



# Grower Summary

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**PE 027**

Review of options for control  
of aphid pests in pepper

Final 2016

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## Headline

This project collated relevant current knowledge on aphid control in protected pepper crops. Information was collected using a systematic literature review and interviews with growers and crop protection specialists. The project identifies key gaps in knowledge and opportunities to improve control of aphid pests.

## Background

Aphids are one of the most serious pests of protected pepper crops grown in the UK. There are four key species of aphid pest; the peach potato aphid (*Myzus persicae*), the foxglove aphid (*Aulacorthum solani*), the melon and cotton aphid (*Aphis gossypii*) and the potato aphid (*Macrosiphum euphorbiae*). Crop damage typically occurs when large populations of aphid retard and distort plant growth. In addition, honeydew produced by aphids can lead to the growth of sooty moulds on foliage and fruit. The foxglove aphid presents an additional problem in that its saliva contains toxins, which cause yellowing, twisting and distorting of the young leaves and necrotic spots on the fruit.

Growers of both conventional and organic crops rely heavily on the use of aphid parasitoids, in particular *Aphidius colemani*, to control aphid pests. Predators, such as *Aphidoletes aphidomyza*, are also widely used for aphid control. Pesticide usage survey data shows that aphid control is cited as the reason for 74% of insecticide usage. For aphid control in conventional crops there is a current reliance on the use of pymetrozine (Chess WG) and pirimicarb (e.g. Aphox), while in organic crops, fatty acids (e.g. Savona) are frequently relied upon.

Integrated Pest Management (IPM) is well established and widely used by UK protected pepper growers. Growers are, however, under pressure to continue to effectively manage aphid pests. These pressures include, hyperparasitoids, which disrupt biological control programmes, insecticide resistance in key aphid pests, the limited range of effective insecticides and concerns over pesticide residue levels. In order to meet these and other challenges, growers need more information, which can either be immediately implemented or used to identify knowledge gaps and opportunities. Where knowledge gaps and opportunities exist, there is the potential for targeted research and knowledge transfer activities to develop practical solutions with which to improve aphid control in protected peppers crops.

## Summary

### **Objective 1: Review and collation of current knowledge of controls and biology of aphid pests affecting pepper crops**

#### *Task 1.1 Interviewing key industry representatives*

A total of sixteen representatives of the UK protected pepper industry were interviewed. This included six conventional pepper growers, one organic pepper grower (who also maintained a conventional crop), one conventional chilli grower, seven representatives of biological and chemical control suppliers and one seed supplier. Each representative was interviewed by phone or in person using a semi-structured approach so that the same set of questions was asked in each case.

#### *Task 1.2: Systematic retrieval of peer-reviewed scientific literature*

Peer-reviewed scientific literature was obtained from online databases, including Web of Knowledge, CAB Abstracts and Science Direct. Databases were searched using a range of keywords, including the species names of biological controls and aphid pests, active ingredients etc. A total of 270 peer-reviewed scientific journal papers were reviewed.

#### *Task 1.3: Retrieval of relevant 'grey' literature*

'Grey' literature included AHDB Horticulture (formerly HDC), IOBC conference proceedings and other conference proceedings. A total of 22 AHDB Horticulture reports and factsheets, 12 conference proceedings, seven book chapters and two Defra reports were reviewed.

#### *Task 1.4: Collation and summarising of key information*

Peer reviewed scientific literature and relevant 'grey' literature was summarised and combined with results from the interviews with industry representatives.

All interviewed growers confirmed that they were managing aphid pests at the time of the interviews (August to September 2015). All but one of the interviewed growers considered aphids to be a major pest of protected pepper and chilli crops. Several interviewed growers indicated that lepidopteran pests were also a key concern. Growers and crop protection specialists confirmed that the most common aphid pests were *Myzus persicae*, *Aulacorthum solani*, *Aphis gossypii* and *Macrosiphum euphorbiae*.

Biological controls were used by all interviewed growers, with preventative releases made early in the season. Once aphids were recorded in the crop, growers increased release rates of biological controls accordingly. The most widely used biological control was the aphid parasitoid *Aphidius colemani*. The aphid predator *Aphidoletes aphidimyza* was also widely used. *Aphidius ervi* was frequently used, particularly for control of *Aulacorthum solani*. Other species of parasitoid wasp used included *Aphidius matricariae* and *Aphidius abdominalis*. Growers reported that some crops were naturally infested with *Praon* spp., and a few growers had purchased *P. volucre* in the last five years. Other than *Aphidoletes aphidimyza*, growers rarely used other aphid predators, although the interviewed organic grower did release the hoverfly *Episyrphus balteatus*. Few growers released the lacewing *Chrysoperla carnea*, despite biological control suppliers frequently mentioning this species during interviews.

With a reliance on aphid parasitoids in pepper crops, hyperparasitism is become a major problem for pepper growers. All interviewed growers were aware of hyperparasitism and confident in recognising its presence within the crop. When high rates of hyperparasitism are detected, releases of parasitoids are stopped and an insecticide application made to reduce hyperparasitoid, parasitoid and aphid numbers. After spraying, *A. aphidimyza* was often released to provide aphid control. This is the same approach as that described by crop protection specialists. Open rearing units (ORUs) were thought to exacerbate hyperparasitism problems by several growers and crop protection specialists while others thought that ORUs usefully maintained and boosted parasitoid numbers in the crop.

Interviewed growers only used insecticides to manage aphid pests when populations were sufficiently large that reliance on biological control was no longer economically viable or hyperparasitism rates were high. Conventional growers generally used pymetrozine (Chess WG), typically applied through the irrigation system, which was sometimes followed by an application of pirimicarb (e.g. Aphox). Organic growers used fatty acids (e.g. Savona). Growers were happy with the efficacy of available insecticides but there were concerns about the reliance on pymetrozine and pirimicarb. Indeed, *Myzus persicae* and *Aphis gossypii* are known to have developed resistance to carbamate insecticides, such as pirimicarb, as well as pyrethroid insecticides. The interviewed organic grower felt that fatty acids provided useful control of aphid pests but noted that *Aphis gossypii* in particular had a tendency to survive sprays. Although biopesticides present a potential alternative to currently used insecticides, few growers mentioned their use. The interviewed organic grower had, however, used maltodextrins (e.g. Majestik).

Pepper crops represent a difficult crop to spray effectively, particularly on lower leaf surfaces, due to the large drooping leaves of mature pepper plants, most of which hang at approximately 30° off vertical. Ultra low volume sprays are known not to penetrate the pepper crop canopy

as effectively as high volume sprays. Coverage using high volume sprays can be improved by using a vertical spray boom with two types of nozzle, 'lifters' and 'fillers'. The 'lifter' nozzles drive a spray underneath the near-vertical leaves and so lift them up to allow the 'filler' nozzles to cover the lower leaves further inside the canopy with a fine spray. Despite this modification, complete coverage of lower leaf surfaces may not be achieved.

Interviewed growers were aware of the importance of good hygiene practices both within and between crops. Despite this, none of the growers interviewed mentioned using physical barriers such as screens on glasshouse vents to prevent aphids entering the crop. Indeed, there was concern that such screens would be prohibitively expensive and would negatively affect environmental conditions within the glasshouse.

The majority of growers interviewed received information relating to aphid control from visiting supplier representatives. Most interviewed growers were happy to receive their information from suppliers but some expressed a wish to access their own information so they could receive a wider range of opinions. To this end, several growers researched their own information from websites such as the AHDB Horticulture website. Several growers commented that factsheets were very effective and could be circulated amongst staff.

### **Objective Two: Identify knowledge gaps in aphid control in pepper crops and opportunities to adopt controls used in other countries or on other crops for use in pepper crops in the UK**

The completed interviews and literature review highlighted several knowledge gaps and opportunities to improve aphid control. Hyperparasitism was highlighted by interviewed growers and crop protection specialists as being a key concern due to the disruption that this causes to biological control programmes. Hyperparasitism is typically managed through the use of an insecticide application, which reduces aphid, parasitoid and hyperparasitoid numbers. Despite the importance of hyperparasitism there has been little research in this area. Preliminary work has, however, been completed investigating the potential of a system in which semiochemicals are used to manipulate hyperparasitoid behaviour. This approach could address grower concerns over the use of insecticides to manage hyperparasitism and would be of benefit to growers of other crops in which aphid parasitoids are regularly used.

One of the main benefits of improved biological control of aphid pests using predators would be a reduced reliance on the use of *Aphidius colemani*, which in turn may reduce the impact of hyperparasitism on aphid control. Opportunities include the use of flightless morphs of the two-spotted ladybird (*Adalia bipunctata*) and greater use of the lacewing *Chrysoperla carnea*. There is, however, still much to learn about the importance of interactions, both negative and

positive, between different biological controls, in particular generalist predators, used in pepper crops. Where parasitoids are used, there are opportunities to improve their efficacy by exploiting attractants, to target their activity, and pre-conditioning wasps before release into the crop.

Growers currently rely on the use of pymetrozine (Chess WG) and to a lesser extent on pirimicarb (e.g. Aphox) and there is concern that over reliance on these two active ingredients may lead to development of insecticide resistance in aphid pests. Resistance has already been reported to pyrethroids and carbamates (e.g. pirimicarb) in *Myzus persicae* and *Aphis gossypii* populations. Reviewing the literature does, however, point to several active ingredients not currently registered for use in protected pepper crops grown in the UK but which may provide useful alternatives to currently used insecticides. These active ingredients include spirotetramat (e.g. Movento) and flonicamid (e.g. Mainman), which are effective against the aphid pests affecting pepper crops and are generally compatible with biological controls that may be used in these crops. In addition, several coded biopesticides have been identified as being effective against aphid pests through the SCEPTRE (HDC project CP 77) and MOPS (AHDB Horticulture project CP 124) projects. In other work, the biopesticide neem (NeemAzal) has recently been evaluated in organic pepper crops and gave good aphid control, reducing aphid numbers and preventing visible aphid damage. It should be noted that neem is not yet registered for use in the UK.

Despite the concerns highlighted in the interviews that fitting screens to vents and doors would be prohibitively expensive and would disrupt temperature and humidity control, the fact that this approach has been successfully demonstrated in protected lettuce crops indicates that it is worth further investigation. Similarly, although few growers discussed the importance of application technology, previous work has demonstrated the benefits of modifying spray equipment to improve coverage. Work to date has been focused on wide bed organic cropping systems and so further work in conventional cropping systems is required.

## **Financial Benefits**

The home marketable production of protected peppers grown in the UK in 2014 was worth £200k per hectare, with 258 tonnes of peppers produced per hectare and a total of 23,700 tonnes of peppers produced across the UK in total (Basic Horticultural Statistics 2014). The cost of routine aphid control in a conventional pepper crop has been estimated at £5.8k per hectare per season. When aphid outbreaks occur, however, in the pepper crop the cost of control increases substantially due to the increased number of biological control and

insecticide applications, washing fruit damaged by honeydew and loss of yield. Together these costs may mean that aphid control exceeds 100k per hectare per season.

## Action Points

Results from the interviews with growers and crop protection specialists indicate that aphid control in protected pepper crops is based on current best practice. The following action points, therefore, relate to gaps in knowledge and opportunities identified through this project:

- There is a lack of information on the biology and control of hyperparasitism. Interviewed growers were interested in alternatives to the current use of insecticides to manage hyperparasitism. Preliminary work investigating the use of semiochemicals to manipulate hyperparasitoid behaviour shows considerable promise but requires further work to develop a practical solution for growers. Improved control of hyperparasitism would be of benefit to a wide range of growers who regularly use aphid parasitoids to control aphid pests.
- Extending the range of biological controls, in particular the use of predators, used to control aphid pests may help to improve control and reduce hyperparasitoid problems by reducing the reliance on *Aphidius colemani*. Greater use of generalist predators would, however, increase the need for further work to investigate interactions between biological controls, such as intraguild predation.
- There are several insecticide active ingredients, such as spirotetramat and flonicamid and biopesticides, such as neem, that could provide useful control of aphid pests and reduce the reliance on, and possible development of resistance to, pymetrozine. Further work to determine the efficacy of these alternative insecticides and biopesticides as well as their compatibility with IPM programmes used in pepper crops is required.
- Assessing the potential of using screens over vents and doors to prevent sporadic invasion by large numbers of aphids is required to determine the cost-effectiveness of this approach. In particular, it will be important to confirm that environmental management can be successfully adjusted to compensate for any effect the screens may have on temperature and humidity in the glasshouse.
- Work in a wide bed organic cropping system has demonstrated that modification of spray equipment can improve spray coverage and as a result control of aphid pests. There is potential both to further improve spray coverage and to adapt these systems for use in conventional crops.