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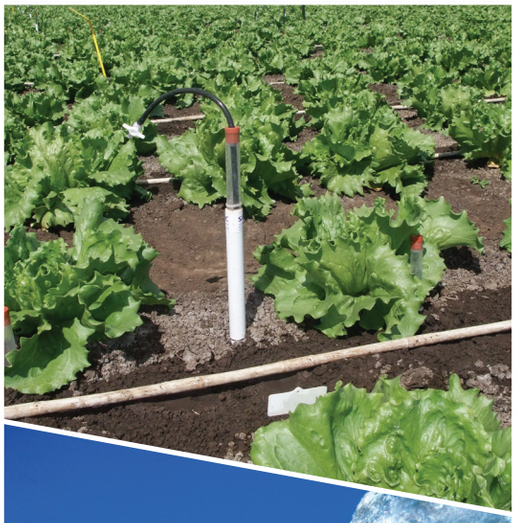
Development of Hippodamia and Micromus biocontrol agents for use in Brassica and other vegetable crops.

HAL R&D project number: VG05806

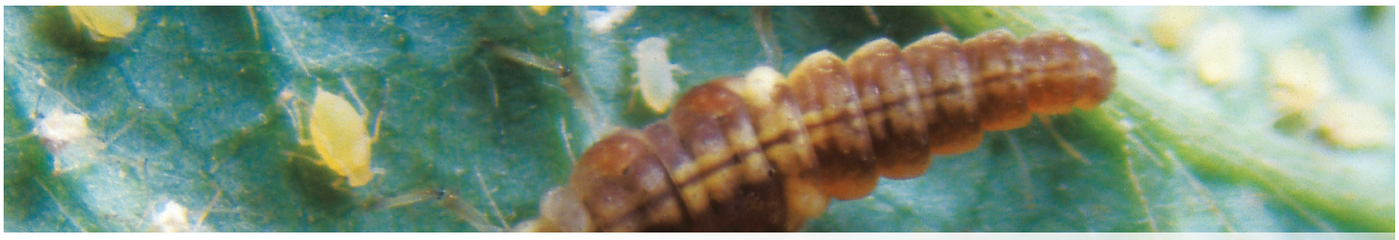
Improving our understanding of two important biological control agents for vegetable pest management.



Increasing energy efficiency and assessing an alternate energy option for Australian protected cropping.

HAL R&D project number: VG09124

Ensuring greenhouses stay 'green' on the energy front.



Development of Hippodamia and Micromus biocontrol agents for use in Brassica and other vegetable crops.

Brown lacewing larvae surrounded by it's aphid food source

Facilitators:

Project VG05806 was completed by primary investigator Leigh Pilkington from the NSW Department of Primary Industries, in collaboration with the Charles Sturt University. Dr Stephen Goodwin, previously of NSW Department of Primary Industries, is acknowledged as the original project applicant and planner.

Introduction

Vegetable growers can encounter a lot of difficulty trying to manage a variety of arthropod pests including western flower thrips and aphids. A final report has recently been released for project VG05806 which has been developed to improve understanding of the positive role of biological control agents such as the predatory white-collared ladybird (*Hippodamia variegata*) and Tasmanian lacewing (*Micromus tasmaniae*). The potential of these predators has been examined in outdoor crops and greenhouse horticulture. This project has been developed through the collaborative work of the Charles Sturt University and the NSW Department of Primary Industries.

Research Background

Throughout the project essential laboratory information was gathered and field data on the white-collared ladybird (*Hippodamia variegata*) and Tasmanian lacewing (*Micromus tasmaniae*), which are the natural enemies of western flower thrips and aphids. Effective integrated pest management strategies for use in field Brassica and greenhouse vegetable crops were also documented.

"Researchers examined limitations such as climate which may interfere with the year-round use of either or both of the predators in different vegetable growing districts. As well as factors such as the effectiveness of pesticides commonly used in greenhouses, dietary habits, habitat range in field situations, range of wild prey species and knowledge of the beneficial insects' movements," explained the primary investigator Leigh Pilkington, from the NSW Department of Primary Industries. "The results have contributed towards the body of knowledge on *Hippodamia variegata* and *Micromus tasmaniae* and their future use as biological control agents in greenhouses and against Brassica crop pests in a field crop scenario."

Project Findings

- *Hippodamia variegata* and *Micromus tasmaniae* were found to be abundant in both brassica crops and non-crop vegetation, with populations varying seasonally.
- Both *Hippodamia variegata* and *Micromus tasmaniae* moved from non-crop habitat to crops and their movement was affected by time and distance. These optimum distances can be found within the project.
- Non-crop vegetation is an important source of predators for the repopulation of fields after the application of chemical sprays. *Hippodamia variegata* exhibited stronger repopulation from croplands than *Micromus tasmaniae*, which tend to move back into fields from non-crop vegetation.
- A key step in determining the potential of both predators for use in a biocontrol program was to identify the prey range and the suitability of various pest species as prey. DNA techniques uncovered highly asymmetrical intraguild-predation activity as well as secondary predation. Of great concern was the high percentage of *Hippodamia variegata* gut contents which tested positive for *Micromus tasmaniae*. This may suppress biological control by eliminating competitive beneficials from food systems.
- A critical step in showing the potential for *Hippodamia variegata* and *Micromus tasmaniae* as greenhouse biocontrol agents will be to establish which greenhouse pests will facilitate development along with those that do not. This is important for conservation biocontrol in the field as well as inundative releases common with greenhouse biocontrol. By encouraging wild populations, *Hippodamia variegata* and *Micromus tasmaniae* may be able to provide conservation biocontrol against the crop pests investigated, particularly the aphid *Myzus persicae* which is a pest in both greenhouse and field crops.

A white collared ladybird with aphid prey

Conclusion

The project has demonstrated the importance of environmental control in greenhouses and the importance of non-crop areas in agro-ecosystems as alternative and source habitat for natural enemies. Evidence indicates that the two organisms have great utility in pest management but as yet, there are no commercially viable rearing protocols to allow a commercial producer to provide the quantities that would be needed by industry. Transportation protocols for the two organisms also need to be developed for use in a commercial supply situation.

The biological control agents' efficacy in a commercial greenhouse production facility now needs to be confirmed in large scale trials. It is recommended that extensive work be completed in greenhouses, and in the field, when rearing protocols are established.

The Bottom Line: VG05806

- Complete reliance on chemical control is a complex approach to pest management requiring careful management of resistance in the crop.
- Biological control agents are likely to have a greater long-term impact than chemicals.
- Non-crop areas are an important habitat for pest enemies such as ladybirds and lacewings.

Acknowledgements

This project has been funded by HAL using the vegetable levy and matched funds from the Australian Government.

Increasing energy efficiency and assessing an alternate energy option for Australian protected cropping.

A clean, well-managed greenhouse

Facilitators:

Project VG09124 is currently being completed by project leader Jeremy Badgery-Parker from the NSW Department of Primary Industries, with the assistance of David Hunt from the Queensland Department of Employment, Economic Development and Innovation (DEEDI).

Introduction

Australia's broad range of climates requires protected cropping production systems to be specifically designed to suit the local conditions to optimise efficiency and productivity. This can be achieved with the identification of: suitable greenhouse designs, technologies and techniques, a thorough knowledge of their application, and their accurate installation and use. Project VG09124 is currently being completed by the NSW Department of Primary Industries, in collaboration with the Queensland Department of Employment, Economic Development and Innovation (DEEDI). The fourth milestone for the project has recently been completed, which investigates the potential opportunities that are now being documented in order to ensure that sustainable and efficient systems are developed for the future.

The Cost of Improving Crops

While more efficient technologies can increase yields by up to 20 per cent, they also increase the demand on energy resources. Energy conservation requires a whole farm approach in order to improve energy efficiency and minimise waste. A technical review and energy use information pack is being developed, as well as a self-assessment tool to enable growers to account for and manage energy use in their greenhouse enterprises.

"The self-assessment tool and information packs will help growers identify the energy used by current production equipment or practices and recommend what can be adjusted to reduce energy (electricity and fuel) costs and allow them to make informed decisions on upgrading their production facility or moving to more sophisticated technology," explains DEEDI research scientist David Hunt.

To date, walk-through assessments of various sites have revealed the following:

- An irrigation system on average can consume 20 per cent of all energy costs, primarily due to the filtration and treatment systems needed to maintain good water quality.
- Post production areas can consume 10-75 per cent of all energy used in vegetable production, depending on the level of harvesting and processing technology used.
- In high-tech facilities that manipulate the growing environment, on-site fuel use for heating can contribute up to 75 per cent of overall energy costs and substantially increase the carbon footprint.
- Old and inefficient equipment being used and left on continuously in offices, staff rooms and workshops can substantially add to energy costs.

"Energy saving techniques that can help growers achieve optimum energy efficiency can be as simple as repairing damaged structures and patching holes to prevent heat loss and

maintain correct ventilation. Other methods were also explored such as servicing and lubricating mechanisms to ensure motor, vents and doors operate properly, and calibrating the thermostat/thermometer to ensure readings are accurate so control systems work together and are triggered at the correct temperature," said Mr Hunt.

Study Tour

In 2011, Mr Hunt visited the World Future Energy summit exhibition in Abu Dhabi, the IPM Essen international horticultural fairs in Germany and pivotal production/research facilities in Holland and Europe. The purpose of these trip was to review international protected cropping, initiate new ideas for the Australian industry and develop key international contacts for future collaboration. The following products and practical applications were identified to be of potential benefit to the Australian protected cropping industry:

- ThermaCote®, a spray-on thermal barrier that can be applied to virtually any surface to insulate a structure, container or piping.
- Solyndra®, a new form of solar photovoltaic (PV) panel.
- Concentrated solar power systems to concentrate solar energy to a central point which is then used to generate steam to power electrical generators.
- Solar-powered water treatment systems.
- Nano-technology for real-life applications in industry.
- Water condenser units for controlling humidity within protected structures.
- Electric and air-powered vehicles as an alternative to petrol or diesel vehicles for on-site transport.

"These innovations represent exciting possibilities for further Australian research," said Mr Hunt. "While there are many challenges ahead, the Australian protected cropping industry is well positioned to take advantage of world knowledge and to conduct locally-relevant research that will help to secure the future of this industry."

Demonstration Site

In a further bid to identify and assess alternate energy options for the greenhouse industry, a small scale field trial and demonstration site has now been installed at the NSW DPI Somersby field station. The site will be used to firstly trial, then at a later date to display, two promising technologies – geothermal heat pumps and the application of phase change materials (PCM) to greenhouse temperature management.

"What we are doing is effectively gathering the data so that we have a real story of the economics and efficiencies relevant to growers and assist those who are considering system upgrades and new developments," says project leader Jeremy Badgery-Parker.

In addition, a series of field days and workshops is being conducted to disseminate information to industry and assist in industry adoption of alternative techniques and technologies.

An example of a good greenhouse

Conclusion

This project integrates two approaches to achieve significant energy savings and reduced carbon emissions for the protected cropping industry. It involves an investigation into the feasibility and practicality of supplementing greenhouse energy demand with alternate cleaner energy options, while comprehensively reviewing and assessing energy efficiency opportunities for greenhouse enterprises. The Australian protected cropping industry can use this information to move forward into adopting lower carbon energy options and management strategies to achieve greater energy efficiency at the enterprise level, leading to significant energy and cost savings in greenhouse horticulture.

The Bottom Line: VG09124

- Energy use accounts for a large part of the production costs in protected cropping.
- Growers need to be able to reduce costs, reduce carbon emissions and make better energy investment decisions.
- Technology-based production systems should be designed to optimise efficiency and productivity.

Acknowledgements

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