources and limit wounds in orchards, could aid to control latent *Colletotrichum spp.* infections and prevent postharvest decay. All the registered products are effective when used at the recommended dose.
- Alternaria brown spot (ABS) had a significantly higher fruit and tree incidence under shade netting than in open orchards. There were no significant differences between Alternaria core rot (ACR) disease tree and fruit incidence for orchards with or without shade netting.
- Adequate sanitation practices are critical to prevent severe ABS and ACR in orchards since symptomatic and asymptomatic plant material can act as an inoculum source for both diseases.
- Potassium phosphite can be applied at lower, tree row volume (TRV) – based spray volumes, 21 days prior to rain to effectively control Phytophthora brown rot.
- The South African *P. nicotianae* population is sensitive to novel oomycides. Once registered, these new fungicides will provide alternatives to mefenoxam for the control of Phytophthora root rot.
- Resistance management strategies for the control of *Phytophthora nicotianae* such as the use of other oomycides in rotation or mixtures with phosphonates are recommended.
- Phosphonate applications should be done 21–28 days before harvest to achieve the highest residue in the fruit, which will, in turn, provide effective brown rot control.
- Valuable insights were shared on the mefenoxam sensitivity in *Phytophthora spp.* which can be used to develop diagnostic tools to monitor mefenoxam.
- Resistance in *Phytophthora* citrus pathogens:
  - The presence of *Phytophthora nicotianae* inocula retrieved from various sources in all nurseries sampled, indicate that management strategies should be applied diligently to prevent the spread of inoculum and tree infection.

SA has a comprehensive HLB Action Plan, which has been adopted by government and relevant stakeholders.

Recognition awards

- **The CRI Technical Merit Award** was presented to Dr Tim Grout for his outstanding contribution to the Southern African citrus industry over the years.
- **The Best Student/Poster Award** was awarded to Shannon Goodchild.
- **The Best Presenter Award** was awarded to Luke Cousins.