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Project TF 181 (Defra Horticulture LINK HL 0194)

Tree Fruit

Developing integrated management controls for pear sucker

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Pear sucker (Figure 1) is a very serious pest of commercial pears in the UK, leading to significant damage (Figure 2) and crop loss in some orchards every year. This factsheet outlines the results and recommendations made from a Defra funded Horticulture LINK project which explored novel techniques for managing and controlling pear sucker.

Action points

- A wide range of naturally occurring predators including anthocorids, earwigs, ladybirds and spiders will prey on pear sucker and can regulate populations of the pest.
- Anthocorids are the main predators, but they do not overwinter in pear orchards. By including plant species in hedgerows/windbreaks which are attractive to anthocorids, populations can be enhanced.
- Earwigs are also important voracious predators of pear sucker. Where adequate populations are present, pear sucker is not a significant pest. Inspect orchards for earwigs, especially those with ongoing pear sucker problems and take measures to boost earwig populations where they are absent.
- Avoid the use of broad-spectrum insecticides and only use those which are known to be safe to anthocorids and earwigs.
- To encourage early season influx of anthocorids and other predators into pear orchards, conserve nettles, willow, hawthorn and hazel trees in the vicinity of pear orchards, and consider planting these if they are not already present.
- Hawthorn is an excellent source of predators, though if it is used, it should be regularly inspected and managed to avoid the risk of fireblight.
- If planting large orchards, include a network of as many hedgerows/windbreaks as is practical to ensure that all parts of the orchard are relatively close to a source of natural enemies.
- Dormant season sprays of kaolin give good suppression of the first generation of pear sucker nymphs where necessary.

1. **Pear sucker nymph**

2. **Typical fruit damage resulting from pear sucker infestation**

Introduction

Pear sucker is a devastating pest of pears which cannot currently be effectively and reliably controlled with pesticides. Many of the crop protection products currently approved for use against pear sucker are broad spectrum in nature and are harmful to a number of naturally occurring pear sucker predators. Their use can therefore exacerbate the problem. Pear growers are in need of new and improved control measures which encourage the development of natural predators and can be used within integrated pest management (IPM) programmes.

HDC part funded Defra Horticulture LINK project HL0194, which ran from 2008 until 2012. It aimed to combine exploitation of semiochemicals, conservation biocontrol and selective physical controls to develop improved IPM methods for the pest.

Pear sucker description and life history

Pear sucker overwinters in the adult stage (Figure 3). Adults are 1.5–2.0 mm long, dark brownish black, with transparent wings. In winter they can be found resting on pear trees, but some disperse to trees and other vegetation outside the orchard. In spite of the cold, they often make short flights on bright sunny days.

3. Adult pear suckers with their eggs laid on developing shoot

Eggs which are 0.6 mm long and oval in shape (Figures 3 and 5) are laid on spurs and shoots between late February and full blossom. At first they are straw coloured but gradually become orange. Hatching usually begins at bud burst and continues until the end of the flowering period. The nymphs (Figure 4) are flattened insects with red eyes and orange-yellow bodies which darken with age. They live on the blossom and leaves of the trusses and mature to form the first summer generation of adults. Eggs of the summer generations are laid on the leaves, mainly along the mid-rib (Figure 5). During the summer, the nymphs live in drops of honeydew on the underside of leaves (Figure 6), on blossoms and fruits and in leaf axils on developing buds.

4. Pear sucker nymphs

5. Summer generation eggs laid along the leaf mid rib

6. Nymph living in drop of honeydew

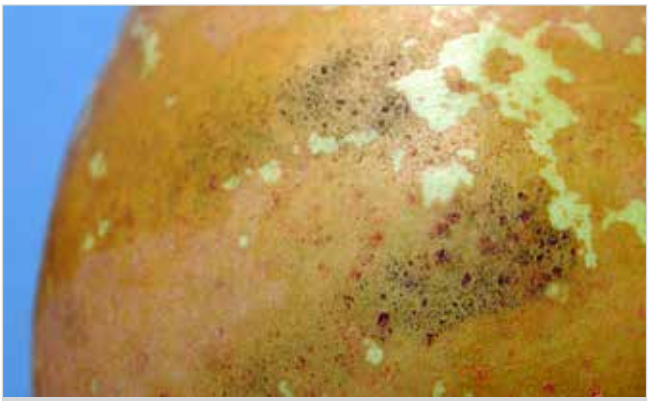
There are usually three generations per year with peak adult populations occurring about early June, late July and mid October. There is some overlap of generations during the summer. In the absence of control measures, even small numbers of adults surviving the winter can give rise to very large populations by the end of the summer.

During the growing season the presence of pear suckers may be detected by examination with a hand lens, or on a dry day by the droplets of honeydew on the underside of the leaves. The honeydew attracts bumble bees, flies, wasps and other bee species, which feed on it, and the presence of these insects on pear trees is usually a sign of infestation by pear sucker.

Pear sucker damage

Pear sucker nymphs feed on developing leaf and blossom trusses in the spring and on leaves in the summer, sucking the sap and weakening the tree. Blossoms, branches and even whole trees may be killed when infestations are large. Sooty moulds grow on the honeydew excreted by the nymphs, so that blackened shoots and foliage (Figure 7) are an indication of pear sucker infestations; these moulds persist on the wood into the dormant season. The moulds may also cover the fruits (Figure 8), spoiling their appearance.

7. Blackened shoots are an indication of pear sucker infestation



8. Sooty mould grows on the honeydew excreted by the nymphs

Pear suckers can also cause damage later in the season when the young of the third generation feed on the developing fruit buds in the leaf axils. This may result in death or a reduction in vigour of fruit buds, thus causing a decrease in the following season's crop. Very large infestations in late summer may lead to premature defoliation in September and October.

Pear sucker is also known to transmit pear decline, a debilitating phytoplasma disease of young trees, which causes an incompatibility between scion and rootstock.

Current knowledge of pear sucker management

Pear sucker is known to be favoured by hot, dry conditions. Rainfall reduces populations, honeydew deposits and damage.

Soft succulent, vigorous foliar growth is known to encourage infestations (Figure 9). Avoiding this by reducing nitrogen levels (where possible), removal of shoot growth, or the use of plant growth regulators will reduce the risks and severity of attack.

9. Soft succulent, vigorous foliage can encourage pear sucker infestations

A programme of low dose sprays of sulphur is known to make the foliage less susceptible to pear sucker. However, on some varieties, there may be a risk of phytotoxicity occurring.

Naturally occurring predators such as anthocorid bugs and earwigs have long been known to prey on pear sucker. Anthocorids are often visible feeding on pear sucker eggs and nymphs during the day. In contrast, earwigs are active at night, with the result that their usefulness can often be overlooked. Growers have traditionally been encouraged to conserve anthocorids and earwigs in and around pear orchards, by avoiding the use of broad-spectrum insecticides from 2-3 weeks after blossom onwards.

Earwigs can fully control pear sucker if there are very high populations in the orchard. More commonly though, where populations are not as high, earwigs and anthocorids can be expected to prevent or limit damaging outbreaks, but cannot be relied upon to gain complete control.

As a result, the industry believed it was time to fund further research into novel methods of control which avoided the use of broad-spectrum insecticides.

Defra funded Horticulture LINK research

Various industry parties including HDC (see further information section) collaborated to set up a Defra Horticulture LINK project to research novel methods of control. The project ran from 2008 until 2012, was led by Oliver Doubleday (G H Dean & Co Ltd) and co-ordinated by Jerry Cross (East Malling Research).

The aim was to develop new ways of managing the pest by building on existing knowledge and technology, whilst avoiding the use of traditional insecticide control. The project was broken into four major sections: the identification and exploitation of pear sucker sex pheromone; the development and use of anthocorids and other natural enemies of pear sucker; the identification and exploitation of plant volatiles which attract pear sucker; the identification of physically acting spray treatments.

Identification of a sex pheromone

Recent research by scientists at East Malling Research (EMR) and Natural Resources Institute (NRI) has successfully identified and exploited sex pheromones for a range of midge and weevil pests of fruit crops. Experience of scientists in USA had suggested that a pear sucker sex pheromone possibly exists and could be identified. This could provide a tool for monitoring pear sucker populations and, more importantly, a possible means of controlling the pest by mating disruption, mass trapping or attract-and-kill approaches.

In the early stages of the project, EMR scientists identified that the dominant pear sucker species in the UK is now *Cacopsylla pyri* and not *C. pyricola*, which was dominant when the last surveys were conducted in the 1970's. The research therefore focussed on *Cacopsylla pyri*. Unfortunately, no sex specific compounds that might be components of a sex pheromone could be identified. It was concluded that a pear sucker sex pheromone is unlikely to exist, or if it does exist, it is very weak and transitory and could not be exploited for monitoring or control purposes.

Work elsewhere has shown that acoustic signalling can act as a means of sexual attraction in various species of planthopper and psyllid, and this could be further researched in future.

Development and use of anthocorids and other natural enemies

Anthocorid bugs (Figures 10 and 11) are known to be powerful predators of pear sucker and can naturally regulate pear sucker populations. However, they do not overwinter in pear orchards and their influx in spring is often inadequate or too late. The project set about trying to identify trees and herbaceous plants which could act as sources or reservoirs of anthocorids. It was hoped to improve the species composition of hedgerows/windbreaks and develop management methods for a greater, more timely influx.

10. Anthocorid bugs are the main predators of pear sucker

11. Anthocorid nymph feeding on pear sucker eggs

It was found that two species of anthocorids occur on pear (*Anthocoris nemoralis* and *A. nemorum*) and both are important predators of pear sucker. It was discovered that *A. nemoralis* has a preference for feeding on psyllids (including pear sucker) which occur early in the season, whereas *A. nemorum* has a preference for feeding on aphids which tend to occur slightly later. Work was done to search for hedgerow species which host both psyllids and aphids which can act as an attraction for anthocorids.

Grey and pussy willow (Figure 12), hawthorn, hazel (Figure 13) and stinging nettles (Figure 14) were identified as the best sources of anthocorids as well as being rich sources of other important pear sucker natural enemies including ladybirds, earwigs and spiders.

12. Pussy willow is a good source of anthocorids

13. Hawthorn and hazel harbour anthocorids

14. Stinging nettles are a rich source of predators including anthocorids

In contrast, Italian Alder (*Alnus cordata*), which is typically used as a windbreak species in pear orchards, supports very few predators (Figure 15). Growers should therefore encourage or plant any or all of the above species in existing or new hedgerows or windbreaks in and around pear orchards.

15 . Alder windbreaks harbour very few predators

It should be noted however, that if establishing a new hedgerow with these species, it might take 6-10 years for characteristic arthropod fauna to establish after planting, although some dominant species may colonise earlier.

Many growers have traditionally killed stinging nettles in and around hedgerows. This new finding indicates that their growth and development should be encouraged where practically possible.

Further studies in this project identified that anthocorids can disperse over a distance of at least 50 m in a single day. Very large orchards (Figure 16) which are devoid of hedgerows and other sources of anthocorids are at a disadvantage as the anthocorids have greater distances to travel to find their prey. To encourage rapid influx into pear orchards, it is best to include a network of hedgerows/windbreaks within the orchard and which incorporate the species listed above. Ideally all parts of a pear orchard should be as close to a source of natural enemies as is practically possible.

16. Large orchards which are devoid of a network of hedgerows have a much slower influx of naturally occurring predators of pear sucker

It was also found that anthocorids have only a low prey consumption rate as their body size is small compared to pear sucker. Earwigs (Figure 17) are less mobile and slower to increase in orchards than anthocorids, but they have a higher consumption rate of pear sucker. It is interesting to note that pear sucker tends to be a much bigger problem in orchards where earwig numbers are low or absent, suggesting that every effort should be made to enhance earwig numbers. HDC is funding another project (TF 196) to investigate the effects of commonly used insecticides on earwigs, important predators in apple and pear. The results could be used by the industry to significantly increase earwig populations which would help to reduce pear sucker populations.

17. Earwigs are very useful predators of pear sucker

Spiders (*Phylodromus* sp.) and ladybirds (especially Harlequin – Figure 18) were also found to be important pear sucker predators.

18. Harlequin ladybird

Identification and exploitation of plant volatiles which attract pear sucker

Research in the Netherlands has shown that pear sucker infested pear trees are strongly attractive to anthocorid predators. It was hoped to identify plant volatiles which provide this attraction and exploit these to further enhance the influx of anthocorid predators.

In the project, despite collecting a large number of plant volatiles from pear foliage infested with pear sucker adults and nymphs and incorporating the most promising in lures, none of them were found to be attractive to anthocorids in field trials.

Identification of physically acting spray treatments

A number of growers currently use physically acting chemicals to control pear sucker, however the life stages on which they act, their relative efficacy, optimum concentrations and effects on anthocorids have not yet been determined scientifically. The project assessed a number of different products including magnesium sulphate, sulphur, various adjuvants and kaolin for control of pear sucker, the first of these three in admixture.

Magnesium sulphate and sulphur had little direct insecticidal effect, but non-ionic and silicone wetters did, especially when used at high concentrations.

In addition, early season sprays of kaolin greatly reduced egg laying by overwintering adults in early spring, having lasting results on the populations well into the summer. However, kaolin may also deter egg laying by anthocorids so later applications are not recommended.

Further laboratory work showed that the above materials were relatively safe to eggs and nymphs of Orius and anthocorid bugs.

Further information

HDC Project reports

TF 181 Exploiting semiochemicals, conservation biocontrol and selective physical controls in integrated management of pear sucker (Defra Horticulture LINK HL0194)

TF 196 Investigation of the effects of commonly used insecticides on earwigs, important predators in apple and pear

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