HORTICULTURE

Grower Summary

CP 089

Maintaining the expertise for developing and communicating practical Integrated Pest

Management (IPM) solutions for Horticulture

Final *2016*

Disclaimer

The results and conclusions in this report may be based on an investigation conducted over one year. Therefore, care must be taken with the interpretation of the results.

Use of pesticides

Only officially approved pesticides may be used in the UK. Approvals are normally granted only in relation to individual products and for specified uses. It is an offence to use non-approved products or to use approved products in a manner that does not comply with the statutory conditions of use, except where the crop or situation is the subject of an off-label extension of use.

Before using all pesticides check the approval status and conditions of use.

Read the label before use: use pesticides safely.

Further information

If you would like a copy of the full report, please email the AHDB Horticulture office (hort.info.@ahdb.org.uk), quoting your AHDB Horticulture number, alternatively contact AHDB Horticulture at the address below.

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Project title:	Maintaining the expertise for developing and communicating practical Integrated Pest Management (IPM) solutions for Horticulture
Project number:	CP 89
Project leader:	Jude Bennison, ADAS
Report:	Final Report , 18 April 2016
Previous reports:	Interim reports 2012, 2013, 2014 & 2015
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Location of project:	ADAS Boxworth and commercial farms and nurseries
Industry Representative:	-
Date project commenced:	01 April 2011
Date project completed (or expected completion date):	18 April 2016

Grower Summary

Headline

- Three young entomologists and key ADAS scientific support staff have been mentored in order to equip them to develop and communicate IPM strategies on horticultural crops, thus maintaining this expertise in the industry. Novel strategies investigated in the final year of the project paved the way for further research on control of vine weevil, western flower thrips and two-spotted spider mite within IPM programmes.

Background

Use of refuge traps to disseminate entomopathogenic fungi for the control of adult vine weevil

Vine weevil is one of the most problematic pests in soft fruit crops and hardy nursery stock. Larval feeding in the roots causes plant stunting, wilting and death while adult feeding on foliage renders ornamentals unmarketable. Although biological control methods are available for vine weevil larvae, control of adults currently relies on chemical insecticides, which provide unreliable control and interfere with Integrated Pest Management (IPM) programmes. Novel IPM methods of controlling adult vine weevils is therefore a priority.

Vine weevils are known to aggregate during the day in sheltered locations and this behaviour has been exploited to design artificial refuges for use in lure-and-kill control methods. Previous Defra-funded work has shown that adult vine weevils pick up fluorescent powder or powdered formulations of entomopathogenic fungi (EPF) from within artificial refuges and then spread it to other weevils either when visiting refuges or whilst feeding at night. The most effective EPF for use in such refuges was confirmed as Metarhizium brunneum. When Defra-funded work assessed the control efficacy of artificial refuges containing M. brunneum in semi-field conditions the results were unclear due to a natural fungal infection in the vine weevil culture and so the experiment was repeated in this Fellowship project.

Using Neoseiulus cucumeris to deliver an entomopathogenic fungus to strawberry flowers for the control of thrips

Western flower thrips (WFT) is serious pest of strawberry, causing fruit damage that can make the crop unmarketable. On most fruit farms WFT is resistant to all available pesticides, thus control relies on the use of predators. Biological control on soft fruit crops is now threatened by use of pesticides for control of spotted wing drosophila (SWD). Foliar sprays of entomopathogenic fungi (EPF) can kill WFT, are not affected by insecticides used against SWD and are compatible with IPM programmes. However, targeting WFT in the flowers with foliar sprays is difficult. Work in this project investigated whether predatory mites can be used to carry spores of the EPF, Beauveria bassiana, to flowers to infect and kill WFT.

Determining the speed of kill of adult vine weevil when using E-nema Nematop® Käfer-Stopp traps

Entomopathogenic nematodes (EPN) are known to provide effective control of vine weevil larvae. E-nema in Germany have recently developed a product for the home garden market using nematodes to control adult vine weevils. The Nematop® Käfer-Stopp (weevil-stop) trap is a wooden refuge trap filled with a gel containing the EPN, Steinernema carpocapsae. The weevils shelter in the trap and become infected by the EPN. The speed of weevil kill was unknown therefore work in this project investigated this.

Monitoring the effects of insecticide applications for spotted wing drosophila on predatory mites and two spotted spider mites in raspberries

The invasive pest SWD is currently controlled with pesticides and these are likely to have an impact on IPM programmes. Control of the two-spotted spider mite (TSSM, Tetranychus urticae) is an example of an important raspberry pest for which an IPM programme has been developed. Growers release the predatory mite Phytoseiulus persimilis and the predatory midge Feltiella acarisuga for control of TSSM and also integrate acaricides. Amblyseius andersoni and Neoseiulus) californicus are naturally-occurring predatory mites that also help regulate TSSM populations. Work in this project investigated the impacts of SWD control on predatory mites and control of TSSM on raspberry crops on two commercial farms.

Summary

Use of refuge traps to disseminate entomopathogenic fungi for the control of adult vine weevil

Roguard® traps (used for trapping cockroaches) containing talc and fluorescent powder mixed with M. brunneum or just talc and fluorescent powder (untreated control) were used as artificial refuges. Six traps of either treatment were placed in an insect-proof mesh 'tent' cage with potted strawberry plants. Five replicate cages of each treatment were assessed. Forty marked weevils were released into each cage and after approximately five weeks the number of dead and live adult weevils in each cage was assessed. The presence on the bodies of fluorescent powder (indicating that they had entered a refuge trap or had come into contact with another weevil which had), white or grey-green hyphae/spores (indicating that it had been infected with fungus) and their location was also recorded. All weevils were subsequently incubated and observed for six weeks to check for evidence of fungal infection.

In total 95.5% and 94.5% of weevils were recovered at the end of the experiment from the untreated and treated cages (traps containing M. brunneum) respectively. In the treated cages, 37.5% were found dead, 57% were found alive, 5.5% were missing and 3% had obvious signs of fungal infection. In the untreated cages, 24.5 % were found dead, 71% were found alive, 4.5% were missing and none had signs of infection. Analysis showed that there

were significantly more vine weevil adults found dead in the treated cages compared to in the untreated cages. Following incubation, significantly more were found to be infected with M. brunneum in the treated cages (41.7%) than the untreated cages (0%).

This work showed that the traps were effective in intiating a fungal epidemic amongst the vine weevils. However, as few weevils were observed with infection until after incubation at optimum temperature and humidity, it is likely that the success of this method is highly dependent on suitable environmental conditions. Further work on effective EPF dose and formulation would be needed to further develop this method if approval could be gained for using an EPF in this way.

Using Neoseiulus cucumeris to deliver an entomopathogenic fungus to strawberry flowers for the control of thrips

Laboratory tests were set up in plastic boxes to investigate the ability of N. cucumeris to carry powdered Beauveria bassiana (Botanigard®) spores to flowers. Chrysanthemum flowers were used as strawberry flowers were unavailable. Three treatments were investigated; (1) Botanigard® only, (2) N. cucumeris only and (3) Botanigard® mixed with N. cucumeris. The treatment was placed at one end of the box on a chrysanthemum leaf. At the other end of the box was placed either a chrysanthemum flower (treatments 2 and 3) or commercial pollen (Nutrimite™) on a chrysanthemum leaf (treatment 1). Fifteen adult WFT were added to each box. The boxes were then placed in an incubator set at 23°C and after one week the numbers of live and dead adult WFT were counted. The WFT were then incubated on damp filter paper for a further week and assessed for B. bassiana sporulation. Petals from the flowers were also incubated on selective agar and assessed for the presence of B. bassiana spores.

Significant differences in WFT mortality were found at the end of the bioassay (100% in the Botanigard® only treatment, 8% in the Botanigard® and N. cucumeris, and 0% in the N. cucumeris only treatment). Following incubation, 76% of WFT in the Botanigard® only treatment were found to have B. bassiana infection compared with 33% in the Botanigard® and N. cucumeris treatment but these differences were not statistically significant. No WFT infection occurred in the N. cucumeris only treatment. No petals in the N. cucumeris only treatment were found to have B. bassiana spores on them compared to 67% in the Botanigard® and N. cucumeris treatment.

Lack of water sources in the Botanigard® only treatment are likely to have contributed to the high WFT mortality observed. The presence of B. bassiana spores on the petals in the Botanigard® and N. cucumeris treatment shows that the Botanigard® was taken to the flowers, although both WFT and N. cucumeris may have carried them there. N. cucumeris were observed moving freely with spores on their bodies. Furher work would be needed using whole plants in a more realistic environment to furher investigae this potential novel method for using entomopathogenic fungi for WFT control, if approval could be gained for using EPF in this way.

Determining the speed of kill of adult vine weevil when using E-nema Nematop® Käfer-Stopp traps

The experiment assessed two treatments; Nematop® Käfer-Stopp (weevil-stop) traps with the S. carpocapsae nematode gel (treated) or traps without the gel (untreated control). Each treatment had five replicates with each replicate consisting of an insect cage containing either treated or untreated traps. Each cage contained of a seed tray filled with a coir substrate with a trap and a sprig of yew (as a food source for the weevils) placed on top. Five adult vine weevils were released into each cage. The cages were kept in a glasshouse maintained at conditions optimal to S. carpocapsae activity. The numbers of live and dead vine weevils were assessed regularly for thirty days. Dead vine weevils were removed and dissected to determine whether nematode infections were evident.

At the end of the experiment 92% and 8% of the weevils had died in the treated and untreated cages respectively. Of the weevils that had died on the treated cages, 83% were confirmed to contain nematodes (Figure 1). The first dead weevils were observed after nine days and 50% died after approximately 15 days. Although the traps were effective they are currently too expensive for commercial use. The traps will be further investigated together with a vine weevil lure in the current AHDB Horticulture project HNS 195 'Improving vine weevil control in HNS'.

Figure 1. Entomopathogenic nematodes Steinernema carpocapsae inside a dissected vine weevil adult body

Monitoring the effects of insecticide applications for spotted wing drosophila on predatory mites and two spotted spider mite control in raspberries

Raspberry crops on two commercial farms that had SWD on site were monitored. Site 1 used IPM for TSSM control and the varieties monitored were Tulameen and Maravilla. Site 2 relied on naturally occurring predators and acaricides for TSSM control and the variety monitored was Kweli. The sites were monitored on several occasions during the summer, before and after pesticides were used for SWD control. On each visit assessments were made of TSSM incidence and severity and relevant predator establishment.

At Site 1 on cv. Tulameen, low numbers of P. persimilis (released by the grower) and A. andersoni and N. californicus (naturally-occurring) survived an application of thiacloprid (Calypso) and TSSM numbers remained stable during May and June. On cv. Maravilla, low numbers of P. persimilis (released by the grower), A. andersoni and N. californicus (both naturally-occurring) survived three applications of spinosad (Tracer) and one application of chlorpyrifos (Equity, no longer available). Predatory mites were considered responsible for reducing TSSM numbers to negligible levels between 11 August and 2 September.

At Site 2 on cv. Kweli, the acaricides clofentezine (Apollo) and abamectin (Dynamec) together with naturally-occurring A. andersoni and N. californicus maintained TSSM populations at low levels. A proportion of the A. andersoni and N. californicus populations survived acaricides applied for TSSM control, Tracer and pyrethrum applied for SWD control, and Equity and Calypso applied for control of other pests. These results highlight the importance of naturally-occurring predatory mites in maintaining spider mite control when applying pesticide programmes for control of SWD and other pests.

Financial Benefits

- Growers of soft fruit crops and agronomists will benefit from being aware that naturally-occurring predatory mites can play an important role in maintaining spider mite control when applying pesticide programmes for control of spotted wing drosophila and other pests.

- Growers of HNS and soft fruit crops will benefit from being aware that the e-nema vine weevil traps can lead to high mortalities of adult vine weevils within 30 days. The traps are currently too expensive for commercial use but further development of the traps together with the identification of a vine weevil lure is being done in the current AHDB Horticulture project HNS 195 ‘Improving vine weevil control in HNS’.

- Results of this project have demonstrated that powdered formulations of entomopathogenic fungi have potential for use in a novel lure and kill approach for adult vine weevils and in a novel approach for using predatory mites to carry the fungal spores to flowers. Further development of these novel approaches is dependent on the potential approval of the use of entomopathogenic fungi in these methods.

- The horticultural industry will benefit from the mentoring of three young entomologists and key ADAS scientific support staff in developing and communicating new IPM strategies for horticultural crops, thus maintaining this UK expertise.

Action Points

Growers of soft fruit susceptible to spotted wing drosophila (SWD) should be aware that naturally-occurring predatory mites can play an important role in maintaining two-spotted spider mite control when using pesticides for control of SWD. Identification of these mites can be done by ADAS on request, via ADAS soft fruit consultants or direct to jude.bennison@adas.co.uk

Growers of HNS and soft fruit should keep up to date on further developments of the e-nema vine weevil trap for control of adult vine weevils via the results of current project HNS 195 'Improving vine weevil control on HNS', which will be available on the AHDB Horticulture website and reported in AHDB Horticulture Grower.