Travel report for the GCRI Trust

International Organisation for Biological Control conference: Integrated control in Protected Crops, temperate climate, Niagara Falls, Canada

4-8 June 2017

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Headlines

- Dutch researchers have made the first steps in developing a lure to divert aphid hyperparasitoids away from parasitised aphids to improve biological control of aphids on sweet pepper and other protected crops.
- Dutch researchers have shown that the 14-spot ladybird has potential for preventive release for control of aphids at low densities.
- The predatory mite *Amblydromalus limonicus* has been shown to have potential for control of whitefly in protected ornamentals in cool weather conditions
- Researchers in Canada have shown that cold foggers may be a more efficient way of applying entomopathogenic fungi to protected crops than spraying.

Background

The International Organisation for Biological Control (IOBC) working group 'Integrated Control in Protected Crops' meets every three years to exchange information on new developments in the integrated control of pests and diseases on protected crops. There were 126 international delegates from Europe, Canada, the USA, Colombia, Egypt, Israel, Japan and Korea. Delegates included researchers, students, consultants and extension workers, suppliers of biological control agents and biopesticides and a few growers. The conference included presentations of talks and posters, discussion sessions and visits to commercial growers of protected edible and ornamental crops. Crops covered in the presentations and visits included protected ornamentals, cucumber, herbs, strawberry, sweet pepper and tomato.

Travel findings

1. *The potential of volatiles to lure hyperparasitoids away from aphid parasitoid hosts (Jetske de Boer, Department of Terrestrial Ecology, Wageningen, The Netherlands).*

Hyperparasitoids (parasitic wasps that parasitise aphid parasitoids) are common problems in IPM programmes in The Netherlands. In sweet pepper crops, up to 96% hyperparasitism can occur during August and September. This project aims to develop lures that divert hyperparasitoids away from parasitised aphid mummies. *Dendrocerus aphidum* is the most common hyperparasitoid in Dutch protected crops and has a wide host range, attacking many different species of parasitoids that in turn parasitise many different aphid species. *Asaphes vulgaris* is also commonly found. Experiments were done with sweet peppers infested with the tobacco aphid *Myzus persicae nicotianae* parasitised by the primary parasitoid *Aphidius colemani*. Results showed that *D. aphidum* is attracted to the scent of aphid mummies but not to plants uninfested with aphids. *Asaphes vulgaris* has different behaviour to *D. aphidum* as it host feeds on the aphid mummy as well as parasitising it. Further research is planned to identify the volatiles from aphid mummies that attract hyperparasitoids and to develop traps for control. Research is also planned on overwintering behaviour of the hyperparasitoids and to identify their source when they start to enter protected crops in the spring.

Implications for UK growers: Hyperparasitoids are also very common in UK protected crops such as sweet pepper and hardy nursery stock and are a major threat to biological control of aphids. Aphid mummies attacked by a hyperparasitoid can be recognised by the ragged emergence hole made by the hyperparasitoid rather than the neat, round hole made by the primary parasitoid (Figs 1 and 2). They have been studied in sweet pepper by Rob Jacobson in AHDB Horticulture-funded projects PC 295a and b and in hardy nursery stock, strawberry and sweet pepper by ADAS in the IPM Horticultural Fellowship project CP 89, funded by AHDB, HTA and the East Malling Trust. A wider range of hyperparasitoid species have been identified on UK nurseries than on Dutch sweet pepper crops. Links with the Dutch researchers will be maintained and opportunities for further UK research will be explored.

Figure 1. Aphid ‘mummy’ with round emergence hole made by primary parasitoid, ©ADAS

Figure 2. Aphid ‘mummy’ with ragged emergence hole made by hyperparasitoid, ©ADAS

2. The potential for 14-spot ladybird (Propylea quatuordecimpunctata) for aphid control (Gerben Messelink, Wageningen UR Greenhouse Horticulture, The Netherlands)

Biological control of aphids in protected crops is not easy. On many Dutch sweet pepper, cucumber and aubergine crops growers use frequent releases of aphid parasitoids (although there is a major problem with hyperparasitoids, see 1. above) supplemented with the predatory midge *Aphidoletes aphidimyza* and sometimes also with lacewings and hoverflies if aphids reach high densities. This project looked at the potential for the 14-spot ladybird ('P14', Figures 3 and 4) for its ability to establish and control of aphids when still at low densities in protected crops, as observed with natural populations in outdoor field crops. In a sweet pepper crop, released P14 adults established between April and September and kept aphids at low densities. The ladybirds were able to move over 100m and find new aphid colonies quickly. P14 can survive for several months on alternative food sources e.g. pollen and start laying eggs once they have switched to feeding on aphids. P14 ladybirds are not yet commercially available for biological control but if larger scale trials demonstrate their benefits this may lead to the production of a new biocontrol agent for preventive aphid control in IPM programmes.

Figure 3. 'P14' 14-spot ladybird adult © Gerben Messelink, Wageningen

Figure 4. 'P14' 14-spot ladybird larva © Gerben Messelink, Wageningen

Implications for UK growers: Biological control of aphids can be difficult on some crops in the UK as in the Netherlands. The 14-spot ladybird is native to the UK so if this became commercially available there should be no regulatory hurdles to release in UK protected crops.

3. Potential for Amblydromalus limonicus for control of whitefly in protected ornamentals in cool weather conditions (Sarah Jandricic, Ontario Ministry of Agriculture, Food and Rural Affairs, Canada).

The predatory mite *Amblydromalus limonicus* has been available in Canada since 2011. The predator feeds on both western flower thrips larvae and on the eggs and nymphs ('scales') of both glasshouse whitefly (*Trialeurodes vaporariorum)* and tobacco whitefly (*Bemisia tabaci*). *Ambydromlaus limonicus* is reported to be effective over a wide range of temperatures and is more active than other predatory mites at 13-14 °C, potentially giving it an advantage over other whitefly natural enemies in cool condititions. However, few growers of ornamentals in Ontario use *A. limonicus* as it is more expensive than other whitefly and thrips natural enemies. The price would be less of a deterrent if the predator was demonstrated to growers be more reliable and effective than other whitefly natural enemies in the cooler months. Trials were done on commercial crops of potted gerbera and Mandevilla (Dipladenia) to compare the potential of *A. limonicus* for whitefly control in autumn/winter compared with other management strategies. In a gerbera crop heavily infested with glasshouse whitefly parasitoids *Encarsia formosa* and *Eretmocerus emericus* were tested with or without the addition of *A. limonicus* at a high release rate of 150/m^2 used either with or without supplementary pollen(NutriMite^{TM}, Biobest) as additional food for the *A. limonicus.* These biological control programmes were compared with the use of the chemical insecticide spirotetramat. The most effective treatment was the combination of the parasitoids with *A. limonicus*. Providing pollen for the predatory mites did not improve whitefly control in this situation. The gerbera grower is now using whitefly parasitoids between March and October and adding *A. limonicus* if whitefly is found in the crop between November and March. Future trials will test earlier releases of *A. limonicus* together with Nutrimite^{TM} to achieve earlier establishment of the predators. During the conference we visited a grower of bedding and pot plants who released *A. limonicus* to his poinsettia crop as a key component of his IPM programme. The predators are released every 2-3 weeks five times from sticking at a low rate of two per plant. Nutrimite^{TM} was applied using a Makita blower (Fig. 5) to aid establishment.

Figure 5. Makita blower used to apply Nutrimite™ © Neil Helyer, Fargro

Trials were done on crops of Mandevilla over two years. The plants were imported from Florida or South America and were infested with *Bemisia* on arrival. In year 1, the combination of *A. limonicus* and parasitic wasps brought *Bemisia* levels down to near zero, reducing whitefly numbers faster than the parasitic wasps alone. In Year 2, when compared with *Amblyseius swirskii*, *A. limonicus* gave better whitefly control, but chemical intervention was still needed due to the high initial numbers of *Bemisia*. These studies indicated that *A. limonicus* could play a role in controlling whiteflies under cool weather conditions when other biocontrol agents are less effective.

Implications for UK growers: In the UK, *A. limonicus* is available but can only be released under licence to fully protected crops i.e. not to those in poly tunnels or outdoors as it is non-native. As in Canada, it is more expensive than other whitefly natural enemies. However, its potential for use in low temperatures and its activity against both whiteflies and thrips should make it cost-effective and growers are beginning to include it in IPM programmes on some crops. UK growers are also starting to use pollen (Nutrimite™) as a supplementary food for some species of predatory mites to improve establishment when pollen is not available on the crop.

4.The potential of using foggers for application of entomopathogenic fungi (Michael Brownbridge, Vineland Research and Innovation Centre, Ontaro, Canada).

As in the UK, due to problems with pest resistance to chemical insecticides and acaricides, the withdrawal of pesticides and to increasing regulatory and retail demands to reduce reliance on pesticides, the role of biopesticides in IPM programmes is becoming more important in Canada. Biopesticides include entomopathogenic fungi, bacteria, viruses, plant extracts and semiochemicals.

Currently, entomopathogenic fungi such as *Beauveria bassiana* (e.g. Botanigard WP and Naturalis-L) are recommended by the suppliers to be applied as a high volume spray. However, this application method is time- consuming and it is difficult to achieve good crop coverage, particularly on leaf undersides to reach the target pest e.g. whiteflies. Automated low volume and ultra-low volume spraying (also known as fogging) could offer a quicker and more efficient application method, minimise worker exposure and reduce waste by avoiding run-off. Low volume spraying equipment was tested with entomopathogenic fungi to assess how it affected fungal fitness, viability and numbers of spores reaching the target. The Dramm 'AutoFog' (cold fogger, Figure 6) had no effect on Botanigard WP spore viability or germination rate and can be safely used to apply this biopesticide. However, colony forming unit (CFU) counts were lower than expected and this needs further investigation. The 'Bio PulsFOG' (thermal fogger) killed over 90% *B. bassiana* spores during application. It is possible that the system could be modified to avoid the spores being exposed to lethal temperatures and physical shock, e.g. by using larger nozzles or more water. However, application of *Bacillus subtilis* using the PulsFOG did not reduce viability of the spores (*Bacillus* spores are more robust than fungal spores). Current trials are determining the efficiency of low-volume spray equipment for delivery of microbial biopesticides by assessing deposition and efficacy in protected crops.

Figure 6. Dramm AutoFog © Dramm

Implications for UK growers: UK researchers Dave Chandler (Warwick Crop Centre) and Jude Bennison (ADAS) are working together with specialists at Silsoe Spray Application Unit on optimising application of biopesticides in the current AHDB-funded project CP 158 'AMBER' (Application and Management of Biopesticides for Efficacy and Reliability). They will liase with Michael Brownbridge in Canada over any further development of application of microbial biopesticides through foggers.

Personal statement

Attendance at this IOBC conference enabled me to keep up to date with recent developments in IPM in protected crops and to network with international IPM specialists and discuss potential collaboration. Some of the research findings could already be used by UK growers and others will alert UK growers to potential new future IPM solutions for current and potential future pest problems.

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Acknowledgements

I am grateful to the GCRI Trust and ADAS for contributing to the costs of attending this conference.

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