Grower Summary

SF 120 (HL 01107)

Biological, semiochemical and selective chemical management methods for insecticide resistant western flower thrips on protected strawberry

Annual 2014

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GROWER SUMMARY

Headline

- The use of blue sticky roller traps along the tunnel legs (30 cm wide, 100 m long, Optiroll, Russell IPM) can significantly reduce thrips numbers and fruit damage.

Background and expected deliverables

The development and spread of pesticide resistant strains of WFT, which cannot be controlled with pesticides, seriously threatens the viability of the UK strawberry industry. In 2009 serious outbreaks occurred in several high value crops in southern and central England causing serious losses. The aim of this project is to develop a comprehensive range of new effective methods for managing insecticide resistant western flower thrips (WFT) in tunnel-grown strawberry in the UK. The methods include improved monitoring with attendant damage thresholds, a computer-based population and risk forecasting model, new selective pesticide treatments, new biopesticides, mass trapping and novel, more cost-effective strategies for using existing predators. These components will be integrated into a comprehensive management strategy for the pest which will be tested on a commercial scale in the later stages of the project.

Summary of the project and main conclusions

Progress on each objective of the project is summarised below:

Objective 1 (Monitoring, trapping and damage thresholds)

In controlled experiments, four or eight adult thrips per flower and their subsequent larvae resulted in bronzing that exceeded the economic injury level of 10% of the fruit surface bronzed, in the absence of predators. The addition of the predatory mite *Neoseiulus cucumeris* to flowers reduced fruit bronzing below the economic injury level when there were four or eight adult thrips per flower. The results confirm that it is the larval stages of the western flower thrips that cause most of the fruit bronzing, as *N. cucumeris* do not feed on adults. The presence/absence of *N. cucumeris* must be taken into account when developing action thresholds for growers.

Economic fruit damage (sufficient to downgrade fruit to Class 2) occurred in commercial crops when there were between five and 11 adult thrips per flower (mean of seven adult thrips per flower in six crops monitored). Damage occurred at five adult thrips per flower in a field with poor establishment of predatory mites (4% of fruits with predatory mites). Damage occurred at 11 adult thrips per flower in a field with good establishment of predatory mites (72% of fruits with predators), although there was a lot of variability. There was no economic crop loss due to thrips bronzing in six crops where thrips density remained below five adult thrips per flower throughout the season, in the presence of predatory mites. Further data is required to determine the numbers or percentage incidence of predators required to reduce fruit damage in the field, although 100% incidence is ideal. There were insufficient data to draw conclusions on the relative susceptibility of different cultivars to thrips damage, but the limited data available showed similar susceptibility to damage between the cultivars tested. Weekly monitoring is required to predict damage as thrips numbers can change rapidly.

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Objective 2 (Model)

New data have been obtained on the rates of development of WFT on strawberry at fluctuating temperatures in the laboratory confirming that WFT developmental rate at 10°C is not zero as assumed by all previous studies (minimum temperature for development was said to be around 10°C). Most eggs hatched after 8-10 days under the constant temperature of 16°C, close to the 8-9 days predicted by the model. However under the 16/10°C, most eggs hatched between 9-11 days which is shorter than the predicted 14-15 days (assuming the developmental rate is zero at 10°C). Similarly for the 14/10°C regime, the predicted length is around 18 days, compared to the observed 11-13 days. These data are being used to validate the model developed in Years 1 and 2.

Objective 3 (Predators)

No work on this objective was planned for 2013.

Objective 4 (Pesticides and biopesticides)

The fungal biopesticides used in the first years of the project are known to be pathogenic to WFT (i.e. they kill WFT in laboratory experiments). However, in our experiments there was a lack of control in cage and polytunnel experiments. To try to understand the reasons for this an experiment was done to quantify the deposition of a commercial biopesticide spray within a strawberry crop, to enable us to understand whether biopesticides are being deposited in places where thrips are located, and to give information on the number of spores that are acquired by thrips. All parts of the strawberry plant sampled received a number of viable spores. All of the thrips found were located in the flowers but they varied in number of spores that they received. This suggests that secondary pick up of viable spores is an important means of inoculation for WFT biocontrol with entomopathogens. Further work is required to evaluate the persistence of the fungal spores on the strawberry crop and to determine the number of spores per thrips required to cause death.

Objective 5 (IPM strategy)

In two EMR experiments on a commercial site in Kent we were unable to provide confirmation of the effectiveness of roller traps to reduce crop damage caused by WFT feeding. Very low numbers of thrips were attracted to the blue roller traps in the early assessments, even though there were thrips present in the flowers. It is likely that the flowers present in the planting were more attractive to WFT early in the season. In the last assessments, when numbers of flowers were decreasing and numbers of thrips per flower were increasing, numbers of thrips caught on the traps increased. Damage to fruit was high in both plantings and the crop became unmarketable. Because the experiment was terminated by the grower we were not able to determine if the traps reduced populations on the plants from July onwards; in 2012 the roller traps caught higher numbers of thrips from July (see 2012 Annual Report) and thrips populations and fruit damage decreased significantly at this time.

In the ADAS experiment in Cambridgeshire, there was no effect of the roller trap treatment on reducing thrips numbers. Percentage of fruit damaged by thrips was low, however, there was a trend that ripe and white fruit damage was always higher in the control treatment. Significantly less ripe fruit with five or more seeds surrounded by bronzing were found in plots with roller traps compared to the control. Mean numbers of WFT remained below two

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adults per flower in plots with or without roller traps throughout the experiment, probably as a result of the biological control programme used by the grower. At the ADAS Essex site, the roller trap treatment significantly reduced the number of thrips per flower on 25 July, 9 and 22 August. Percentage of fruit damaged by thrips was low and there was no difference in fruit damage between the two treatments. Mean numbers of thrips remained below four per flower in plots with or without roller traps. More predators, particularly *Orius* sp. were found at the Cambridgeshire site where they used a biological control programme compared to the Essex farm where they used pesticides. No predatory bugs were recorded on the roller traps on any assessment date at either site. This suggests that using roller traps does not trap flying anthocorid adults. At both sites there was no difference between the numbers of thrips found on the roller traps close to and far from the pheromone lure, indicating that a 2.2m distance between lures was effective in making the roller trap evenly attractive to WFT across the entire 30m.

Financial benefits

Strawberry production in the UK is intensive and the crop is of high value, the UK industry being amongst the most effective in Europe. In 2007, 50,739 tonnes of strawberries, worth approximately £212 million were produced from approximately 2,922 ha grown in Britain. A further estimated 41,126 tonnes, worth approximately £174 million, were imported.

The development and spread of pesticide resistant strains of WFT which cannot be controlled with pesticides seriously threatens the viability of the UK strawberry industry. In 2009 serious outbreaks occurred in several high value crops in southern and central England causing serious loss. The average everbearer crop yields 20,000 kg of Class 1 fruit over one season with a current value of £2.70 per kg (£54,000 per ha). On some farms in 2009, WFT damage to everbearer fruit was so severe following failure of spinosad to control the pest that total crop loss occurred for the latter third of the season, i.e. a loss of £18,000 per ha. Even on farms where spinosad is still effective, WFT damage can lead to at least 20% of the fruit being downgraded to Class 2 for half of the picking season. The value of Class 2 fruit is less than £1.50 per kg. Thus, WFT currently causes minimum estimated financial losses of approximately £3,000 per ha per season. There is great concern that UK everbearer crop losses will escalate with the further spread of spinosad-resistant strains of WFT. Furthermore, WFT is favoured by hot summer weather conditions. If the 2009 summer weather had been hot it is possible that losses would have been much more extensive.

This project will deliver a new sustainable cost-effective IPM strategy for management of WFT on tunnel-grown everbearer crops which is vital to the survival of the UK strawberry industry. The development of a reliable IPM strategy for successful control of WFT would benefit growers by preventing crop losses and fruit downgrading due to WFT damage. In this project we aim to develop a range of complementary methods for managing WFT. For instance, using WFT predators which may include two releases of *Amblyseius cucumeris* in sachets (costing up to £325 per ha) and two releases of *Orius laevigatus (*costing up to £600 per ha). If this strategy prevented fruit downgrading due to WFT damage for the whole everbearer season, use of the two predators could give a minimum potential 324% return on investment. On farms with spinosad resistance the benefit of investing in a reliable IPM strategy would be much greater as it could prevent entire crop losses.

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Action points for growers

- Plan your IPM programme carefully in early spring, together with a consultant who is experienced and up to date in thrips management strategies on everbearers.

- Western flower thrips were shown to overwinter in senescent/dead strawberry flowers and weeds, such as chickweed, groundsel and dandelion. Overwintering in crops resulted in significantly more thrips in second year crops than in first year crops at the beginning of the season. Growing one year crops, avoiding planting new crops in used grow-bags or reducing the overwintering thrips population would reduce thrips risk.

- In first year crops, the first thrips were observed around the outside of the crop, particularly near weedy field margins, demonstrating the need for good weed control to reduce thrips risk.

- Once thrips had established they were found throughout crops, but numbers were greatest in the mid to top areas of sloping fields (excluding the tunnel ends and sides) where temperatures are higher. This is the area of greatest risk of fruit damage.

- Before the crop is flowering, WFT can be most effectively monitored using blue sticky traps with a pheromone lure. In strawberry the best position for traps is to mount them onto a post (a cheap bamboo cane is sufficient) held in place with a rubber band, with the bottom of the trap (landscape orientation) about 10 cm above the top of the crop (one hand width). If any flowering weeds e.g. dandelion or groundsel are present, thrips can be monitored by tapping the flowers over a white card.

- From crop flowering, the number of adult thrips per flower is the best estimate of thrips numbers. When monitoring for thrips the selection of flower age and position affects population estimates. Select flowers of medium age (all petals present, anthers brown, pollen shed) from the top of the plant for monitoring thrips adults, as young (petals fresh, anthers yellow, pollen not shed) or senescent (petals dropping) flowers will result in an underestimation.

- Bronzing damage to strawberry fruit increased with increasing numbers of adult thrips per flower. Significant damage that might result in downgrading of fruit occurred when there were about four adult thrips per flower in the absence of predatory mites.

- The addition of the predatory mite *Neoseiulus cucumeris* to flowers maintained fruit bronzing below the economic damage threshold when there were four or eight adult thrips per flower in controlled experiments.

- In commercial crops where predators had been released, economic damage was observed at or above five adult thrips per flower. Economic damage occurred at five adult thrips per flower when there was poor predator establishment (4% of fruits with predators) and as high as 11 adult thrips per flower where there was good predator establishment (74% of fruits with predators), therefore good predator establishment is an important component of IPM programmes.

- Growers should monitor *N. cucumeris* establishment (they are most easily seen under the calyx on fruit). Use compatible spray treatments and continue to release predators until they can be found on most fruits.

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- Damage thresholds can only be a guideline as there is much variability. Damage can be caused or exacerbated by spraying, sun scorch and other factors.

- In 2012 the use of blue roller traps along the tunnel legs (30 cm wide, 100 m long, Optiroll, Russell IPM) reduced thrips numbers by 61% and fruit damage by 55%. The use of blue roller traps with additional WFT aggregation pheromone reduced thrips numbers by 73% and fruit damage by 68%. However, in experiments in Kent in 2013 there was no evidence to suggest that the blue traps with pheromone lures had any effect on thrips numbers or fruit damage from May to July; the experiments were terminated by the host grower at the beginning of August due to crop damage. At the ADAS Essex site the roller trap treatment significantly reduced the number of thrips per flower in July and August. However, there was no difference in fruit damage between the two treatments. In an experiment in Cambridgeshire there was no significant effect of the roller trap treatment on thrips numbers in the flowers; at this site thrips were well-controlled by the growers's biological control programme. Note that the aggregation pheromone is a precision monitoring tool and there is no approval for its use as a control agent in commercial crops at this time.

- Monitor thrips numbers in flowers and fruit damage **weekly** throughout the season. Confirmation of thrips species by an entomologist experienced in thrips identification will provide useful information should it be necessary to consider insecticide treatment.

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