Grower Summary

PE 006

Protected herbs: improved biological control of aphids

Final 2012

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Contractor:	ADAS UK Ltd
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Headline

New information has been provided on the potential of commercially-available parasitoids for biological control of hawthorn-parsley aphid and mint aphid.

Background and objective of project

Until recently, biological control of aphids on protected crops relied mainly on three aphid parasitoid species; *Aphidius colemani*, *Aphidius ervi* and *Aphelinus abdominalis*. A new aphid parasitoid mix produced by Viridaxis and available from BCP Certis includes these three parasitoid species as well as three 'new' species; *Aphidius matricariae*, *Praon volucre* and *Ephedrus cerasicola*. This mix of six parasitoid species has given good control of a wide range of 'difficult' aphid species on strawberry and ornamental pot plants.

This project investigated the potential of the six currently available parasitoid species (provided by Viridaxis through BCP Certis) against two 'problem' aphid species, hawthorn-parsley aphid and mint aphid, on all year round protected pot herbs.

Summary of the project and main conclusions

Objective 1: In laboratory studies, determine the parasitism and host-killing of hawthorn-parsley aphid and mint aphid by the six parasitoid species

Parasitism: the behaviour of *Aphidius colemani*, *Aphidius ervi*, *Aphidius matricariae*, *Praon volucre*, *Ephedrus cerasicola* and *Aphelinus abdominalis* was observed in Petri dishes when offered a mix of second and third instar aphids (the life stage preferred for parasitism). Either 20 hawthorn-parsley aphids or 20 mint aphids were offered on a piece of parsley or mint respectively. Each mated female parasitoid was observed using a binocular microscope for 10 minutes, recording the number of times that the parasitoid attacked an aphid with its ovipositor (egg-laying tube). At the end of the observation period the parasitoid was allowed to continue to parasitise the aphids for a further two hours. The parasitoid was then removed and the aphids transferred to clean potted parsley or mint plants, using a separate pot of plants for each dish of aphids. Each pot of plants was then covered with a perforated bread bag in order to prevent other parasitoids or predators from attacking the aphids. Numbers of mummified (parasitised) aphids were recorded after 10 and 14 days.

Hawthorn-parsley aphid: all six parasitoid species attacked the aphids, although only one *Aphidius ervi* individual made a single attempt to parasitise a hawthorn-parsley aphid. *Aphidius colemani*, *Praon volucre* and *Ephedrus cerasicola* made the most attacks, although the number of attacks varied between individuals. All the parasitoid species except for *Aphidius ervi* successfully parasitised the aphids, confirmed by the presence of mummified aphids 14 days after the observations were completed. However, the number of mummified aphids was low and aphid mummies were not always recorded from dishes where attacks had occurred. This suggests that attacked aphids sometimes died before mummifying, that attacks did not necessarily result in an egg being laid in the aphid or that eggs were laid but that the parasitoid was not always able to develop within this host.

Mint aphid: five of the six parasitoid species (all except *Aphidius ervi*) were observed to attack the aphids. *Aphidius colemani*, *Aphidius matricariae* and *Ephedrus cerasicola* were recorded to make the most attacks, although the number of attacks varied between individuals. Mummified aphids were recorded 14 days after being attacked by *Aphidius matricariae*, *Ephedrus cerasicola* and *Praon volucre* but not by *Aphidius colemani*. The other parasitoid species did not successfully parasitise the mint aphids and did not lead to aphid mummies developing.

Host-killing – evidence of host-killing by *Aphidius colemani*, *Aphidius ervi*, *Aphidius matricariae*, *Praon volucre*, *Ephedrus cerasicola* and *Aphelinus abdominalis* was recorded by confining a mated female parasitoid in a Petri dish together with a mixture of second and third instar aphids for 24 hours. Ten aphids of either species were offered on a piece of parsley or mint respectively. After 24 hours the aphids in each dish were checked using a microscope, recording the numbers alive or dead.

Hawthorn-parsley aphid: the mean percentage of aphids dead after 24 hours ranged from 7.3% with *Aphidius matricariae* to 62.7% with *Aphidius colemani*. Aphid mortality when no parasitoid was confined with the aphids was 12.5%. Aphid mortality in dishes containing *Aphidius colemani*, *Ephedrus cerasicola* (46.7%) and *Aphelinus abdominalis* (48.3%) was significantly higher than in dishes not containing an aphid parasitoid. Aphid mortality in dishes containing *Aphidius colemani* was not significantly higher than in dishes containing *Ephedrus cerasicola* or *Aphelinus abdominalis*. The other parasitoid species did not significantly increase aphid mortality. Where aphid mortality was significantly increased by the presence of an aphid parasitoid this may have been due to the parasitoids' host feeding on the aphids, or by repeated 'stings' during egg laying or by the parasitoids disturbing the aphids so that they left the plant material and starved.

Mint aphid: the mean percentage of aphids dead after 24 hours ranged from 9.8% with *Aphidius matricariae* to 54.3% with *Ephedrus cerasicola*. Aphid mortality when no parasitoid was confined with the aphids was 11.4%. Aphid mortality in dishes containing *Aphidius ervi* (32.5%), *Praon volucre* (42.5%), *Ephedrus cerasicola* and *Aphelinus abdominalis* (41.1%) was significantly higher than in dishes not containing an aphid parasitoid but did not differ significantly from each other. The other parasitoid species did not significantly increase aphid mortality. The reasons for the higher aphid mortality recorded are likely to have been as previously described.

Aphidius matricariae is reputed to be an aggressive parasitoid, with the females able to kill aphids by repeated 'stinging' with their ovipositors, in addition to acting as a parasitoid (de Menten, personal communication). However, results with hawthorn-parsley aphid and mint aphid found no evidence of this behaviour either in the number of attacks recorded or in aphid mortality

Table 1. Summary of results from laboratory experiments recording parasitism and host-killing of six aphid parasitoid species.

Parasitoid species	Hawthorn-parsley aphid			Mint aphid		
	Attacks recorded	Mummified aphids	Host-killing	Attacks recorded	Mummified aphids	Host-killing
Aphidius colemani	✓	✓	✓	✓	-	-
Aphidius ervi	✓*	-	-	-	-	✓
Aphidius matricariae	✓	✓	-	✓	✓	-
Praon volucre	✓	✓	-	✓	✓	✓
Ephedrus cerasicola	✓	✓	✓	✓	✓	✓
Aphelinus abdominalis	✓	✓	✓	✓	-	✓

✓ = attack recorded, *= only a single attack recorded, **-** = no attack recorded

Objective 2: In small-scale research glasshouse experiments, evaluate control of hawthorn-parsley aphid and mint aphid by individual or mixed parasitoid species.

Aphidius colemani and *Aphidius matricariae* were selected for these semi-field experiments to test control of hawthorn-parsley aphid and mint aphid on potted parsley and mint plants respectively. The experiments were done using insect cages placed in a computer-controlled glasshouse compartment set to maintain a temperature of approximately 20°C.

To record parasitism of hawthorn-parsley aphids by *Aphidius colemani*, 12 pots of pest-free young parsley plants were each infested with 25 mixed-age hawthorn-parsley aphids. Two infested pots of plants were then placed into each of six insect cages. After 24 hours, five mated female *Aphidius colemani* were released into three of the cages (a rate equivalent to 40/m^2). No parasitoids were released into the other three 'control' cages. After 10 days the numbers of live and mummified aphids were recorded and the numbers of additional mummies were recorded after a further seven days. To record parasitism of mint aphids by *Aphidius matricariae* a similar experiment was done but the numbers of live and mummified aphids were recorded 12 days after the parasitoids were released and the final assessment of the numbers of mummified aphids done after a further nine days.

Hawthorn-parsley aphid: 10 days after releasing five mated female *Aphidius colemani* in cages containing 50 hawthorn-parsley aphids the mean number of aphids recorded remained largely unchanged at 56 per cage. However, of the aphids recorded, 57% had been parasitised. In comparison, in cages where no parasitoids had been released the number of hawthorn-parsley aphids had increased from 50 to a mean of 294 in 10 days.

Mint aphid: 10 days after releasing five mated female *Aphidius matricariae* in cages containing 50 mint aphids the number of aphids recorded had been reduced to a mean of 31 per cage. Most of these aphids were healthy but 9% had been parasitised. In comparison, in cages where no parasitoids had been released the number of mint aphids had increased from 50 to a mean of 142 per cage in 10 days.

There is published evidence that aphid parasitoids may attack aphids more readily if they have developed on an aphid of the same species or have already successfully attacked aphids of that species. To test this, an additional experiment using hawthorn-parsley aphids and *Aphidius colemani* was completed. Nine cages were prepared with aphid-infested parsley plants as previously described. Two mated female *Aphidius colemani* direct from BCP Certis were released into three of the cages (a rate equivalent to 16/m^2). Two 'conditioned' mated female *Aphidius colemani* that had been reared on hawthorn-parsley aphids were released into three further cages. No parasitoids were released into the final three 'control' cages.

'Conditioned' *Aphidius colemani*: 10 days after releasing two mated female *Aphidius colemani* that had been reared on hawthorn-parsley aphids, in cages containing 50 hawthorn-parsley aphids the mean number of aphids recorded had increased to 149 per cage. Similarly, in cages where two mated female *Aphidius colemani* direct from BCP Certis

were released, the mean number of hawthorn-parsley aphids increased from 50 to 115 per cage. In cages where no parasitoids had been released the mean number of hawthorn-parsley aphids had increased from 50 to 149. These results indicate that a single release of two *Aphidius colemani*, either 'conditioned' or direct from BCP Certis, did not effectively control hawthorn-parsley aphid when each plant was initially infested with 25 aphids.

Evidence to indicate that 'conditioned' parasitoids were more effective in controlling hawthorn-parsley aphid than parasitoids direct from BCP Certis was inconclusive. Parasitised aphids were only recorded in one of the three cages in which 'conditioned' parasitoids had been released, suggesting that in the other two cages the parasitoids died before parasitising any aphids or were unable to parasitise these aphids. Overall mean parasitism per cage was, therefore, low (14%) but in the cage where parasitism was recorded it was high (42%) and the number of healthy aphids low (46). In cages where parasitoids direct from BCP Certis were released, parasitism was recorded in each cage, with a mean of 22% (with a range of 15 to 30%) of aphids parasitised.

Objective 3: In an experiment on a commercial herb nursery, evaluate control of hawthorn-parsley aphid on parsley by selected individual/mixed parasitoid species.

The planned experiment could not be done as work in Objectives 1 and 2 took much longer than expected, by which time numbers of plants infested with hawthorn-parsley aphid on the host nursery were much lower than earlier in the season and this would have put the experiment at risk. Therefore, intensive monitoring of parsley crops on two commercial nurseries was done to establish the aphid infestation time during the 5-week production period and the percentage parasitism given by the growers' release strategies. On both crops, hawthorn-parsley aphids were found only on plants 4-5 weeks after they were sown. Parasitism was recorded at only one site and then at very low levels (2.3% of aphids parasitised). A tentative identification by the Natural History Museum indicated that the single parasitoid collected from this site was an *Aphidius matricariae* male. This parasitoid species must have been naturally-occurring as at this site, only *Aphidius colemani* had been released. At the second site no parasitism of hawthorn-parsley aphids was recorded even though the mix of six parasitoid species had been released weekly. It is likely that the aphids infested the parsley too late in the production stage for any parasitised aphids to have developed into visible 'mummies' before the marketing stage.

Financial Benefits

Results from this project have shown that a single release of a high rate of *Aphidius colemani* and *Aphidius matricariae* can reduce populations of hawthorn-parsley aphid and mint aphid on parsley and mint respectively. Further work is needed to determine whether releases of multiple parasitoid species are more effective than those of a single species and to establish a cost- effective release strategy for successful biological control of both these aphid species. This work will be done in the extension project to PE 006 during 2012. Developing improved biological control strategies for these aphid species will contribute to more robust IPM programmes, reduced plant losses and reduced labour time needed for effective aphid control.

The new parasitoid mix includes three species able to successfully parasitise mint aphid, *Aphidius matricariae*, *Praon volucre* and *Ephedrus cerasicola*. Until recently these three species had not been available to growers. Results of this project will save growers wasting money on releasing single species of the previously available parasitoid species such as *Aphidius colemani* in mint crops.

Action Points

- Ensure that aphids on parsley and mint are correctly identified. Use the HDC Crop Walkers Guide for herbs or the HDC Herb Best Practice Guide www.hdc.org.uk/herbs/ for help with recognition.
- On nurseries where hawthorn-parsley aphid occurs, consider releasing *Aphidius colemani* or the mix of six parasitoid species available from BCP Certis, which includes *A. colemani* and four other parasitoid species that also attack this aphid.
- Where mint aphid is confirmed on mint, consider releasing the mix of six parasitoid species available from BCP Certis. Three parasitoid species in this mix, *Aphidius matricariae*, *Praon volucre* and *Ephedrus cerasicola*, attack mint aphid.
- Do not release *Aphidius colemani* to mint as it will not control mint aphid.