fresh NOTES
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Ceres Crop Protection Seminar 2014

About 150 growers, scientists, technical advisors and industry role players gathered in Ceres last Wednesday to attend the annual HORTGRO Science Crop Protection Seminar – discussing latest research trends and industry issues relating to the effective and sustainable management of pests and diseases.

Even with the use of pesticides and other modern methods of crop protection, around one third of food production is globally lost to pests, making it the number one headache of fruit growers.

Fruit fly, apple scab, grain chinch bug, nematodes, mites and the value of plant resistance inducers were unpacked and discussed by different experts.

“We need an integrated approach to improve pest management and improve the use of biological control agents,” said Matthew Addison, HORTGRO Science Crop Protection Manager and US researcher.

“If we want to succeed in our goals: improve production, secure market access, reduce pests and diseases and maintain a healthy eco-system everybody has to join in and help monitor and control outbreaks in order to manage it.”

“We need to do more research and we need more funding. We are lagging behind when we compare ourselves

with researchers from other countries. South Africa has a unique eco-system with unique challenges. We have to find local bio-control agents, before we start looking for solutions from abroad."

Nando Baard from FruitFly Africa

Fruit Fly

Nando Baard, from FruitFly Africa, said other countries zealously watch for possible outbreaks of exotic fruit flies and are not shy to spend millions when they become aware of possible incursions. "When New Zealand discovered just one exotic fruit fly immediate measures were put in place and more than R8 million were spent to control a possible outbreak."

The situation in South Africa is one that we have to watch and monitor very carefully. Currently we have *Bactrocera invadens* in the Limpopo, but there is a real danger that it ends up in the South Western Cape.

"Our worse-case scenario is the closure of current and new markets. It could cost the industry billions."

Nando explained different strategies that are in place to control the pest: suppression, sanitation, baiting and chemical control.

“If we want to control it successfully we need area-wide management of the population; look at alternative hosts and effectively apply an integrated management strategy.

“The time for free-riders has passed. The more everybody participates and helps with monitoring and applying the correct measures – the better it will be collectively for everyone.”

Apple Scab

Bekker Wessels, from ProCrop, highlighted the importance of understanding a disease in order to treat it.

“Apple scab is no stranger to the Western Cape. If you don’t want to start the season with leaf infection, you have to keep your orchards clean, know seasonal differences, have a game plan, watch the weather and make sure that your equipment is correct and in good order.

“The first step in calibration is to determine the correct nozzle type, nozzle settings and speed, and adapt your applications for your specific orchard conditions.”

According to Bekker, to effectively control apple scab the timing of the sprays is everything. “If you sprayed preventatively and it is followed by adverse weather conditions such as rain, you have to spray again - otherwise you are going to have problems.”

Grain Chinch Bug

Grain Chinch Bug, a phytosanitary pest that is endemic to the Western Cape and acts like a hitch-hiker contaminating fruit has been a problem for many years said **Dr Shelley Johnson**, US Entomologist and researcher, unpacking the current status of this pest.

"There is little basic information on the biology of the pest, which hampers the development of control measures, but yes we can control this pest by reducing interceptions on export fruit and thus reducing the chance of infestation in the orchard and packhouse."

Shelley gave an update of current research that is investigating chemical ecology and thermal biology of the bug. "In order to manage the pest we have to understand the lifecycle of this bug and actively reduce the chances of infestation and apply good agricultural practices."

The source of grain chinch bugs is wheat/oats/barley fields and other wild grasses growing in or near orchards. Aestivating bugs, that is bugs going into summer dormancy, are looking for places to shelter, especially under the bark of blue gum trees.

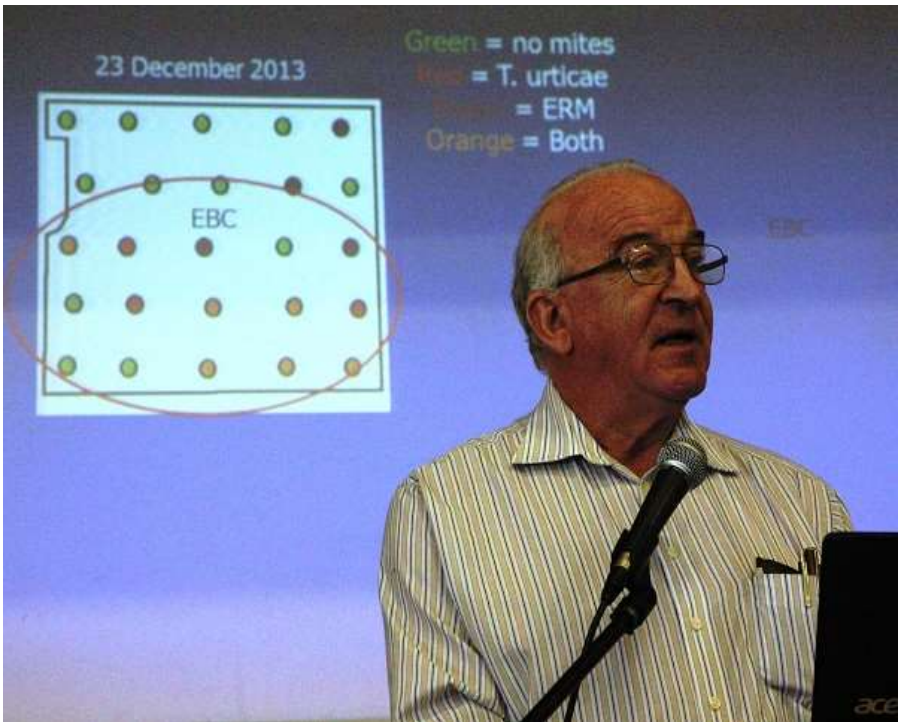
Strategy

- Monitor orchards and inspect fruit to identify problem orchards.
- Avoid using fruit from these orchards (in close proximity to wheat fields or blue gum trees) for export to sensitive markets
- Cut any grass in the orchards.
- Bins should not be stacked near wheat fields or blue gum trees.
- Bins containing fruit should be covered with a tarpaulin, while stacked on the premises and during transport.
- Blue gum trees in the vicinity of orchards and packhouses should preferably be removed.

Shelley also warned that grain chinch bug can enter packhouses. “Be on the look-out for loose corrugated cardboard near doors that can be used to trap bugs. Packaging material should not be stored near doors and should be covered and fruit should be inspected in the packhouses.”

Mites on Pears

If you want to manage mites on pears, two things are vital: monitoring and keeping to treatment thresholds.



This was the crux of the message delivered by **Dr Ken Pringle,** well-known US mite expert who presented research done by his colleague, **Dr Juanita Heunis**.

In the monitoring process we need to identify the pest mites and see if predatory mites are present, but when we look at pears we also need to take weather conditions into account. Is it for instance hot, dry and windy as this could in combination with mite infestation lead to problems with leaf scorching.

"It is more difficult to control mites on pears as pears are more sensitive to mite damage than apples. But effective monitoring reduces unnecessary spraying and limits the development of resistance to miticides. We have the ability to biologically control pest mites. Once infestation crosses the threshold, you have to determine the correct timing for spraying in order to limit leaf scorching and leaf drop."

In a research project conducted by Juanita a sensitivity index was constructed for four well-known pear cultivars. The cultivars were rated from very to less sensitive, they were: Comice, Bosc, Bon Chretien (Bartlett) and Packham's.

The following was found:

1. Where there was scorching it started at the same time in every case – and the question was asked whether this was related to the weather?
2. Threshold seems to be between 0.5 and 1 two-spotted mites per leaf in Ceres. And the scientists need to do more work here.
3. Apply herbicides early.
4. Biological control is possible on pears in Ceres. But, do not spray too early – as this removes the food for the predacious mites.

5. Limit the number of miticides applied - as over-application will lead to resistance.

Weather

Juanita found that when weather conditions were taken into account and there was light to moderate heat and water stress, it did not lead to scorch leaf. But when you add mites to the equation it could result in leaf scorch.

Conversely the same is true of light to moderate mite infestation. Mites alone will not lead to leaf scorch, but when you add heat and water stress, the result will be leaf scorch.

Lastly, Ken warned growers that they should correctly manage plants on the orchard floor.

He again emphasized the importance of the Monitoring System and the use of predatory mites as a biological control agent:

- Identify 25 evenly spaced trees in 2ha blocks
- Examine one leaf from the inside and one leaf from the outside for the number of adult phytophagous and predatory mites.

EPNs

There is great excitement and anticipation around Entomopathogenic Nematodes (EPNs) as bio-control agents of orchard pests and **Dr Antoinette Malan**, research entomologist from the US, is at the forefront of this ground-breaking research - although it has only been studied in South Africa since 2002.

Nematodes are among the most ubiquitous organisms on earth, as they virtually occur in every possible environment, either as free-living nematodes or as parasites of vertebrates and invertebrates. Antoinette explained that there are many different kinds of nematodes, but the ones creating the buzz are the insect-parasitic/Entomopathogenic nematodes (EPNs for short).

She explained the life-cycle of this very clever little animal: Once it has found a host, it can grow from not being visible to the human eye to 9 mm within a couple of days. Once in the soil they find possible insect hosts by feeling vibrations or by recognizing CO^2 secretion. When they enter the host they spit out the bacteria that they carry with them and start feeding off the dead insect. Once their food source is depleted, they will enter the soil again - carrying the bacteria with them - and start scouting for their next victim."

According to Antoinette there are more or less a hundred EPN species worldwide with a total of 24 EPN species on the African continent - of which 12 are new. In South Africa 6 new species have been described.

So what are the implications for growers? Currently scientists are investigating the application of EPNs to the soil and directly onto trees.

About orchard application, you should know the following:

- EPNs cannot be treated the same as a chemical application – “they are little animals” and are highly sensitive to environmental conditions.
- Knowledge of handling nematodes is imperative for their success – “especially a full understanding of their life cycle”.
- There are major difference between aerial and soil applications.
- Ecological research in the field did not keep pace with the potential use of EPNs outdoors; and possible problems are foreseen when applied in “open conditions”.
- Currently large field trials in SA are only possible with imported formulated nematodes.

Dr Antoinette Malan explaining the finer workings of EPNs

Antoinette’s research has focused on the control of soil-borne insects, like the banded fruit weevil and false codling moth larvae.

In terms of the **Banded Fruit Weevil**, the following were found:

- Currently artificially cultured weevils are needed for screening, which is a drawback.
- It shows great potential for control using EPNs.
- In laboratory trials some resistance by the insect to EPNs was shown.
- Double nematode concentration might be needed.
- It has the potential to be the ideal solution.
- All the stages of the insect are susceptible: pupae, larvae and emerging adults.
- The soil stage can be very long – and from that perspective there is a long window of opportunity.
- Scientists are working on large field application and long term monitoring.

For **False Codling Moth** the following emerged:

- Most EPN species gave excellent control.
- Field trials showed high level of infectivity.
- Persistence is a big plus for soil application.
- Industries approve the import of *H. bacteriophora* for large field trials.
- Currently variable results were obtained with regard to efficacy.

Nematodes infecting a False Codling Moth larvae

Aerial Applications

EPNS could also be applied directly to orchard trees, although certain considerations apply:

- Insects such as codling moth and mealybugs are highly susceptible.
- There is only a short window period for application.
- Temperature and humidity remain the main problems – as trees must stay wet before and after application.

Secret Technology

Currently EPN's can be produced *in vivo* (in live insects) or *in vitro* (artificially in large containers), and there are challenges with both processes, but the real challenge lies in the formulation used – which at this stage is secret technology.

The formulation of nematodes refers to the methods used once the EPNs have been produced. The major goals of a nematode formulation include maintenance of quality, enhancement of storage stability, ease of transport, and reduction of transport costs.

The nematodes in the formulation can be actively moving, of reduced mobility, or in a partial anhydrobiotic state. The main impediment of moist formulations is that they need to be kept refrigerated, as the nematodes tend to migrate out of the

formulation. Immobilisation or partial desiccation of nematodes has been employed in formulations to obtain a longer shelf-life.

As different species of nematodes have different requirements for moisture and oxygen, it is not possible to use the same formulation for all nematodes. One of the best formulations is water dispersible granules that have been developed for steinernematids. It combines relatively long nematode shelf-life without refrigeration. Before and after formulation it is important that the quality of the nematodes should be checked.

- Addition of a non-active substance
- Storage ability, ease of transport
- Moist formulations needs to be kept refrigerated
- Needs to be checked for quality before and after use

What other spin-offs could the industry expect in terms of EPN applications?

- 50% reduction in a given pest population would be adequate
- Elimination of pest individuals with possible chemical resistance
- Window period for control for soil pest – no chemicals are being used
- Seeding of orchard soil with nematodes
- Secondary control against soil stages, such as fruitfly

In conclusion Antoinette explained that all endemic species are highly infective and that even at very low temperatures nematodes are active. More than one application per year will be necessary and inconsistencies with field control of EPNs need to be resolved. More research is urgently needed to study field application and the efficacy under different environmental conditions.

GEÏNDUSEERDE WEERSTAND IN PLANTE

Plante het net soos mense gesofistikeerde stelsels om hulself teen siektes te beskerm.

Die doeltreffendheid van hierdie weerstand teen siektes, oftewel patogene, hang grotendeel van spoed af: hoe vinniger ‘n plant die aanvaller herken, hoe meer effektief is sy verdediging.

Hoe hierdie prosesse binne die plant werk en hoe mens hierdie “weerstandigheid” kunsmatig kan aanskakel en verbeter – is ‘n proses wat bekend staan as geïnduseerde weerstandigheid, sê **dr. Adéle McLeod**, plantpatoloog van die US.

Geïnduseerde weerstandigheid is ‘n aantreklike en volhoubare alternatief tot gewone chemiese beheer van plae en siektes en ‘n studieveld wat baie belangstelling lok. Tans is daar verskeie produkte in Suid Afrika beskikbaar, wat plantweerstandigheid kan aktiveer.

Die kunsmatige “aanskakel” van die plant se weerstandsreaksie kan wees óf direk na die aktiveerder herken is, of dit kan “primed” wees, sê Adéle.

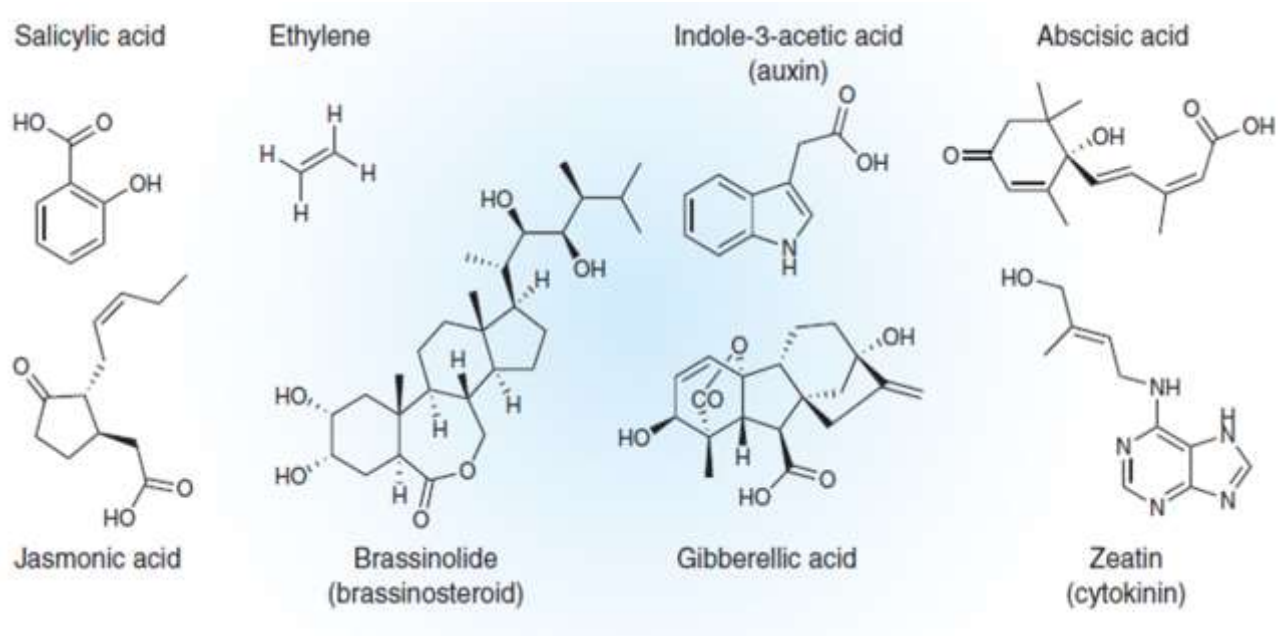
“Priming” is die proses waardeur die plant slegs tot verdedigingsaksie oorgaan wanneer die patogeen (siekte) aanval. Geïnduseerde weerstand is dikwels ‘n kombinasie van direkte aktivering en “priming”.

Hierdie geïnduseerde weerstand stel die plant in staat om vinniger en sterker verdedigingsreaksies teen ‘n wye verskeidenheid van siektes te loods.

Omdat plantinduseerders nie ‘n wesenlike impak op plantproduksie en plantgroei het nie, is dit ‘n aantreklike manier om gewasse te beskerm sonder om opbrengste te beïnvloed. Die verdedigende effek van “priming” kan oor ‘n lang periode gehandhaaf word en kan selfs van een plant generasie na die volgende oorgedra word.

Die geïnduseerde weerstandsreaksie kan gewoonlik sistemies na ander plantdele versprei, of dit kan ‘n gelokaliseerde effek hê. Die aktivering van geïnduseerde

weerstand in plante word gefassiliteer deur fitohormone wat die verdedigingsisteme in plante bestuur. “Fitohormone is letterlik die alarmseine van die plant,” sê Adéle. “Buiten verdediging help fitohormone ook met plantgroei, voortplanting en die plant se hantering van omgewingstres.”



Fitohormone se molekulêre werking. *Pieterse et al., 2009. Nature Chemical Biology 5:308-316*

Indien ‘n plant se “alarm” afgaan, versterk die selwande; antimikrobiese sekondêre metaboliete word geproduseer en spesiale proteïne wat mikrobiese selwande kan afbreek, word opgebou. Dié proses kan binne ‘n paar dae tot ‘n week ná weerstandsindusering voltooi wees, en is effektief teen ‘n breë reeks plantsiektes - insluitend blaarvelk bakteriese en swam patogene, nematodes, verwelksiektes en sekere insekte. Die voordele van plantweerstandsindusering sluit in:

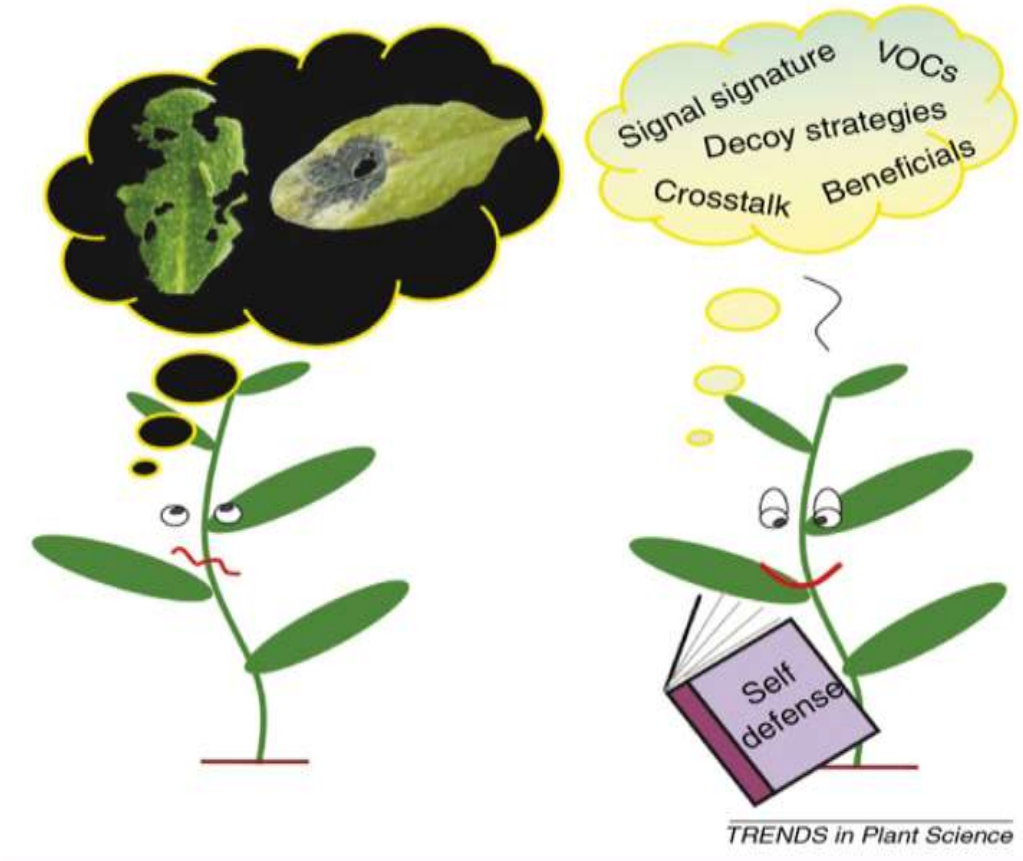
- Geen direkte effek op plantsiekte/patogeen
- Geen direkte seleksie druk op patogeen soos met swamdoders
- Onwaarskynlik om weerstands probleme te ontwikkel
- Veilig vir die omgewing
- Effektief teen “breë spektrum” siektes, soos virusse, bakterieë, swamme, nematodes & insekte
- Indien geïnduseerde weerstand eers geaktiveer is, word weerstand verkry vir ‘n verlenge periode van tyd
- Biologiese beheer deur geïnduseerde weerstand vereis slegs ‘n aanvanklike hoë populasie vir kort periode

Is daar enige risiko's betrokke by geïnduseerde weerstand?

Volgens Adéle toon sommige eksperimente 'n kompromis tussen effektiewe siektebeheer & plantproduktiwiteit (groei en opbrengste).

"Sommige veld eksperimente het ook verlaging in opbrengste waargeneem, alhoewel dit nie altyd statisties is nie. Dit is eerder die soort, dosis en konsentrasie van die induseerders wat 'n koste tot volg het, eerder as die direkte verdediging self," sê Adéle. "Kultivars kan ook verskil in hulle reaksie op weerstandsinduseers en die toedieningstyd is ook belangrik."

Weerstandsinduseerders se effektiwiteit teen siektes verskil, maar kan gemiddeld 'n impak van tussen 25% tot 80% hê. "Dit moet egter deel vorm van 'n geïntegreerde beheer strategie. Die tydperk wat beskerming verleen word, verskil ook van gewas tot gewas," sê Adéle."Daar is nog baie vra rondom toedienings, maar dit bly 'n aantreklike en volhoubare opsie vir gewasbeskerming."



Pieterse & Dicke (2007)

Attending...

Photo (left): Matthew Addison, HORTGRO Science Crop Protection Manager, explaining the importance of biological control agents.

Photo (right): Speakers: Bekker Wessels, ProCrop, and Dr Adéle McLeod, Plant Pathologist from the University of Stellenbosch at the Crop Protection Seminar.

Drs. Antoinette Malan (second left) and Ken Pringle (far right) with some of their entomology students at the Crop Protection Seminar in Ceres.