Grower Summary

TF 194 (HL 0189)

Developing biocontrol methods and their integration in sustainable pest and disease management in plum and cherry production

Annual Year 3

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

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Headline

Progress is being made in the development of novel biocontrol techniques for controlling insect pests and diseases in stone fruit crops.

Background and expected deliverables

The overall aim of the project is to develop alternative, sustainable, non-pesticidal methods for managing brown rot, aphid pests, plum fruit moth and light brown apple moth in UK plum and cherry crops by incorporating biocontrol approaches. These are the most important crop protection problems in UK stone fruit production and they are currently controlled with pesticides. The non-pesticidal methods developed for the individual pests and diseases will be combined with existing non-chemical methods for other pests and diseases in Integrated Pest and Disease Management (IPDM) programmes which will be tested and refined.

The project will investigate new biocontrol methods with a view to subsequent development by industry, as follows:

- A microbial biocontrol agent or alternative non-pesticidal treatment for brown rot.
- Sex pheromone based systems for control of plum fruit moth and light brown apple moth, the latter a new pest in the UK which is highly damaging to cherries.
- If possible, a novel biocontrol approach for aphid pests which exploits the vectoring of entomopathogenic fungi by ants.
- An autumn entomopathogenic fungal treatment for aphids.
- A sex pheromone attract-and-kill treatment or autumn control approach for damson hop aphid.
- An autumn entomopathogenic nematode treatment for plum fruit moth.

The IPDM programmes will be more sustainable than current systems which rely on pesticides which are harmful to natural enemies. Natural enemies and biodiversity will be enhanced in the orchard environment.

Residue surveillance shows that approximately 60% of UK produced stone fruit contains pesticide residues with multiple residues in 25% of samples. The IPDM system will reduce pesticide use in stone fruit (by > 50%) and greatly reduce, hopefully eliminate, the occurrence of detectable pesticide residues in harvested fruit

Summary of the project and main conclusions

Objective 1 (BCAs for brown rot)

Two microbial strains have been identified (one yeast and one bacterium) that have consistently suppressed brown rot development on cherry and plum in laboratory experiments. These are being identified and will be subjected to further trials next year.

Of the commercial BCAs, only Serenade showed some effects in reducing brown rot development, especially on cherry. A pilot field trial on plum also indicated that the efficacy of using Serenade pre-harvest to control brown rot on plum is limited. Further trials are needed to confirm this.

Applying Indar to mummified fruit (with brown rot) in winter, completely suppressed sporulation on mummified fruit the following spring.

Objective 2 (exploiting ants in aphid control)

Vectoring of Lecanicillium longisporum to Myzus cerasi by Lasius niger under glasshouse versus outdoors conditions

A replicated experiment was done in glasshouse versus outdoor conditions examining the passive vectoring of the entomopathogenic fungus (EPF) *Lecanicillium longisporum* by the common black ant *Lasius niger* to colonies of the cherry blackfly *Myzus cerasi*, feeding in the shoots of young pot-grown cherry in September 2011 at East Malling Research. The fungus was grown on the surface of nutrient impregnated cloth which was tied in a band round the trunk of each cherry tree at about 1 m above the ground. An isolated artificial ant colony was provided at the base of each tree, the ants being forced to cross over the surface of the EPF colonies on the band to acquire honeydew from the aphis, their principal source of food in the experiment. Ants became contaminated with EPF spores and the experiment examined whether mycosis due to the EPF would develop in the aphid colonies. The population growth of the aphid colonies, ants attending them and the development of mycosis in the aphid colonies were closely monitored.

The EPF bands did not obviously affect the ants, though there was some evidence of greater cleaning behaviour of ants which were exposed to the EPF. At first, the ants showed preference for feeding on the extra floral nectaries present on the leaf petioles of the cherry but they switched their feeding to the aphids as the aphid colonies became larger. The attendance of ants which had been exposed to the EPF through crossing the band treatment did not affect the population growth of the aphids, compared to the controls where ants were not exposed to the EPF. Aphid population growth proceeded rapidly in both cases. Outdoors, generalist insect predators (mostly ladybirds), attacked the aphid colonies and reduced the rate of increase of aphid populations, but this was not affected by the ± EPF treatment. In the glasshouse, such predators were excluded and the aphid population growth was much more rapid. After 3 weeks, at the end of the experiment, some mycosis was observed in the aphid colonies on the EPF-banded trees. Mycosis due to EPFs was also present on control trees, but at a much lower level. This experiment indicates that the vectoring of EPFs to control *M. cerasi* did not cause sufficient or timely mortality to warrant use of the method for biocontrol. There were also severe practical difficulties in producing, applying and maintaining viable EPF colonies on nutrient bands exposed to typical fluctuating weather conditions. For these reasons, this approach is not promising and will not be further researched in the project.

The effects of the presence of root aphids and ant exclusion or supplementary feeding with sucrose on cherry blackfly (Myzus cerasi) and its predators on cherry trees

An orchard experiment was done in May - July 2011 at East Malling Research to determine whether exclusion of ants with sticky bands or providing alterative sugar sources for *Lasius niger* can lead to better predation of aphids by aphidophagous predators and a reduction in cherry blackfly (*Myzus cerasi*) damage on cherry in the presence or absence of grass root aphids. The experiment was a factorial comparison with two factors 1) ‘Ant’ which had three levels: i) untreated control where ants had full undistracted access to the *M. cerasi* colonies ii) ants excluded by a sticky band round the base of the tree trunk; iii) ants provided with a liquid sucrose solution feeder at the base of the tree to distract ants from attending the aphids and 2) the factor ‘±Root aphid’ which had two levels: i) grass root aphids present ii) grass root aphids absent. The presence versus absence of grass root aphid was applied by killing the grass host of the aphid with the herbicide glyphosate in the plots where root aphids were required to be absent. Replicated plots of newly planted cherry trees artificially infested with *M cerasi* were used in two different old cherry orchards where the old trees had been felled and removed leaving the stumps. Assessments were madein three time periods 1) of ants foraging in the cherry trees visiting extrafloral nectaries before treatment 2) additional assessment of ants visiting the feeders after treatment but before artificial aphid infestation 3) additional assessment of the aphid colony size, ant attendance and numbers of predators after aphid infestation.

The two orchards, though close and similar, had very different levels of ant attendance on the *M. cerasi* colonies, possibly due to very different populations of spiders (especially *Enoplognatha ovata*) which killed many foraging ants and built webs round the cherry tree trunks to a high degree in one orchard, so greatly reducing ant attendance on aphids.
In the orchard where there was a high degree of ant attendance, both ant exclusion and sucrose feeding greatly reduced aphid populations growth compared to untreated controls where ants defended the aphids against predators. The main predators were hoverfly larvae, earwigs and ladybirds which effectively devoured the aphids on the plots where ants were excluded or distracted by the sucrose feeders. In the plots with a low degree of ant attendance probably due to the spiders, the aphid populations were very low and treatment effects were not clear.

The presence of grass root aphids had some effect during the first two assessment periods when ant foraging and feeding at extra floral nectaries was reduced. In the last assessment period, the presence of root aphid did not significantly affect ant attendance on the aphids, though populations were lower where the root aphids were present.

In conclusion, this experiment further supported the finding that exclusion of ants by sticky barriers or distraction with sucrose feeder is an effective measure for control of *M cerasi*.

Objective 3 (autumn control of aphids)

Four further replicated large plot orchard experiments, two on cherry and two on plum, were done in 2010-2011 to evalaute the efficacy of end-of-season clean up sprays with the aphicide thiacloprid (Calypso) for control of *Myzus cerasi* and to identify the best time of application. Single sprays of Calypso were applied at 2 week intervals from end of September to mid-November. The cherry experiments yielded no results because at one site no aphids developed even on the untreated control plots and at the other site aphid populations were too variable for statistical analysis. One plum experiment yielded no results as the orchard was grubbed unexpectedly before the spring aphid assessments could be done. At the other site, the Calypso sprays on 16 Sept, 14 October and 28 October all greatly reduced leaf curling plum aphid numbers and probably mealy plum aphid numbers compared to the control, though for this latter species populations were too patchy for clear statistically significant treatment effects.

Objective 4 (plum fruit moth mating disruption and autumn control with nematodes)

The efficacy of mating disruption (MD) using monthly sprays of Checkmate OFM-F or Checkmate OFM-XL laminate dispensers were compared with a growers full standard insecticide programme for control of plum fruit moth on plum. The work was done using four unreplicated, large plot experiments at Machine Farm, Fladbury, Worcestershite, Castle Fruit Farm, Newent, Gloucestershire, Mann of Ross, Ross-on-Wye, Herefordshire and Hayle Farm, Horsmonden, Kent. Two of the trials (Machine Farm, Fladbury and Mann of Ross) were continued for their third year, mainly using the same orchard plots as in previous years, though the pheromone MD and laminate treatments at Mann of Ross were moved to another orchard in 2011 because the orchard used for them was grubbed in autumn 2010. The trials at Castle Fruit Farm and at Hayle Farm, Horsmonden, were done for a second year on the same plots. The following conclusions were drawn from the results in 2011:

- The MD laminate treatment caused 100% trap shut down at 2 sites and >96% shut down at 2 sites in 2011.
- The MD spray treatment gave 100% shut down at only one site and 77% and 96% shut down at two others. At the fourth site, the MD spray treatment performed poorly, only reducing catches by 20% compared to the growers and untreated control plots.
- No damage to fruits at harvest was found in any of the plots at 3 of the sites, possibly because poor weather conditions (rain and cool temperatures) did not favour the pest in 2011.
- A low but significant level of damage was found at the most heavily infested site. The MD laminate treatment had 97% less damage than the untreated control. The MD spray treatment gave moderately good control, reducing damage by 68%, performing as well as the grower’s standard insecticide treatment.
- No phytotoxicity was observed.

These 2011 results differ from the 2010 results which indicated that the laminate MD treatment was less effective than the MD spray treatment. The reasons for the difference between the two years is unclear. It may be that in 2011, weather conditions were less suitable for the spray formulation, which might be washed from the leaves by rainfall.

The results from 2009, 2010 and 2011 as a whole indicate the MD treatments are effective for control of plum fruit moth. Good control was achieved even in the heavily infested site at Machine Farm, Fladbury.

Note there is a virtual zero tolerance of plum fruit moth in harvested fruit. MD treatments generally only perform well when pest populations are low to moderate and they have to be used in conjunction with insecticides or other control methods when pest populations are high.

Objective 5 (light brown apple moth sex pheromone mating disruption)

No field experimental work could done on this objective in 2011 because the emergency approval for the Exosex LBAM MD system expired and was not renewed in time and in any case LBAM moth populations were extremely low following the severe 2010-11 winter. Experiments would probably not have yielded useful results. Effort was devoted instead to obtaining experimental approval for a new biopesticide product for control of summer fruit tortrix moth which has become the dominant totricid pest in UK cherry orchards. Experimental work to evaluate this product will be done in 2012 and 2013.

Financial benefits

Modern intensive UK stone fruit production requires high capital investment and the crops are valuable. In 2006, 1,100 tonnes of cherries worth £2.03 million and 14,100 tonnes of plums worth £10.56 million were produced from 420 ha and 950 ha of orchards grown in Britain, respectively. 22,300 tonnes of cherries worth £48.4M and 66,000 tonnes of plums worth £57.1 million were imported. A very large proportion of the fruit consumed in the UK is imported because the UK industry is currently too small: Only 5% of cherries and 17% of plums consumed are produced in the UK (see below) and there is considerable scope for home production to be increased. The UK fresh market is even undersupplied during the main seasons in July (cherries) and August-September (plums). Multiple retailers including Sainsbury’s, the leading supplier of UK produced stone fruit, are seeking to source a far greater proportion of stone fruit from the UK as well improving the environmental acceptability of stone fruit production and to improve consumer trust by eliminating the occurrence of reportable pesticide residues.

Better rootstocks which are more productive and crop reliably, new varieties which extend the season, effective methods of avoiding frost damage and rain induced splitting of cherries, coupled with increased demand for locally produced fruit are resulting in an expansion of UK stone fruit production. The recent development of an effective protein based spray treatment which simulates the plant's defences against fruit splitting in cherries, caused by wet conditions before and at harvest, means that serious unpredictable losses which have hitherto dogged the UK industry can be avoided. Establishing new crops requires substantial investment (£50,000/ha for cherries) and growers need confidence that their orchards will crop reliably and that their fruit will find a profitable market. Growers are gaining confidence and it is expected that UK production will increase substantially through new plantings over the next few years.

Annual value in area of impact

Brown rot, aphids, plum fruit moth and light brown apple moth are the main pest and disease problems of UK stone fruit production and are very common wherever and however stone fruits are grown in the UK. A very high percentage of stone fruit orchard plantations are infected by these pests and diseases. A survey of the incidence of brown rot in plum and cherry orchards in Defra project HH2604STF completed in 2004 showed that losses in cherries after one weekof post-harvest cold storage ranged from 11 to 96% and losses in Victoria plums after one week of cold storage varied from 12% to 100%. Storage losses averaged about 50% in both crops. Losses in the orchard varied from 0-32% and averaged about 20%, despite pesticide treatment. This is equivalent to 220 tonnes of cherries, worth £400,000 and 2820 tonnes of plums worth £3.2 million per annum.

Market potential

If, conservatively, the UK industry were able to double production substituting imports or increasing consumption, the increased production would be worth £12.6 million per annum.

Expected annual added value

The knowledge and technologies delivered by this project will give UK producers confidence that serious losses due to pests and diseases can be avoided without more intensive use of pesticides which will underpin the expected expansion in production. If potential imports were only reduced by 20%, this would be worth >£20 million/annum to the UK economy. Cherry and plum crops are typically worth £6,800 and £3,700 per ha.

Grower uptake and customer acceptance

The project benefits the entire supply chain. Involvement of all elements of that supply chain in the consortium shows strong support for the project objectives. There is a high degree of confidence that the novel crop protection methods identified will be adopted by the industry.

Grower capital investment and cost recovery

It is not anticipated that this project will result in substantive additional capital investments for growers. Pesticide control methods used currently typically cost £150/ha per annum. It is likely that crop protection costs will increase because it is probable that the selective biological and semiochemical based control methods will be more costly than broad spectrum pesticides used currently. However, even if they were 2 - 5 times more costly, their cost of would still be small in relation to the value of the crop.

Other benefits

There are important environmental and human safety benefits which will result from reduced pesticide use, especially from reduced use of OPs. Some of the technologies are likely to be transferable to other crops grown under protection.

Action points for growers

Growers may need to consider autumn-winter application of Indar in orchards where a high number of mummified brown fruit is present to reduce inoculum production next spring.

Several applications of Serenade pre-harvest may also be considered, especially for organic orchards.

A spray of Calypso or another suitable aphicide in late September or early October will greatly reduce aphid populations the following spring.