Grower Summary

SF 094

Minimising pesticide residues in strawberry through integrated pest, disease and environmental crop management

Annual 2010

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.

HDC is a division of the Agriculture and Horticulture Development Board.

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Project Title:	Minimising pesticide residues in strawberry through integrated pest, disease and environmental crop management
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GROWER SUMMARY

Headline

Progress is being made with developing non-pesticidal methods for control of the major pests and diseases of strawberry.

Background and expected deliverables

The overall aim of the proposed project is to develop alternative, sustainable, non-pesticidal methods for managing Botrytis, mildew, black spot, aphids, blossom weevil and capsid bugs on strawberry so greatly reducing (by >50%) pesticide use and eliminating the occurrence of reportable pesticide residues in harvested fruit. The methods developed for the individual pests and diseases will be combined with existing non-chemical methods for other pests and diseases in an overall Integrated Pest and Disease Management (IPDM) system, and this will be tested and refined in commerical strawberry production over 2 seasons.

Summary of project and main conclusions

Progress on each objective of the project is summarised below

Powdery mildew

Inoculum in planting material

In Year 2, the experiments on determining the possibility (and the amount) of powdery mildew in initial planting materials were repeated. As in the first year, the work failed to observe any mildew development from two batches of commercial Elsanta runners and module (tray) plants of Albion and Elsanta.

Alternative products

Several alternative products were evaluated together with a commercial fungicide on Albion under tunnels. There were a few alternatives that showed good controlling effects against mildew and these will be further evaluated next year.

Powdery mildew forecasting

The development of a prototype computerised system for predicting risks of mildew infections was completed. This model has been evaluated at one Kent site between June 2009 and September 2009. During this period, the model-managed tunnel received only three sprays, compared to many more in the conventional tunnel. However, mildew failed to establish on all plots despite the fact that Elsanta is said to be highly susceptible. It is therefore not possible to attribute whether the lack of powdery mildew is due to the lack of inoculum, control success, or cultivar resistance.

Botrytis

Latent infection in planting material

Ten samples of 50 cold-stored cv. Elsanta plants (six of A+ and four of medium waiting bed), from six propagators were assessed for the incidence of latent *Botrytis cinerea*. Internal infection by *B. cinerea* was detected in the crowns of nine samples, at levels ranging from 2% to 8%. Eight out of ten samples had *B. cinerea* in trimmed petioles, with infection in 5% to 50% of plants having a petiole stub. Incubation of plants without disinfection showed that *B. cinerea* was present in between 7% to 78% of plants within a sample. Overall, a mean 27% of A+ plants were infected with latent *B. cinerea* and 11% of waiting bed plants. However, samples with an average of 15% plants infected occurred in material from both propagation methods.

Fungicide applications to both A+ and waiting bed plants were principally directed at powdery mildew control, but some products also had activity against botrytis. Rovral, a fungicide used against Botrytis in strawberries, was also used by three propagators. There was no relationship between the use of fungicides and Botrytis incidence.

Control of fruit infection using Binab (Trichoderma spp.)

Work was not carried out on this task in 2009.

The control of latent infection in planting material

Plants of cold-stored A+ cv. Elsanta were given hot water treatment (35°C for 7 minutes, followed by 50°C for 2 minutes) pre-planting. *B. cinerea* in crowns and leaves was not controlled by this treatment; 36% of hot water treated and the same incidence of untreated plants had latent *B. cinerea.*

Five fungicides (Cercobin WG, Rovral WG, Scala, Signum and Switch) and one biocontrol agent (Serenade ASO) were used as a single application to plants with newly emerged leaves. After 21 days there was no difference in the proportion of these leaves with *B. cinerea* between the control (65%) and treated, although there was an indication of a reduction following the Cercobin WG drench (10% of leaves affected). Hot water treatment caused plant stunting, but no phytotoxicity was seen in leaves, flowers or fruit following the chemical applications.

Latent flower infection by Botrytis

A further batch of flower samples were assessed on Elsanta to determine latent flower infections, which is used to validate predictions given by Botem. In contrast to the last year, a considerable level of Botrytis infections were observed, which were consistent with the predictions given by Botem. Furthermore, a trial was conducted to determine whether latent flower/fruit infection differed significantly among three treatments on Elsanta: untreated, model-managed and conventional. Only a single round of Botrytis specific fungicide was applied in both model-managed and conventional tunnels. There were few differences in the incidence of latent fruit rots among the three treatments: the incidence of latent rots is less than 3% for all three treatments. This suggests that the incidence of latent fruit rots is too low under protection to justify fungicide applications that are specifically targeted at Botrytis.

Biocontrol of Botrytis

Experiments have been conducted to investigate where combinations of commercially available biological control agents (BCAs) might control *B. cinerea* on strawberry leaves more effectively than individual BCAs, focusing on the persistence of biocontrol activities, spread of BCAs among leaves and biocontrol efficacy in relation to application regimes: mixed versus single BCA, pre- versus post-inoculation application and sequential versus simultaneous application. [This was jointly funded by this Hort LINK project and a CRD project]. Three BCA products (Sentinel, Serenade and Trianum) were used for this study. Overall, Serenade did not significantly reduce sporulation of *B. cinerea* on strawberry leaf discs whereas Sentinel and Trianum gave a similar and significant biocontrol efficacy.

Biocontrol efficacy remained almost unchanged ten days after application at 20/20°C (day/night) or 24/16°C temperature regimes. In contrast, reduced biocontrol efficacy at 26/14°C suggests BCA survival was reduced under these conditions. Incidence of *B. cinerea* sporulation on leaf discs was c. 60% higher on leaves that emerged after the BCA application than on leaves directly exposed to BCA, indicating insufficient amount of the BCA had managed to spread to new leaves. Combinations of BCAs, whether applied simultaneously or sequentially (48 h apart), did not improve disease control over the most effective BCA within the combination applied alone. This indicated possible antagonism or interference between the BCAs. Results suggested that there was significant antagonism for most combinations of the three BCAs tested and the degree of antagonism increased as the time from BCA application to pathogen introduction lengthened.

Pesticide dissipation

An experiment was carried out to determine whether fungicide dissipation differs between protected and open-field conditions, and hence their persistence under protection. Systhane EW20 (myclobutanil) and Rovral FLO (iprodione) were applied at the full rate and sprayed until run-off with a hand-held sprayer. Leaves were sampled to estimate residues on two occasions: immediately and eight days after the spray. Results suggested that:

1. Iprodione is more persistent on strawberry leaves than myclobutanil.
2. Even without rainfall, fungicide dissipation is greater for those plants in open field than those under protection, especially for myclobutanil.
3. Only rainfall close to the time of fungicide application may lead to considerable wash-off of residues.

Black spot

Molecular comparison of black spot isolates

DNA was extracted from 186 isolates, most from apple (102), strawberry (52) and cherry (23), and a few (5) from weeds. All 186 isolates were screened for the six SRR primers, developed in Year 1 at EMR. Preliminary analysis of molecular data suggested that:

1. There were no overall significant differences in isolates from apple, strawberry, cherry and weeds.
2. Within the same host species, there are significant differences in groups of isolates from different sites/cultivars.
3. Overall, the isolate differences are more related to site isolates rather than to host differences.

European tarnished plant bug

Experiments were conducted to quantify the relative attractiveness of candidate herbaceous flowering plants and cover crops to the European tarnished plant bug (*Lygus rugulipennis*). Numbers of *L. ruguipennis* peaked in August and September in the trials and had begun to decline by October when overwintering adults were emerging. The capsid was attracted to mayweed, sweet alyssum and common vetch compared to strawberry and lucerne in an unprotected trap crop trial on a commercial site. *Lygus* nymphs were highly attracted to sweet alyssum. Earwigs were more likely to be present on strawberry than the trap crop species. In an experiment at EMR the three plant/plant mixes used, flowered at different times, so it was not possible to make a direct comparison of relative attractiveness on particular days. However, in season totals, lower numbers of *Lygus* adults were recorded on the plant mix of corn chamomile, corn marigold and cornflower than on mayweed and vetch.

In the lucerne experiment under protection at the commercial site, *Lygocoris pabulinus* was the most common capsid sampled on strawberry and lucerne. Although there were not high enough numbers of invertebrates to analyse statistically, it was evident that there was very little difference between the numbers of invertebrate taxa on lucerne compared to strawberry, including *L. pabulinus* .

At the protected strawberry bug vac site at least double the numbers of *L. rugulipennis*, spiders and earwigs were found in strawberry compared to lucerne. There was a significant reduction in male *L. rugulipennis* and *Lygus* nymphs on strawberry after bug vaccing. *Lygus* numbers were reduced by 39-61% on strawberry and 2-56% on lucerne. Beneficial insects were not significantly affected by the bug vac.

Four experiments were conducted at EMR to investigate the reported repellancy of hexyl butyrate to *L. rugulipennis*. Dispensers with hexyl butyrate release rates ranging from 0.2-37 mg/day were used in these experiments. There was no significant effect of hexyl butyrate on *L. rugulipennis* distribution at the rates emitted from these dispensers when compared with the controls. There was also no effect on the proportions of adult male and female *L. rugulipennis* in samples from treated plots.

Aphids

In the second year of an experiment in a commercial plantation to assess the attractiveness of different plants to predators and parasitoids of aphids, very low numbers of arthropods were collected from red campion and ox eye daisy. There was therefore no evidence of attractiveness of these plants to predators and parasitoids.

In an experiment sown in 2009 at EMR, significantly higher season totals of anthocorid and coccinellid adults (ladybirds) were found on vetch, while highest numbers of coccinellid larvae were found on the flower mix of corn chamomile, corn marigold and cornflower. These results may in part be due to a combination of plant flowering period and the developmental stage of the predator present at that time. Highest numbers of chrysopid larvae (lacewing) were found on mayweed. There were no significant differences in numbers of anthocorid nymphs or Orius nymphs and adults on the three treatments.

In experiments to assess the attractiveness of plant volatiles to predators and parasitoids, low numbers of beneficial species were caught in water traps containing lures of various plant volatiles in May and June. There was no evidence to suggest that any of the volatiles were attractive at the rates used at this time of year. In an experiment undertaken in August, higher numbers of hoverflies were caught in traps containing lures of germacrene or phenyl ethanol, but there was no effect of any of the volatiles tested at the rates of release used on any other beneficial species.

A large scale, randomised block experiment to test autumn sprays of Calypso to control *Chaetosiphon fragaefolii* (strawberry aphid) the following spring was undertaken. Autumn sprays (October-November 2008) of Calypso significantly reduced the numbers of aphids present on the strawberry leaves the following spring (April 2009). A spray at the beginning of October was more effective than an application in mid October or early November.

In order to determine the potential of a parasitoid for control of *C. fragaefolii*, parasitised aphids were collected from organic strawberry crops in Herefordshire in May 2009. Cultures are in place at BCP Certis and EMR. At 17ºC min: 27 ºC max mummies were observed nine days after parasitoid oviposition and adults emerged after a further six days (egg to adult 15 days). Initial tests show that *Aphidius. eglantariae* is fairly specific to *C. fragaefolii* and does not attack the other main aphid species commonly found on strawberry.

Strawberry blossom weevil super trap

Two replicated field experiments to test PV2 with other synomones (TMTT and caryophylene) and different trap designs were conducted.

Numbers of strawberry blossom weevil captured in the UK experiments were very small and not suitable for statistical analyses. General trends in the data were;

- Increasing catch of strawberry blossom weevil with increasing PV2 release rate.
- No increased attraction of strawberry blossom weevil with caryophylene nor TMTT synergism with the aggregation pheromone lure.
- Greater numbers of non-target arthropods being captured with increasing release rate of PV2.
- The traps with cross vanes coated with fluon captured more strawberry blossom weevil than the other designs.
- The addition of an excluder grid reduced the number of non-target arthropods captured.
- Green and yellow cross vane traps captured fewer non-target arthropods.

This work, together with the previous years work, suggests that the ‘supertrap’ to be evaluated in the remaining years of the project should incorporate a white cross vane funnel trap (coated with fluon), with an excluder grid, a standard aggregation pheromone lure and a high release rate PV2 lure.

Financial benefits

Botrytis, mildew, black spot, aphids, blossom weevil and capsid bugs are very common problems wherever and however strawberries are grown in the UK. A very high percentage of strawberry plantations are infected by these pests and diseases. No quantitative data on losses is available but conservatively assuming 10% of the crop is lost as a result of these infestations, this is equivalent to 5,074 tonnes of strawberries, worth £21 million.

To calculate the expected annual added value that might result from a successful project, it is assumed that it will lead to an average halving in losses in the current crop to 5%, i.e. an additional £10,623 million of UK sales. In addition, the improved consumer acceptability of UK strawberry growing compared to foreign competitors will reduce imports by 10%, yielding an additional £17 million of sales. It is possible that increased consumer confidence in strawberries will also grow the overall market marginally.

Action points for growers

- The Botem model gives accurate predictions of Botrytis risk under tunnels and could be used in future for management of this disease.

- Monitor crops for the development of visible symptoms from latent Botrytis which can be introduced into new plantings by both A+ and Waiting Bed cold stored strawberry runners.

- A clean up spray of an aphicide in October or early November, after cropping has ceased, greatly reduces aphid populations the following spring and may obviate the need for spring treatment with aphicides and reduce the risk of residues.

- Use of tractor mounted bug vaccing shows promise for control of European tarnished plant bug (ETPB). Each pass of the bug vac results in a 50% reduction in ETPB numbers, several passes being needed during the period of risks (July – September) for good control. Correct setting of the height of the bug vac is important for good results.

- Potassium bicarbonate plus the adjuvant Silwet showed promise for control of strawberry mildew.