

A multi target approach to fruitspotting bug management

Huwer, R.K.¹, Maddox, C.D.A.¹, Fay, H.A.C.², Llewellyn, R.³, Danne, A.⁴, Hickey, M.¹, Melville, P.⁵,
Burnett, J.⁶, Allen, A.⁷, Groves, I.⁸

¹ Centre for Tropical Horticulture, PO Box 72, Alstonville, NSW 2477, Australia

² Centre for Tropical Agriculture, PO Box 1054, Mareeba, QLD 4880, Australia

³ BioResources, PO Box 578, Samford Qld 4520, Australia

⁴ School of Biological Sciences, The University of Queensland, Brisbane QLD 4072 Australia

⁵ Horticulture Australia Limited, Level 7, 179 Elizabeth Street Sydney, NSW 2000, Australia

⁶ Australian Macadamia Society, Suite 1, 113 Dawson Street, Lismore, NSW 2480, Australia

⁷ Avocados Australia, PO Box 8005, Woolloongabba, QLD 4102, Australia

⁸ Australian Lychee Growers' Association, 262 Preston Road, Adelaide Park via Yeppoon QLD 4703
Australia

Abstract

Fruitspotting bugs (FSB) *Amblypelta nitida* Stål and *Amblypelta lutescens lutescens* (Distant) (Hemiptera: Coreidae) is a major native pest in subtropical and tropical horticultural crops in Australia and a key pest in avocado.

The pest is known to cause significant damage to more than 25 different tree fruit and nut crops and some vine fruits through the coastal and sub-coastal areas of Queensland, northern New South Wales, the Northern Territory and NW Western Australia.

Until now, using a single targeting approach, namely broad-spectrum insecticides, has been the only management option for growers, which is not sustainable in the long-term.

It has become apparent that a single strategy approach from different research teams has not been able to find a solution and therefore a multi-target approach is needed.

This is a multi disciplinary collaborative project that only started in March 2011. Team members state governments from New South Wales and Queensland, University of Queensland and private consultants. The project is guided by industries including avocados, macadamia, litchi and papaya, with Avocados Australia being one of the major contributors.

Major components of the management strategy under investigation are the following:

1. Chemical control
2. Monitoring and trap cropping:
 - a. Trap cropping and monitoring using alternative host and highly susceptible cultivars
 - b. Pheromone traps
3. Biological control
 - a. Investigation of biological control agents (ecology and biology)
 - b. Mass-rearing of fruitspotting bugs and biological control agent
4. IPM case studies (Demonstrations on commercial farms)
5. Area Wide management (management tested coordinated on an area- wide-scale)

Enfoque múltiple a la gestión de la chinche manchadora

Las chinches manchadoras de la fruta *Amblypelta nitida* Stål y *Amblypelta lutescens lutescens* (Distant) (Hemiptera: Coreidae) constituyen una importante plaga nativa de los cultivos hortícolas subtropicales y tropicales de Australia y una plaga clave del aguacate.

Se sabe que esta plaga causa daños importantes a más de 25 árboles frutales y de nueces diferentes así como a algunas frutas de enredadera en las zonas costeras y subcosteras de Queensland, el norte de Nueva Gales del Sur, el Territorio del Norte y el noroeste de Australia Occidental.

Hasta ahora la única opción a disposición de los agricultores ha sido el uso de un enfoque único, es decir de insecticidas de amplio espectro; esto no es sostenible a largo plazo.

Se ha hecho evidente que un enfoque de estrategia única de diferentes equipos de investigación no ha podido dar con una solución y que, por lo tanto, se requiere un enfoque múltiple.

El presente es un proyecto cooperativo pluridisciplinario que comenzó recién en marzo de 2011. El equipo incluye los gobiernos de los Estados de Nueva Gales del Sur y Queensland, la Universidad de Queensland así como consultores del sector privado. El proyecto está orientado por las industrias de aguacate, macadamia, lichi y papaya; Avocados Australia es uno de los principales contribuyentes.

Los principales elementos de la estrategia de gestión que se investiga son los siguientes:

1. Control químico
2. Vigilancia y uso de plantas cebo:
 - a. Uso de plantas cebo y vigilancia mediante cultivos huéspedes alternativos y muy susceptibles
 - b. Trampas de feromonas
3. Control biológico
 - a. Investigación de agentes de control biológico (ecología y biología)
 - b. Cría en masa de chinches manchadoras y agentes de control biológico
4. Estudios de caso de lucha integrada (demostraciones en granjas comerciales)
5. Gestión de la totalidad de la zona (ensayos y coordinación de manejo a escala de zona)

Key words

Fruitspotting bug, multi-targeted approach, chemical control, monitoring, trap cropping, pheromonetraps, biological control, IPM, area wide management, industry adoption,

Introduction

Fruitspotting bugs (FSB) *Amblypelta nitida* Stål and *Amblypelta lutescens lutescens* (Distant) (Hemiptera: Coreidae) are major native pests in a number of subtropical and tropical horticultural crops in Australia and a key pest in avocados.

The pest is known to cause significant damage to more than 25 different tree fruit and nut crops and some vine fruits through the coastal and sub-coastal areas of Queensland, northern New South Wales, the Northern Territory and NW Western Australia.

For most growers broad-spectrum insecticides have been the only management option, which is not sustainable in the long-term. Endosulfan, the main chemical used against bugs, has also been deregistered leaving few effective alternatives.

It has also become apparent that past research conducted on single control strategies has resulted in limited solutions suggesting a multi-target approach would offer the best chance of success.

This is a multi-disciplinary collaborative project that only started in March 2011. Team members include state government agencies from New South Wales and Queensland, University of Queensland and private consultants. The project is guided and funded through Horticulture Australia by industries including avocados, macadamia, lychee and papaya.

Major components of the research and management options under investigation are the following:

1. Collation of past research
2. Chemical control
3. Monitoring and trap cropping:
 - a. Trap cropping and monitoring using alternative hosts and highly susceptible cultivars
 - b. Pheromone traps
4. Biological control
 - a. Investigation of biological control agents (ecology and biology)
 - b. Mass-rearing of fruitspotting bugs and biological control agents
5. IPM case studies (Demonstrations on commercial farms)
6. Area Wide management (management tested and coordinated on an area- wide-scale)
7. Industry adoption

Components and strategies of the project

1. Collation of past research: Collation of past research and practices will be carried out by Alana Danne, a PhD student from the University of Queensland. The study will encompass a major literature review, and develop a data base of research and practices of fruitspotting bug management, related insects and technologies considered in the project.

2. Investigate effective chemical control options: Ruth Huwer and Craig Maddox from NSW DPI at Alstonville will manage this component which will involve the evaluation of IPM compatible insecticides, new chemistry and biopesticides. Past research under the IPM in macadamias project investigated alternatives to endosulfan for FSB management. Contacts have been made with different chemical companies. Two biopesticides including one insect pathogen and one plant extract were provided to us by Dr. Robert Mensah who has tested these for the cotton industry. A number of new compounds including the biopesticides have been already screened in the laboratory and the most promising of them were tested in a small scale field trial at the Centre for Tropical Horticulture (CTH) at Alstonville. A new Bayer compound as well as the plant extract are showing promising results in the preliminary investigations, but need further testing in small research trials and on commercial farms. The new Bayer product killed 100% of the test insects at 1ml/ 1L and the plant extract killed 100% of the test insects at 20ml/ L in the laboratory screening trial.

3. Development of monitoring and trap cropping: Ruth Huwer, NSW DPI and Harry Fay from DEEDI at Mareeba will manage this component which will investigate two key components of the monitoring program - trap cropping and pheromone traps:

- i. *Trap cropping:* (Responsibility: Ruth Huwer and Craig Maddox)
 - Developing a new monitoring strategy by using trap crops as monitoring tool.
 - Monitoring protocols need to be developed in consultation with crop consultants.
 - There are about 20 trap hedges with different fruitspotting bug host plants in place on commercial farms in NSW and Queensland.

The initial trials at CTH are showing promising results. FSB colonised all the hedges that were planted on the CTH site to monitor their presence from 2007 onwards. Within the *Murraya paniculata* hedges there was a strong preference for particular plants over the last 5 seasons when the population was looked at on a spatial level.

The floral sequence hedge (including avocado, macadamia, longan, pecan, coffee, custard apple, guava and *Murraya paniculata*) did indicate the early presence of bugs with the resulting crops showing significant damage (>50% in 2009/2010) on the avocado and guava

- ii. *Pheromone traps:* (Responsibility: Harry Fay, DEEDI) Pheromone traps would also be a very easy and efficient way to monitor fruitspotting bugs if they prove to be successful. The following 3 aspects will be considered in this study:
 - Adjustment of determined pheromone compounds to optimise their efficacy and stabilise the compounds for field use
 - Design an optimal trapping device
 - Field evaluation of the pheromones and trapping device for both *Amblyopelta* spp. in a range of crops in QLD and NSW

Research on bug pheromones was re-invigorated in 2009 to build on the considerable progress made by Jeff Aldrich (USDA), Geoff Waite (QDPI) and Chris Moore (QDPI) since the early 1990s. With the aid of ACIAR funding and a collaborative effort with the USDA, the previously unknown component of the male sex pheromone of *Amblyopelta l. lutescens* was positively identified. This component had never been recorded from insects but was known from a range of plants, particularly orchids. It was synthesised at the USDA laboratory in Beltsville and an anti-oxidant added to overcome rapid oxidation.

Field trials to test the attractiveness of lures with 3 and 4 components commenced in north Queensland in late 2009.

The pheromones were presented on rubber septa from the centre of sticky panel traps in an avocado crop. Both lure combinations caught approximately 5 times the number of *A. l. lutescens* caught by untreated panels in the same trees over a 12 week period. Males, females and an odd nymph were attracted, which is evidently typical for male-produced pheromones.

Subsequent trials have examined different ratios of 3-components in the pheromone, different purity levels of one component and pheromone release rates. Different component ratios attracted different numbers of bugs, with a suggestion that one component maybe unnecessary. This will soon be tested with a 2-component lure. An 80% pure commercially available component was almost as effective as a 93% pure laboratory-synthesised one, which will help moderate the pheromone cost. Increasing the

rate of pheromone release from 2 to 6 mg lures did not increase bug captures, but did prolong the field life of the lures from 5 to about 6.5 weeks.

The components of the pheromone of *A. nitida* are believed to be known and will soon be re-evaluated through more detailed chemical analysis.

4. Development of biological control options: This component involves two parts;

- Mass-rearing of FSB and *Anastatus*, and parasitoid release strategies (Responsibility: Richard Llewellyn, BioResources)
- Ecology and initial evaluation of various biological control agents (Responsibility: Ruth Huwer and Craig Maddox NSW DPI)

A number of potential biological control agents have been identified and need to be evaluated in the field. These include the egg parasitoids *Ooencyrtus caurus*, *Anastatus* sp., *Centrodora darwini* and *Gryon* sp., as well as the tachinid fly *Trichopoda giacomellii*.

This biological control study will involve six steps:

- i. Searching for biological control agents in QLD and NSW
- ii. Ecology of biological control agents if unknown (including life- cycle, investigation of flora of their environment).
- iii. Mass-rearing of fruitspotting bugs for testing and rearing of biological control agents
- iv. Mass-rearing of biological control agents
- v. Release strategies
- vi. Evaluation of biological control agents in QLD and NSW.

A system for rearing *A. l. lutescens* (banana spotting bug) in good numbers (2,500 eggs per week to date) has been developed but rearing *A. nitida* (fruitspotting bug) has been less successful. Cultures of *Anastatus* sp., a common egg parasitoid of spotting bugs, were established from field collections from several sites in Queensland. However, while good numbers of banana spotting bug can be reared for experimental work the system is not efficient enough to mass rear the sort of numbers necessary for commercial production of parasitoids. Other options need to be investigated.

The Chinese have been mass rearing *Anastatus* sp. egg parasitoids for the control of lychee stink bug on the Chinese tasar moth eggs *Antheraea pernyi* for many years. In October 2010 Richard Llewellyn began discussions with researchers in China and then with AQIS to obtain a permit to import unviable eggs to test with the Australian species of *Anastatus*. Trials with the initial shipment were successful, so Richard set off for China to further his knowledge. He now plans to mass-rear larger numbers, to work through various technical issues and to start some field experiments this spring.

5. Demonstrate improved management options through IPM case studies:

Case studies on commercial farms are important demonstration tool to strengthen adoption of management strategies. This includes testing of selected new insecticides, pheromones, biological control agents on selected sites as a showcase.

6. Implement control strategies on a regional basis through Area Wide Management (AWM):

The new developed strategies that have been giving the best results in the case studies above control strategies will be integrated and tested at farm level and regionally via an Area Wide Management (AWM) approach.

A meeting is planned for July 2011 to get a number of pest consultants from different industries and production areas involved in the project. They will discuss the development of an AWM system that can be used in a coordinated manner by all industries.

7. Industry Adoption: (Responsibility: Mark Hickey, NSW DPI)

An extension program has been developed to ensure that industries are thoroughly consulted and have input into the project, and that research results and project outcomes are accessible to all growers.

A communication plan is being developed and several articles have been submitted to introduce the project to relevant industries.

The industry adoption team includes DEEDI and NSW DPI extension experts.

Conclusion

The ecology of FSB is fairly complex. A good understanding of FSB ecology and biology is needed to achieve sustainable control. A number of tools need to be combined to maximise the chance for successful control and provide management options for growers.

Acknowledgements

The fruit spotting bug project is a collaboration of industry, government and private enterprise. The project is principally funded by avocado, macadamia, papaya and lychee grower R&D levies which are matched by the Australian Government through Horticulture Australia. NSW Department of Primary Industries (NSW DPI) and Qld Department of Employment, Economic Development and Innovation (DEEDI) are also contributing in-kind funds to the project, and NSW DPI is managing the project on behalf of all partners. Other project partners include the University of Queensland, Bioresources and Hortus Technical Services.