Grower Summary

SF 102

Biology and integrated control of blackberry leaf midge on blackberry and raspberry

Final Report 2011

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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 HDC office (hdc@hdc.ahdb.org.uk), quoting your HDC number, alternatively contact the HDC at the address below.

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Headline

- Of the chemical pesticides tested, only chlorpyrifos was effective in controlling blackberry leaf midge, but knowledge of the biology of the pest was improved.

Background and expected deliverables

To meet consumer demand for soft fruit over an extended season, there has been a substantial increase in UK production of protected blackberries and raspberries, mainly in 'Spanish' tunnels. This has led to increased problems with pests previously considered to be 'minor' pests of outdoor crops, including blackberry leaf midge, *Dasineura plicatrix*. This pest is now widespread and is often very damaging, particularly on blackberry. The larvae feed on the leaves of primocane tips, causing leaf twisting and distortion, cane stunting, cane branching and reduced yield in the following year's crop. Prior to this project, the life cycle of blackberry leaf midge on protected blackberry and raspberry was not fully understood.

The project aims and expected deliverables were to confirm the location and timing of key life-stage events of blackberry leaf midge on protected blackberry and raspberry crops and to test integrated control methods for use on protected blackberry, with a view to extrapolating the methods to protected raspberry.

Summary of the project and main conclusions

Objective 1: To confirm the location, timing and duration of key life-stage events of blackberry leaf midge on protected blackberry and raspberry

The biology of blackberry leaf midge was confirmed in two protected blackberry crops during 2009 and 2010, one grown in pots (Meadow field), the other grown in the soil (Chivers field).

In 2008/2009, the pest was shown to overwinter as cocoons in the soil. Most were found at a depth of 3 cm in the path in between the plant rows, at the edge of the ground-cover matting running under the crop canopy. They were also found in the soil in the planting hole, under the polythene covering the ground between plants and in plant debris on the polythene.

In 2009, the first male midge was found in water traps on 8 April in Meadow field and the first females on 15 April in both fields. In 2010, the first females were found on 12 and 19 May in Meadow and Chivers fields respectively and the first males found on 19 May in both fields. The later midge emergence in 2010 is likely to have been due to the very severe winter of 2009/2010.

In 2009, the first midge eggs and larvae were found in leaf tips on 15 and 22 April in Meadow and Chivers fields respectively. In 2010, larvae were first found in Chivers field on 5 May (two weeks before adult midges were detected in this field). Thus the water traps did not detect the first adult midges emerging in 2010, probably due to midge numbers being much lower than in 2009.

Soil temperature data between March and June was modelled in a similar manner to the ADAS raspberry cane midge model to predict first generation blackberry leaf midge emergence and first egg-laying dates. In 2009, results were very promising as the predicted dates were only five days earlier than the actual dates when first eggs were found, i.e. 15 and 22 April in the two fields. This suggested that blackberry leaf midge emerges and lays eggs slightly earlier than raspberry cane midge, at a cumulative soil temperature of around 280°C days above a base temperature of 4°C.

In 2010, we found first eggs and larvae between 5 and 12 May, 11-18 days later than the predicted dates of 22 and 25 April in the two fields. However, the grower noticed the occasional infested leaf tip earlier than this. Midge numbers were much lower than in 2009, thus sampling random leaf tips must have missed the very first infested tips.

In 2009, numbers of midge adults remained low (below two per trap) until June and July. Mean numbers per trap peaked on 22 July in Meadow field (24 per trap) and on 8 July in Chivers field (132 per trap). In 2010, numbers of midge adults were much lower in both fields. Meadow field was only monitored until first adult emergence and on the final trapping date on 19 May there was a mean of only 0.2 per trap. In Chivers field, midge adults were monitored between March and September and mean numbers peaked on 15 July at 34 per trap. The lower numbers of midges occurring in 2010 could have been partly due to the severe winter of 2009/2010 killing a proportion of overwintered cocoons but also due to the plants in Chivers field suffering from *Verticillium* wilt so they produced fewer new leaf tips for egg-laying.

During peak adult activity in both years, numbers of males trapped were much higher than those of females. This could possibly be due to differences in the behaviour of males and females rather than an uneven sex ratio in the population.

In 2009, the percentage of leaf tips infested with eggs and larvae increased rapidly in both fields, from 30% and 5% in Meadow and Chivers fields respectively in mid-April, to 90% and 100% respectively in late June/early July. In 2010, the percentage of infested leaf tips in Chivers field increased from 5% in early May to 100% in late June. Larvae were found until late September in 2009 and until early September in 2010.

Midge larvae fed for approximately two weeks in the leaf tips, causing them to twist. Severely damaged leaves turned brown and withered.

When fully fed, the larvae dropped to the ground to pupate in cocoons.

Monitoring of three protected raspberry crops in June 2009 confirmed that the pest damaged raspberry but the percentage of infested leaf tips was much lower than on protected blackberry crops at this site. This may have been partly due to incidental midge control by chlorpyrifos used against other pests such as raspberry cane midge.

In 2009 there were four overlapping generations in protected blackberry between April and September, unlike on outdoor blackberry where only two generations are reported, in May/June and July/August. In 2010, first generation midges were not active until May/June and there were second and third generations in July/August and August/September. Thus on protected blackberry, depending on the season, first adult emergence can be earlier, there are more generations per season and the pest is active for a longer period than on outdoor blackberry.

Objective 2: To evaluate potential integrated control methods against blackberry leaf midge, for use in IPM programmes on protected blackberry

Biological control agents

In 2009, laboratory experiments indicated that both the predatory mites *Neoseiulus (Amblyseius) cucumeris* and *Amblyseius andersoni* predated midge eggs and young larvae.

In 2009, introductions of both *N. cucumeris* and *A. andersoni* to blackberry using release sachets in research tunnels led to some establishment of *N. cucumeris* in flowers but no apparent establishment of *A. andersoni*. Following grower releases of *A. andersoni* to protected blackberry, there was no apparent reduction in the pest when compared with untreated plants. In 2010, releases of the two species in sachets to blackberry in research tunnels indicated that *N. cucumeris* reduced the percentage of infested leaf tips whereas *A. andersoni* did not. Further work would be needed on a larger replicated scale to confirm the potential control given by each species.

In 2009, in laboratory pot experiments, neither the predatory mites *Macrocheles robustulus* nor the predatory beetles *Atheta coriaria* gave significant reductions in numbers of midge larvae successfully completing their development in compost and emerging as adults. In 2010, similar pot experiments compared the potential of *M. robustulus* (at higher release rates than in 2009) with that of the predatory mite *Hypoaspis aculeifer*. Adding each predator in equal numbers to those of leaf midge larvae did not significantly reduce numbers of adult midges emerging. However, in both years, the reduction given by *M. robustulus* was almost statistically significant, and further replication or adding higher numbers of predators might give a significant result. This species in now commercially available and justifies further investigation should any future funding be available.

In 2009, grower applications of *Beauveria bassiana* (Naturalis-L) to the commercial crop did not give reductions in numbers of midge larvae or infested leaf tips. *B. bassiana* is a contact-acting fungus and is unlikely to reach the target pest inside folded leaf tips. In a laboratory test, application of Naturalis-L to compost did not reduce numbers of blackberry leaf midge larvae successfully completing their development in the compost and emerging as adults.

In 2009, naturally-occurring anthocorid bugs (both *Anthocoris nemorum* and *Orius* sp. adults and nymphs) were observed feeding on blackberry leaf midge larvae in the commercial crop during July and August.

Orius laevigatus are commercially available and work on its potential against the pest was conducted in 2010. In laboratory studies, adult *Orius* established and produced nymphs in blackberry flowers where only blackberry pollen was available as food. In predation studies, adult *Orius* ate at least five midge larvae per day.

In 2010, releases of adult *O. laevigatus* were made to a commercial tunnel of blackberries in late March and early April. The crop was not yet in flower so flowering strawberry and pussy

willow were tested as potential breeding 'banker' plants for *Orius*. A few *Orius* nymphs developed on the strawberry plants but establishment was poor and *Orius* were not detected on the blackberry plants when they began flowering. This was probably due to temperatures being too low for good predator reproduction. However, grower releases of *Orius* in late June led to good establishment on blackberry by early August, indicating that *Orius* could play a useful role in maintaining low midge numbers once temperatures are suitable. In Horticulture LINK project HL0117, ADAS research in 2010 demonstrated the potential of flowering alyssum as a 'banker' plant to aid establishment of *O. laevigatus* in everbearer strawberry, for improved biological control of western flower thrips (Cross *et al* 2011). Further research in this HortLINK project could also benefit midge control in protected blackberry.

Cultural control methods

In 2010, a pot experiment showed that using polythene or woven ground-cover matting over the substrate inhibited successful pupation of larvae dropping to the ground. Black polythene and Mypex ® reduced the numbers of midges emerging by 96% and 53% respectively compared with the compost control. It is possible that if the whole tunnel floor was covered in matting or polythene, and if this could be kept intact and free from plant debris, it might prevent adults successfully emerging from overwintered cocoons in the soil, or prevent first generation midge larvae successfully pupating and emerging as second generation adults. Further work would be needed to validate this potential cultural control method in a protected blackberry crop.

Pesticides

In 2009, grower applications of thiacloprid (Agrovista Reggae, SOLA 0467/2008) and abamectin (Dynamec, SOLA 2290/2007) did not reduce numbers of live midge larvae per leaf tip or percentage of infested leaf tips when compared with untreated plants.

In 2009, grower application of chlorpyrifos (Alpha chlorpyrifos, SOLA 1081/2009 for outdoor blackberry) to outdoor blackberry reduced numbers of live midge larvae per leaf tip by 87% and reduced the percentage of infested leaf tips by 92% when compared to untreated plants. By extrapolation, chlorpyrifos should give some control of the pest on raspberry. Various chlorpyrifos products are approved on both outdoor and protected raspberry. However, chlorpyrifos does not have a SOLA for use on protected blackberry and is not compatible with biological control agents used in IPM.

In 2010, application of a coded pesticide as a foliar spray to blackberries in research tunnels did not give reductions in numbers of midge larvae or infested leaf tips.

Financial benefits

The UK area of blackberries is estimated at 140 ha of which at least 70% is grown under protection, mostly under Spanish tunnels during the growing season. Average yields are estimated at 15 t/ha with a value of £4,800/t and a gross margin of about £16,000/ha. Blackberry leaf midge is present in approximately 70% of the blackberry area, with up to 100% leaf tips infested at peak activity. As there is currently no effective control measure for the pest on protected blackberry, it is estimated that in an average year, yields could be reduced by at least 30%. On infested farms, this would result in gross margin reductions of 60%, costing individual growers £9,600/ha and the industry £2.1m per annum. In the absence of an effective control measure for the pest, it is likely that the cumulative reduction in cane and plant growth on highly susceptible varieties such as Loch Ness, will force growers to grow other more profitable protected soft fruit crops.

This project demonstrated that blackberry leaf midge also attacked protected raspberry, but to a lesser extent than on blackberry. This was probably due to incidental midge control by chlorpyrifos used against other pests e.g. raspberry cane midge and raspberry beetle, and to the raspberry varieties monitored being less susceptible to the pest. The area of raspberries grown in the UK is 1,757 ha (Defra Basic Hort Stats 2010). Average yields are estimated at 14.2t/ha with a value of £6,000/t, giving a gross margin of about £34,500/ha. Blackberry leaf midge currently affects about 20% of the raspberry area, notably on farms where chlorpyrifos is no longer routinely used, or where particularly susceptible primocane varieties are grown and/or double cropped each year. In the absence of chlorpyrifos, e.g. where growers are using IPM, or should this pesticide be withdrawn, in an average year, on farms where the pest is present, raspberry yields are likely to be reduced by at least 15%. This would result in gross margin reductions of 15%, costing individual growers £4,500/ha and costing the industry over £22.5m per year.

This project has provided a significant amount of new information on the biology of blackberry leaf midge on protected blackberry. This knowledge will allow more effective planning and timing of currently available and future control measures should they be developed. Chlorpyrifos was shown to be the only currently effective pesticide and this will benefit control of the pest on outdoor blackberry and on both protected and outdoor

raspberry, on which various chlorpyrifos products are approved. However, a SOLA for use on protected blackberry is unlikely to be supported. Discussions are currently being held with pesticide suppliers over possible testing of other potential active ingredients against the pest, which could not be included in this project due to limited resources.

For example, new knowledge on the location of overwintering cocoons in the soil offers the opportunity for targeting this life stage with a soil-applied pesticide, either at the end of the season or before first generation adults are likely to emerge. An effective soil drench could offer critical control of first generation midges and would be more compatible with biological control agents used on the plants in IPM programmes.

Knowledge on the location of overwintering cocoons also offers the opportunity for cultural control of the pest using ground-cover materials. Work to validate the potential control method demonstrated in this project is justified on a commercial crop scale.

Results in this project indicated that *Neoseiulus (Amblyseius) cucumeris*, *Orius laevigatus* and *Macrocheles robustulus* were the most promising biological control agents against the pest. Further research would be needed to develop an effective IPM strategy including prediction, monitoring, cultural, biological and compatible chemical control methods.

Action points for growers

- Monitor for first generation blackberry leaf midge from early April.

- If the pest occurs on outdoor blackberry or either outdoor or protected raspberry, consider a foliar application of chlorpyrifos which should give some control. However, this pesticide does not have a SOLA for use on protected blackberry and is not IPM- compatible.