Grower Summary

Improving biological control in UK organic vegetable growers (BBSRC iCASE Studentship)

Final report

Project title:	CP 151:Improving biological control in UK organic vegetable growers (BBSRC iCASE Studentship)
Project number:	31120044
Project leaders:	Aidan Thomas Professor Simon Leather (Supervisor)
Report:	Final project summary
Location of project:	Harper Adams University
Date project commenced:	01 10 2015

DISCLAIMER

While the Agriculture and Horticulture Development Board seeks to ensure that the information contained within this document is accurate at the time of printing, no warranty is given in respect thereof and, to the maximum extent permitted by law the Agriculture and Horticulture Development Board accepts no liability for loss, damage or injury howsoever caused (including that caused by negligence) or suffered directly or indirectly in relation to information and opinions contained in or omitted from this document.

[The results and conclusions in this report are based on an investigation conducted over a four-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.]

GROWER SUMMARY

Background

Leafhoppers are herbivorous hemipterans that feed on plants via a stylet that is used to pierce plant tissue and ingest fluids. They can also be vectors for a number of important plant diseases, including those caused by bacterial and viral pathogens. Leafhoppers are highly mobile insects and therefore the risk to growers posed by vectored plant diseases is substantial.

Hauptidia maroccana (Melichar) is a poorly studied, sporadic pest in glasshouse cultivation and feeds on a wide range of wild and cultivated plants. *Hauptidia maroccana* can cause damage to groups of cells on the plant surface rather than targeting the vascular tissue as aphids do. This causes characteristic stippled bleaching of leaves and fruits, leading to loss of photosynthetic area, stunting and quality reductions. Leafhoppers also produce honeydew which allows the establishment of sooty moulds. *Hauptidia maroccana* has also been demonstrated to be a vector of viruses in tomato crops however no such literature exists for diseases of Capsicum.

Hauptidia maroccana is a sporadic pest and control of this insect lacks specificity, normally relying on broad-spectrum plant protection products. Due to the risks of insecticide resistance developing, effective monitoring methods are needed to help ensure controls can be targeted appropriately and are working effectively. As yet, there is no specific biological control commercially available for this species. Previous work has shown that introductions of the mymarid wasp, *Anagrus atomus*, can reduce leafhopper populations to 54%, however this species has a short adult lifespan and parasitises hosts within the plant tissue, making mass production and transportation difficult. There are reports of *Macrolophus* species being deployed to control leafhoppers, and the generalist predator *Macrolophus caliginosus* (Heteroptera: Miridae) has been successfully commercialised as a biological control agent of aphids, spider mite and whitefly, however this species can have prey preferences resulting in ineffective control.

IPM relies on accurate knowledge of the pest being managed. In the case of *Hauptidia maroccana,* there are many areas in which the knowledge of this pest is lacking. In particular, behavioural ecology within a crop, the susceptibility to generalist predators and efficacy of monitoring traps. Previous attempts to introduce parasitoids into cropped environments have been unsuccessful, and while this may be possible in the future with non-Mymarid species, the scale of the work needed to identify and evaluate novel candidates is beyond the scope

of this project. In order to improve the control of this sporadic species a better understanding of how the pest behaves in a crop and its relationship to other extant biocontrols is needed. In particular, the ability of generalists such as *Macrolophus* to locate and predate individuals has not been examined. Determining the impact of these control strategies will require sensitive monitoring of populations. Increasing the catch rate and/or selectivity of sticky traps will enable growers to achieve this.

This project aims to answer key questions about the ecology of the pest leafhopper *Hauptidia maroccana* in order that management of this pest be improved. The project will examine the currently available strategies for management and monitoring with the intention of determining the efficacy of these as well as any directions for improvement.

Objectives

1. Examine the response of *H. maroccana* to visual cues to optimise the selectivity and/or efficacy of sticky traps.
2. Test the efficacy of generalist predators for control of *H. maroccana*. This will encompass foraging behaviours, feeding rate and prey preference.
3. Test for aggregative behaviours of the pest species to provide evidence for or against the formation of hotspots

Summary

Management of the leafhopper *Hauptidia maroccana* is inadequate. Despite not being a regular pest in glasshouses, *H. maroccanais* capable of significant damage. Current control methods rely on one chemical agent (Indoxacarb) and a putative predator. In the face of widespread chemical resistance and unreliability of generalist predators, the risk to growers under these conditions is increased. Part of the problem facing growers is that only very basic information about this pest is known, with few studies on the ecological interactions that will be vital for sufficient control. It is these knowledge gaps that this project addresses. A summary literature review introduces the main topics of study and examines the failure of a previously attempted biological control agent.

Objective 1 builds on evidence from similar species and looks at improving trapping of the pest in glasshouses. Non-yellow traps are tested for efficacy and selectivity under laboratory conditions, and indicate that there is scope for improvement in this area. The visual ecology of this pest is examined further with the use of LED technology to increase the visual signal of traps is examined. The results of which again indicate that there is more complexity to the visual cues evaluated by *H. maroccana* than the consensus implies.

The importance of plant volatiles to herbivores is well studied. For *H. maroccana* however, much is not known. Of particular importance is the ability of this pest to detect and respond to the volatile blends released by plants under attack by conspecifics. Growers have reported that *H. maroccana* forms hotspots within crops. Whether this is due to aggregation or a lack of migration is unknown. Information from experiments here suggests that it is largely due to lack of emigration rather than aggregative behaviours.

The use of the generalist predator *Macrolophus pygmaeus* for control of leafhopper is critically examined and tested under laboratory conditions. The overall picture is mixed with predation of leafhopper nymphs approaching levels of consumption seen for other pests, but predation on adults being almost zero. Furthermore, the response of *Macrolophus* to plant volatiles from infested plants was mixed, which may indicate that under a more complex environment, the ability of this predator to locate *H. maroccana* is reduced.

Financial Benefits

This research has provided important insights into elements of the biology and ecology of this understudied pest species. This project has provided some potential avenues for the improvement of monitoring and control of leafhopper in glasshouses.

Further work examining the ecology of this sporadic pest must be undertaken so that control can be integrated into current systems and disruption of other control systems be avoided. In particular, a long term field study at an appropriate glasshouse examining the effect of *Macrolophus* on leafhopper distribution and population levels is suggested.

Action Points

- Yellow sticky traps remain the most effective tool for monitoring.
- Some growers who have reported greater catch rates on sticky traps mounted to the front of greenhouse harvest trolleys which move through the crop causing many leafhoppers to jump from leaves, which is likely an escape response when disturbed
- *Macrolophus pygmaeus* may provide incidental control of leafhopper nymphs, but should not be relied upon for control
- There is no evidence for *H. maroccana* aggregation behaviour within crops, and results suggest that formation of ‘hotspots’ may be due to a lack of emigration.