Grower Summary

SF 094

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

Annual 2010

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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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GROWER SUMMARY

Headline

New control approaches have been developed for the main pests and diseases of strawberry and these have been combined into a new Integrated Pest and Disease Management programme which will reduce pesticide use and greatly reduce the incidence of pesticide residues.

Background and expected deliverables

The overall aim of the 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 on 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

Experiments were conducted to investigate whether manipulation of nitrogen via fertigation within commercially acceptable ranges could significantly affect powdery mildew development on strawberry plants of cultivar Elsanta. The results showed that increasing nitrogen input via fertigation led to increased mildew development. However, the reduction in mildew development under low nitrogen input is rather limited and, therefore, may be considered for practical purposes to be neutral on powdery mildew development on strawberry under protection.

Black spot

Pathogenicity of black spot isolates from different hosts on strawberry fruit

In November 2011 the pathogenicity of 14 isolates of black spot (*Colletotrichum acutatum*) collected from various apple cultivars, alder, cherry, willow herb and primula on strawberry fruits was tested by inoculating strawberry fruits of cv. Premier with spore droplets of the isolates. All isolates developed sporing lesions on the strawberry fruits but it was not possible to measure aggressiveness as the incidence of botrytis fruit rot was also high on the fruit. The tests will be repeated in spring 2012.

Pathogenicity of black spot isolates from different hosts on strawberry plants

In December 2010 strawberry plants cv. Elsanta were inoculated with 13 isolates of *Colletotrichum acutatum* obtained from different hosts, including strawberry, apple, willow herb, alder and Primula to test the pathogenicity of the isolates on strawberry plants. Black lesions or reddish spots developed on the petioles of most plants inoculated. However, a few lesions were also observed on the uninoculated controls. None of the lesions on the plants were observed to be sporing with *C. acutatum.* Some of the petioles with lesions were subsequently checked for *C. acutatum* using paraquat and sporing colonies of *C acutatum* were detected indicating that the black spot isolates from non-strawberry hosts could also attack strawberry. The plant tests will be repeated in April 2012 using younger runners.

Evaluation of biofumigants to eliminate Colletotrichum-infested debris in soil

The purpose of this study was to evaluate the efficacy of biofumigants against *C. acutatum* in the laboratory based on the protocol developed for *Verticillium dahliae* testing. The biofumigants evaluated were Biofence, based on mustard and an experimental product based on lavender waste. Blackspot-infested strawberry debris was placed in soil in crates in which either Biofence or lavender waste had been added. Strawberry debris was removed at intervals and plated on to a selective media to check for *C. acutatum*. Final evaluation of the plates is still in progress.

European tarnished plant bug

Use of hexyl butyrate as a repellent: In April and in June *L. rugulipennis* were caught in bucket traps containing the sex pheromone alone, but none were trapped where hexyl butyrate dispensers were included indicating that hexyl butyrate was repelling the males. In September only 1 *L. rugulipennis* was caught in the pheromone traps and none in the hexyl butyrate traps although males were present in the field at this time indicating that the adults were not responding to the pheromone at this time in the season. In replicated experiments designed to test the range of influence of the hexyl butyrate dispensers, at 1m spacing no *L. rugulipennis* males were caught in pheromone traps whereas at larger spacings they were indicating a relatively short distance effect.

The use of a bug-vacuum reduced numbers of *L. rugulipennis* on strawberry to approximately half that of an untreated control area, and comparable to an area that had received an insecticidal spray of Calypso.

Strawberry blossom weevil super trap

The possiblity of a single combined trap for strawberry blossom weevil and Europen tranished plant bug was investigated. A green cross vane bucket trap without excluder grid and batedwith lures for both A rubi and L rugulipennis was found to be effective.

IPDM

IPDM Strategy

An integrated pest and disease management programme was devised by combining the results from objectives 1-6 on the six specified pests and diseases together with existing established non-chemical control methods. For diseases the strategy comprised three aspects:

- Reduction of initial inoculum
- Development of risk-assessment system for better timing of management practices
- Increased use of BCAs and natural products during flowering.

For insect pests an integrated approach using habitat manipulation, semiochemical lures, biocontrol agents together with more species specific control was developed. These systems were evaluated in large commercial plots. Where treatment is required, priority was given to use of natural products and commodity substances, the use of biocontrol (e.g. aphids) or the

use of conventional fungicides or insecticides only when a need was identified and the risk of leaving a residue in fruit was assessed as low. Pesticides which have been found to leave detectable residues in fruit, were not, wherever an alternative treatment or chemical was available, used on fruit.

Evaluation of IPDM Strategy

The IPM strategy devised was tested in comparison with the standard commercial programme used at the time by the host farmer, at three sites in England, one in Surrey at Tuesley Farm and two in Kent at Norham Farm and Langdon Manor Farm. The new strategy and the 'standard commercial programme' control were applied to large plots of protected strawberries. The Tuesley Farm site was planted with var. Elsanta on 28th March 2010, the Norham farm site was planted with var. Sonata on 16 May 2011 and the Langdon Manor Farm site was planted with var. Amesti in early April. The results for Tuesley Farm and Langdon Manor Farm are summarised below.

Tuesly farm

- The utilisation of the fungicide Serenade ASO (*Bacillus subtilis*) prior to the use of bumble bees to disperse Prestop Mix (*Gliocladium catenulatum*) to the flowering crop for botrytis control (under Extrapolated Experimental Approval) resulted in no residues in the fruit and no difference in levels of botrytis when compared to a standard grower program.
- Powdery mildew control in the IPDM tunnels was based on a forecasting model utilising in-crop temperature, humidity and disease levels. 7 Potassium bicarbonate applications were used in response to a risk warning. This reduced the number of otherwise weekly fungicide applications against powdery mildew and hence, together with the use of potassium bicarbonate eliminated residues. Levels of mildew were higher in the IPDM area but never reached damaging levels.
- In comparison 9 fungicides were applied for Botrytis through establishment flowering and harvest and a further 9 fungicides plus potassium bicarbonate and sulphur were applied to the GS tunnel for powdery mildew.
- Strawberry blossom weevil numbers in traps and levels of damage were low, awareness of this through monitoring allowed the decision not to apply Calypso (thiacloprid) which was the only insecticide residue present in the GS fruit.
- Aphid numbers at Tuesley farm were greater in the IPDM tunnels in early June but were successfully brought under control through the use of Aphidsure Fragaria (mix of 6

aphid parasitoids) and the use of a maltodextrin spray resulting in no need to apply a conventional insecticide.

- The use of a high rate of *Phytoseilus persimilis* for two spotted spider mite control instead 2 insecticides resulted in slightly higher numbers in the IPDM tunnels compared to the GS but these never reached damaging levels and predatory mites were always visible alongside the pest, this allowed insecticidal control to be delayed until after harvest.
- Other pests were not present in high enough numbers to warrant insecticidal control through flowering and harvest, resulting in no residues on the fruit
- The use of biological control agents either a formulation for dispersal by bees, or by spray application to flowers, together with the use of potassium bicarbonate in conjunction with powdery mildew risk forecasts resulted in no significant differences overall in yield or in the relative proportions of Class 1 and 2 fruit due to fungal diseases.
- The use of biological control agents as insect predators released into the crop as well as low pest pressure in this season resulted in no real differences in pest damage to fruit with only minimal thrips and slug damage to fruit in both programs, causing no differences overall in yield or in the relative proportions of Class 1 and 2 fruit.

Langdon Manor Farm

- Honey bees were used to disperse Prestop Mix (*Gliocladium catenulatum)* for Botrytis control*.* These were introduced at the start of flowering on 17 June and remained for 6 weeks. No other controls for Botrytis were applied during this period. This programme resulted in Botrytis incidence in the fruit similar to that from fruit in the grower plot and no residues detected in the fruit. In the grower tunnels a total of 8 sprays were applied for Botrytis control in the same period.
- Powdery mildew control in the IPDM tunnels was based on a forecasting model utilising in-crop temperature, humidity and disease levels. A total of 12 sprays were applied for powdery mildew control in the IPDM plots. This total includes some pre-flowering sprays and post-harvest sprays. A total of 23 sprays were applied to the grower plots for mildew. Levels of mildew were slightly higher in the IPDM area but never reached damaging levels.
- Strawberry blossom weevil numbers in traps and levels of damage were low, awareness of this through monitoring allowed the decision not to apply an insecticide for this pest in the IPDM area.
- Aphid numbers were successfully brought under control in the IPDM area through the repeated use of a mix of 6 aphid parasitoids resulting in no need to apply a conventional insecticide.

- *Phytoseilus persimilis* was used in the IPDM area in late May and late June for the control of two spotted spider mite. The number of plants infested with two-spotted spider mite was identical for both treatments. Pest numbers declined by late July. No insecticide was used in the IPDM area, whilst the grower standard received sprays in mid-July.
- *Neoseiulus cucumeris* (as slow release sachets) was used in the IPDM area in late April and early June for the control of thrips. Phytoseiids were also found in the grower standard area. Thrips numbers showed a similar pattern in both the IPDM and grower standard areas.
- *Lygus rugulipennis* males were caught in high numbers in pheromone traps in late-August. Nymphs from this generation were found in higher numbers on an alyssum trap crop than in the strawberry crop. There was no difference in damage due to this pest between the grower standard and the IPDM areas.
- Other pests were not present in high enough numbers to warrant insecticidal control through flowering and harvest, resulting in no residues on the fruit.
- The use of biological control agents as insect predators released into the crop resulted in no real differences in pest damage to fruit between the grower standard and IPDM areas, causing no differences overall in yield or in the relative proportions of Class 1 and 2 fruit.

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 risk of Botrytis on early covered June-bearer strawberries is very low so spraying with fungicides against Botrytis may not be necessary. For everbearers later in the season, the EMR Botem computer-based forecasting model (available from Prof Xiangming Xu at EMR, xiangming.xu@emr.ac.uk) can be used to time sprays of fungicides or biocontrol agents and may result in a substantial reduction in fungicide use.
- Effective early control of powdery mildew is essential to minimise the risk later in the crop and if such good early control is achieved then a computer based forecasting model available from EMR can be used to time sprays and may result in a substantial reduction in fungicide use.
- For practical purpose, the effect of increasing nitrogen input via fertigation on mildew development is minimal. Thus, growers can adjust their fertigation primarily on the basis of plant and fruit development without the need to consider the effect on powdery mildew
- Sex pheromone traps for monitoring European tarnished plant bug, a serious pest of late season strawberry, and for the Common Green Capsid, have been developed and are now commercially available for the 2012 season.
- Application of a late season spray of an aphicide (e.g. Claypso) in late October or November will greatly reduce populations of several of the most damaging and common aphid pests of strawberry and result in greatly reduced aphid populations the following spring, possibly obviating the need to spray. New formulations of mixtures of aphid parasitoid species are available from biocontrol suppliers and can be introduced in spring to help keep spring populations low.
- An Integrated Pest and Disease Management programme which should reduce the use of pesticides and greatly reduce the incidence of residues on fruits at harvest has been devised and is being tested for a second year on a large scale on three commercial farms in 2012-13.