Grower Summary

The use of Sterile Insect Technique to increase the success of IPM in horticultural crops

CP 53

Final report 2010

Project title	The use of Sterile Insect Technique to increase the success of IPM in horticultural crops
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Project leader:	Dr Jonathan Knight, Imperial College London
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Key staff:	Dr Jonathan Knight Ms Catherine Walker
Location of project:	Silwood Park Campus, Imperial College London, Ascot, Berks
Project coordinator:	Dr D. Hand Dr R. Jacobson
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The results and conclusions in this report are based on an investigation conducted over a one-year period. The conditions under which the experiments were carried out and the results have been reported in detail and with accuracy. However, because of the biological nature of the work it must be borne in mind that different circumstances and conditions could produce different results. Therefore, care must be taken with interpretation of the results, especially if they are used as the basis for commercial product recommendations.

AUTHENTICATION

We declare that this work was done under our supervision according to the procedures described herein and that the report represents a true and accurate record of the results obtained.

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Headline

Male and female sterility can be induced by the irradiation of tomato leafminer pupae, releasing irradiated females increases the success of SIT.

Background and expected deliverables

Sterile Insect Technique (SIT) has been applied successfully to a range of pest species in some parts of the world, most notably the Mediterranean fruit fly. SIT has considerable potential to increase the use of Integrated Pest Management (IPM) in UK horticultural crops. The use of SIT slows down the initial population growth of pests, allowing natural enemies and/or released biological control agents more time to become established before the pest reaches critical economic damage thresholds. This would have the potential to greatly reduce the need for prophylactic applications of pesticides in situations where IPM has not yet been adopted and could also reduce the number of applications of second line of defence chemicals in existing IPM programmes. Although it is anticipated that this concept could ultimately contribute to control programmes against a wide range of important horticultural pests (e.g. cabbage root fly, carrot fly, onion fly), a pest of glasshouse crops was chosen as the experimental system because glasshouse containment allows more control over both the pest and its natural enemy populations.

Biological control of the tomato leafminer (*Liriomyza bryoniae*) using the parasitic wasp *Diglyphus isaea* has been practised in protected edible crops in the UK for over 15 years. However, many growers continue to experience difficulties in maintaining the pest below economic damage thresholds. This has led to the application of non-specific insecticides that have disrupted biological control of other pests leading to the breakdown of the whole IPM programme in conventionally grown crops. Biological pollination with bumble bees has also been seriously impaired in tomato crops. The situation is worse in organic crops because there are no such products available so tomatoes suffer unacceptable levels of damage. A possible solution would be to slow down the growth rate of the pest population which would allow the parasitoids more time to become established. This can be achieved by releasing sterile male *Liriomyza bryoniae* into the glasshouse when the first flush of pest activity occurs. This would prevent the need for pesticide use and it allows the continuation of other biocontrol activities to go on in the move toward pesticide-free production systems.

Summary of the project and main conclusions

The success of a control program based on sterile insect technique (SIT) is dependent on the production of high quality, sterile male flies that can compete effectively with males of the pest population and mate successfully with the wild females. In the past SIT programs have failed because of poor quality sterile males that were unable to mate with the females of the pest population. The failure has been resolved by developing a quality control system that monitors the production of sterile flies.

End users of the SIT product need to be confident that they are using a high quality, efficient, consistent product to ensure success of its use in an IPM programme. As such, the production of high quality mass-reared males is of great importance. In order to achieve success the males released in this project needed to be both sterile and of comparable quality to the pest population or wild type males. Exposure to too great a dose of radiation to induce sterility affects the fitness of the adult males so it was important to determine the optimum dose of radiation required.

The aim of this work is to produce both male and female adults that after irradiation are unable to produce viable offspring. Ideally releases of sterile flies should be male only, but it is also important to produce sterile females. Females that have been irradiated are unable to produce larvae. They still cause puncture damage to the leaves to lay non-viable eggs but no mines develop. Similarly, wild females that mate with sterile males will puncture leaves but mines do not develop from the puncture marks. Thus irradiated females do not have a negative effect on the performance of SIT pest control. However, although releasing extra non-sterile female leafminers has a significant impact on the success of the control program, it requires high release rates of sterile males to counteract this, which makes it expensive.

At present there is limited information on the population sizes and the economic effects of *Liriomyza bryoniae* infestations. Some tomato cultivars, such as Piccolo, are much more susceptible to leafminer damage than others. In order to develop a comprehensive cost/benefit analysis on the feasibility of SIT to control leafminer infestations data needs to be collected. The success of a SIT program depends on whether or not it is economically feasible to use. It is also important to know the size, particularly the density and distribution of leafminer infestations in order to calculate the numbers of sterile males that would have to be released in order to achieve pest suppression. A questionnaire survey will be used to collect data from growers on the perceived loss and the cost of current control methods. The population size and distribution will be estimated by greenhouse surveys and through crop walking.

Conclusions

- Releasing irradiated females increases the success of SIT as it has been shown, in this project, to reduce the number of mines on leaves.
- Sterility can be induced by the irradiation of pupae with 160 Gy of gamma radiation.
- Further studies to examine the fitness of the irradiated males are needed to produce males with a relatively high level of sterility (less than 0.7 mines per female) but that have a comparable fitness to wild males in order to produce high quality sterile males.

Financial benefits

Questionnaire surveys will be used to collect information on the economic costs of leafminer infestations and the cost of control. Glasshouse surveys and crop walking will be used to collect data on the density and distribution of leafminer infestations within glasshouses. Financial benefits may be quantified after collection of this data.

Action points for growers

None to date