COOPERATIVE RESEARCH CENTRE
FOR TROPICAL PEST MANAGEMENT

Fruitspotting Bug Workshop Report

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13 September, 1994
QFVG, Brisbane
AUSTRALIA

Queensland
Fruit & Vegetable
Growers

DPI
QUEENSLAND
DEPARTMENT OF
PRIMARY INDUSTRIES

CONTENTS

List of Acronyms

AAGF	Australian Avocado Growers Federation
AMS	Australian Macadamia Society
CTPM	Cooperative Research Centre for Tropical Pest Management
FSB	Fruitspotting bug
HRDC	Horticulture Research and Development Corporation
IPM	Integrated pest management
QDPI	Queensland Department of Primary Industries
QFVG	Queensland Fruit and Vegetable Growers
RIRDC	Rural Industries Research and Development Corporation

Acknowledgments

The authors would like to thank the participants for their contributions during the workshop. Special recognition goes to John Bolton (AAGF) for organising the workshop, to Geoff Behncken (QDPI) for the provision of active support and to Elaine Brough (CTPM) and Geoff Norton (CTPM) for structuring and facilitating the workshop process and for editorial assistance.

1 Summary and Recommendations

A workshop involving mainly avocado growers and QDPI research scientists was held in Brisbane on the morning of September 13, 1994. The aim of the workshop was to establish how the tree fruit industry can support or contribute to the research effort to improve fruitspotting bug (FSB) management.

Following an update on the current state of research into FSB, participants took part in a pinboarding exercise to analyse options for improving the situation and develop recommendations.

The following recommendations were made:

1. That the Sunshine Coast resolution to increase the HRDC levy from 3 cents to 6 cents per tray be adopted. If these additional funds are not sufficient to fund the project "Ecology, Behaviour and Management of FSB" then the AAGF should arrange to contribute $15,000/year to that project.

2. That priority be given by QFVG to survey growers of all crops about the extent of damage caused by FSB and the cost incurred.

3. That researchers advise growers how they can assist with research (eg. record observations, allow use of their orchards for study).

4. That research results be published in "Talking Avocados" and included in AVOMAN.

5. That liaison with environmental groups be established through Landcare, QDPI, CTPM (long term) and QFVG (short term) to help reduce community pressure to ban endosulfan.

6. That a multi-industry information sharing workshop be held in August 1995.

The recommendations from the workshop were provided to the AAGF executive for discussion and consideration.

2 Introduction

Rod Glass, research and development coordinator for QFVG welcomed the 17 workshop participants who were mainly avocado growers from Queensland and northern NSW, although some macadamia growers were able to attend (Appendix 2). Rod encouraged participants to take a positive approach to the morning's workshop.

John Bolton, president of the AAGF provided some background information and invited participants to think long term for the ultimate solution to the FSB problem.

2.1 Background to the workshop

A workshop on Fruitspotting bug (FSB) was held at Mareeba, July 1993 to review the FSB problem, identify opportunities and constraints to improved management and develop action plans for research and implementation.

Recommendations for improving FSB management in the short term were to review strategies currently used by growers to determine the current 'best practices', identify IPM compatible chemical pesticides, investigate the effect of climate on FSB in relation to crop phenology and calculate the cost of FSB to the horticultural industry.

For longer term improvements, participants of the Mareeba workshop recommended that research is needed on the overwintering biology and local movement of FSB populations, as well as giving high priority to the continued study of semiochemicals and indicator trees for monitoring.

Although most of the recommendations require major projects and large funding grants, some have already been acted upon:

- Geoff Waite has begun a lead-in project on FSB biology and feeding preferences on avocados through the support of Sunshine Coast avocado growers who made a voluntary contribution for the work; the project has been subsequently supported by HRDC.
- Harry Fay has been working on FSB egg parasites funded by macadamia and pawpaw growers in conjunction with HRDC.
- The Cooperative Research Centre for Tropical Pest Management (CTPM) funded two vacation students to carry out an initial survey on the damage caused by FSB and an exploratory study of FSB parasites in south-east Queensland.
- Michael Ryan is studying the movement of bugs between different FSB populations on a CTPM PhD scholarship.

Geoff Waite (QDPI) is currently preparing a submission to HRDC and RIRDC through the AAGF, AMS and QFVG for a major project on FSB biology and behaviour.

2.2 Workshop objectives

Participants at this second workshop were encouraged to comment on the research proposal and consider ways in which the tree fruit industry can support or contribute to the research effort to improve FSB management. They were then given the opportunity to suggest ways in which to improve industry policies related to FSB management.

2.3 Workshop process

The Cooperative Research Centre for Tropical Pest Management (CTPM), which has considerable experience in running problem specification workshops, facilitated the morning's workshop. The workshop process was designed to access expertise from all participants to define the problem, then explore possible options and develop recommendations to improve the situation. The timetable for the workshop is presented in Appendix 1.

Participants were asked the question "**What role can producers play in improving management of fruitspotting bug?**" Each participant wrote their responses on small cards, with one discrete idea per card.

Research scientists from QDPI gave presentations on the current state of FSB research and outlined research proposals being assessed by funding bodies. Participants were encouraged to ask questions and comment on the presentations then add more ideas to their cards before the pinboarding exercise began.

3 Fruitspotting Bug Research Presentations

3.1 FSB Biology

Geoff Waite, Principal Entomologist, QDPI Nambour

Introduction

Two species of fruitspotting bugs (banana spotting bug and fruitspotting bug) are a major problem to the horticultural industry and the problem is increasing as the area of production expands, more exotic tree species are introduced. As the area of urbanisation encroaches on production areas, alternate FSB hosts in the form of unsprayed backyard fruit trees and ornamentals encourage FSB populations and proximity to community housing presents problems with chemical spraying..

FSB is a major pest of many fruit crops, particularly avocado, macadamia, papaw, mango and cashew and extensive damage occurs even with chemical control. Community pressure for fewer chemical residues on fruit and concerns about the effect of endosulfan on the environment are increasing. Although endosulfan is very valuable in the orchard for FSB control when used correctly, researchers and producers must find better options to facilitate integrated pest management (IPM) systems and reduce pesticide applications while maintaining a viable production unit producing quality fruit.

The Pest

Banana spotting bug (*Amblypelta lutescens*) occurs in tropical regions from Kununurra, Western Australia through the Northern Territory, around the coast line to Cairns, and down the coastal strip to Brisbane but the southern boundary has not been established. Fruitspotting bug (*Amblypelta nitida*) extends through southern Queensland, south to Coffs Harbour, NSW, although it has been found in small numbers as far north as Iron Range and Mareeba. Growers in the Sunshine Coast, Brisbane and northern NSW areas have to contend with both species under equal intensity.

Superficially, the two species are very difficult to distinguish from one another. The notable differences are found in the genitalia and the length of antennal segments in the adult, although nymphs are more distinctive. *A. nitida* nymphs are orange with two indistinct dark spots on their backs, whilst the black spots which mark the odour glands on *A. lutescens* nymphs are more dramatic on a white background, suffused with red. FSB eggs are 2 mm long, ovoid, pale green initially and turning opalescent green which gradually changes to gold opalescence as they near hatching.

Fruitspotting bugs pass through five wingless nymphal stages before they moult into winged adults. This means that immature bugs must feed on the host tree on which the eggs were laid and can only migrate once they reach the adult stage. Most breeding takes place outside the orchard in native hosts, ornamentals and unsprayed trees. Adult bugs then migrate into the orchard where they feed and lay eggs in the crop trees.

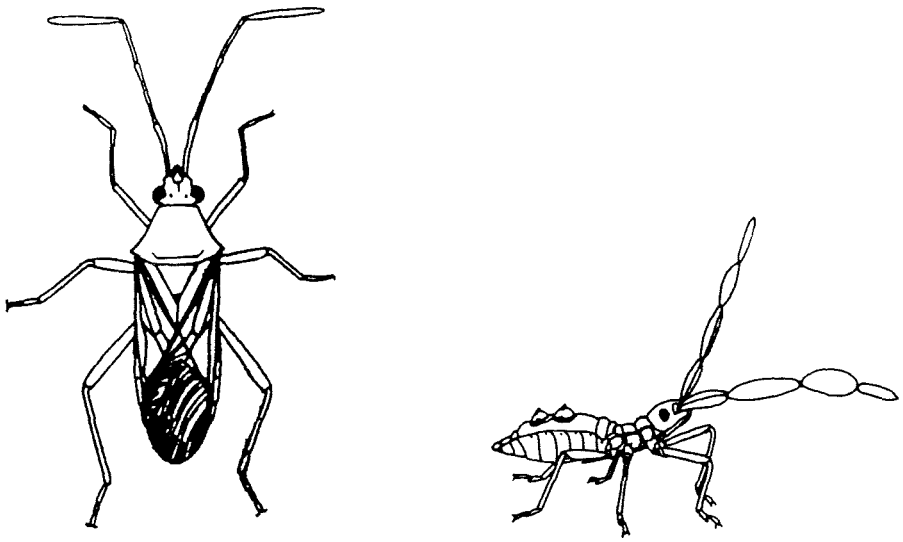


Figure 1. Banana spotting bug (*Amblypelta lutescens*) adult (left) and nymph (right).

FSB is a difficult pest to deal with in the orchard because it is well camouflaged, secretive, elusive and continually migrates into the orchard from external breeding sites. Thus insecticide spraying is required repeatedly to gain control. It is recommended that endosulfan be sprayed fortnightly in orchards where FSB is prevalent, to reduce costs and damage to an acceptable level by protecting the crop for most of the first week and then allowing time for a sprayable population to migrate in before the next spray is applied. This program not only kills the damaging adults, but also breaks the breeding cycle within the crop. Spray programs on individual farms vary according to the farm's susceptibility to the pest and this depends on the farm's geography and location relative to alternative hosts.

Unlike Queensland fruit fly which causes damage through egg laying activity, FSB damage occurs when a bug inserts its long feeding tube (proboscis) into the fruit. It then injects saliva which contains an enzyme for breaking down the tissue to facilitate the uptake of nutrients. Tissue around the feeding point dies and while the rest of the fruit continues to grow, the damaged area does not grow so stress fractures and cracking of the fruit occurs. The symptoms of FSB damage depend on the tree species and the maturity of fruit being attacked. While FSB generally attacks green, immature fruit, there are exceptions.

Fresh FSB damage can often be difficult to detect on avocados. However, when the skin is removed, the presence of water soaked lesions indicate FSB damage. Dimpling can occur when avocado fruit is attacked at a certain stage. When FSB attacks young macadamia nuts, the trees drop the damaged nuts fall. If this occurs after shell hardening these immature nuts reduce total nut quality, thus detracting from the value of the harvest. Table 1 summarises the type of damage caused by each FSB species to a variety of fruit crops.

Table 1 Fruitspotting bug damage on tropical tree crops

Crop	Species†	Plant part	Damage
avocado	*A. n., A. l.*	immature fruit	lesions, cracks
banana	*A.l.*	immature fruit	spots, lesions on fruit
carambola	*A.n., A.l.*	immature fruit	lesions, mis-shapen fruit
cashew	*A. l.*	terminals, nuts, apples	terminal death, abscission of immature nuts, kernel damage
custard apple	*A. l.*	flowers, young fruit	lesions, cracks, abscission of young fruit
guava	*A.n., A.l.*	immature fruit	lesions, abscission of very young fruit
kiwifruit	*A.n.*	immature fruit	lesions
longan	*A.n., A.l.*	immature and mature fruit	abscission of green fruit
lychee	*A.n., A.l.*	immature fruit	abscission of green fruit
macadamia	*A. n., A. l.*	nuts, terminals	nut abscission (immature), kernel damage, terminal death
mango	*A. l., A.n.*	terminals, young fruit	terminal death, abscission of young fruit
papaw	*A.l.*	terminal, leaf petioles	terminal death
pecan	*A. n.*	nuts	kernel damage, abscission of immature nuts
persimmon	*A.n.*	immature fruit	abscission of small fruit, lesions

† *A.n.* represents *Amblypelta nitida*, the fruitspotting bug
A.l. represents *Amblypelta lutescens*, the banana spotting bug.

Other exotics damaged include acerola, carob, citrus, durian, feijoa, fig, grape, jaboticaba, jackfruit, loquat, mangosteen, mulberry, passionfruit, pepper, rambutan, soursop, stonefruit and yellow mombin.

Towards IPM

Despite the fact that growers will need to use pesticide sprays for a variety of pests in the foreseeable future, an effort must be made to reduce reliance on chemical controls because persistent use of broad spectrum sprays disrupts the ecology of the orchard. Many pests in avocado orchards are under biological control but use of broad spectrum sprays disrupts beneficial insects and this may lead to an outbreak of a secondary pest (that is, a pest which was previously under biological control).

Research has found that spiders and assassin bugs are predators of FSB. Work is continuing into the viability of rearing and releasing parasitic wasps for biological control of FSB (see section 3.2).

Scientists need to know which plants, especially native ones, FSB prefer as alternative hosts for feeding and breeding before they can develop an integrated management program. Research has

identified beach birds-eye fruit, corky passion vine fruit, cotton tree, white cedar and soap tree berries as alternate hosts for FSB but these are only a few of the many known and possible unknown hosts.

Pheromones (insect communication scents within a species) and food volatiles are being studied to determine the feasibility of developing monitoring traps or attracting FSB to trap crops where they can be sprayed (see section 3.3).

There are large gaps in our knowledge about the biology and behaviour of FSB which must be filled if better management systems are to be developed.

Geoff Waite is currently preparing a submission to HRDC and RIRDC through the AAGF, AMS and QFVG for a major project on FSB biology and behaviour. The project, entitled "Ecology, behaviour and management of fruitspotting bugs" aims to gain a better understanding of the biology and behaviour of the two species and the relationship between behaviour, alternative hosts and commercial crops.

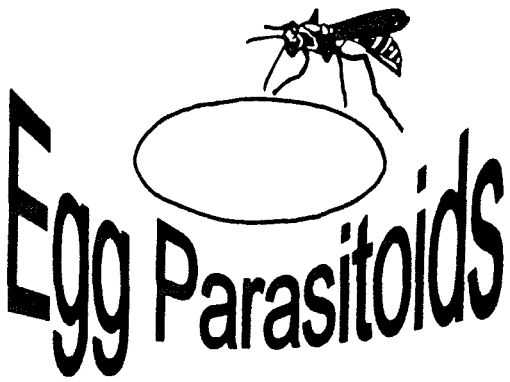
The program will investigate:

- egg parasitoids
- crop phenology and its relationship to FSB susceptibility
- immigration behaviour
- pheromones and fruit volatiles with a view to developing effective monitoring devices to improve the timing and use of pesticides
- mating behaviour
- native hosts
- natural enemies (in particular egg parasitoids)
- general FSB biology.

Using the information obtained, better management which utilises a suite of options, could be employed to cut FSB losses in the commercial fruit sector and reduce costs incurred by current control measures.

3.2 Parasitoids of FSB
Dr Harry Fay, Principal Entomologist, QDPI Mareeba

Two years ago Harry Fay discovered parasitised FSB eggs on mock-orange trees (*Murraya paniculata* (L) Jack) at Mareeba. He bred them out and isolated three different species of parasitic wasps. Of the 71% of parasitised eggs (average of three sites in the Mareeba area) almost three quarters were parasitised by a large ant-like wasp belonging to the genus *Anastatus*. Trials to determine the efficacy of the wasps as potential biological control agents have commenced, with some encouraging results.



Egg Parasitoids

Parasites are organisms which live in or on another living thing (the host), usually without killing it. An insect parasite which kills its hostis known as a parasitoid.

Egg parasitoids lay their eggs into the eggs of the host. The parasitoid eggs hatch within the host egg and feed on the host embryo so the insect that emerges from the egg is the free living adult parasite ready to mate and repeat the cycle. Some species of parasitoids lay many eggs within each host egg, whilst others lay a single egg.

There are also larval and pupal parasitoids which lay their eggs on or in the larvae or pupae of other insects.

One benefit of using egg parasitoids as biological control agents is that they kill the host before it develops into a damaging larva or adult.

The most common egg parasitoids are wasps. Some types of wasps are bred in commercial 'insectaries' for sale to farmers who wish to release parasitoids into their crop as natural enemies.

Research is examining the potential to develop methods for the mass rearing and release of parasitoids into the field. The *Anastatus* parasitoid appears to use bugs as well as their eggs in host locations and can be reared on alternate host eggs, such as emperor gum moth eggs. In such eggs desirable ratios of male to female wasps are produced. In addition, the wasps seem to be fairly tolerant of endosulfan at normal rates, which may provide more flexibility in new pest management strategies for FSB. Since FSB appears to breed locally, parasitoids have the potential to act like a mobile insecticide i.e. once released they will go and find the bug eggs wherever they are in the near vicinity.

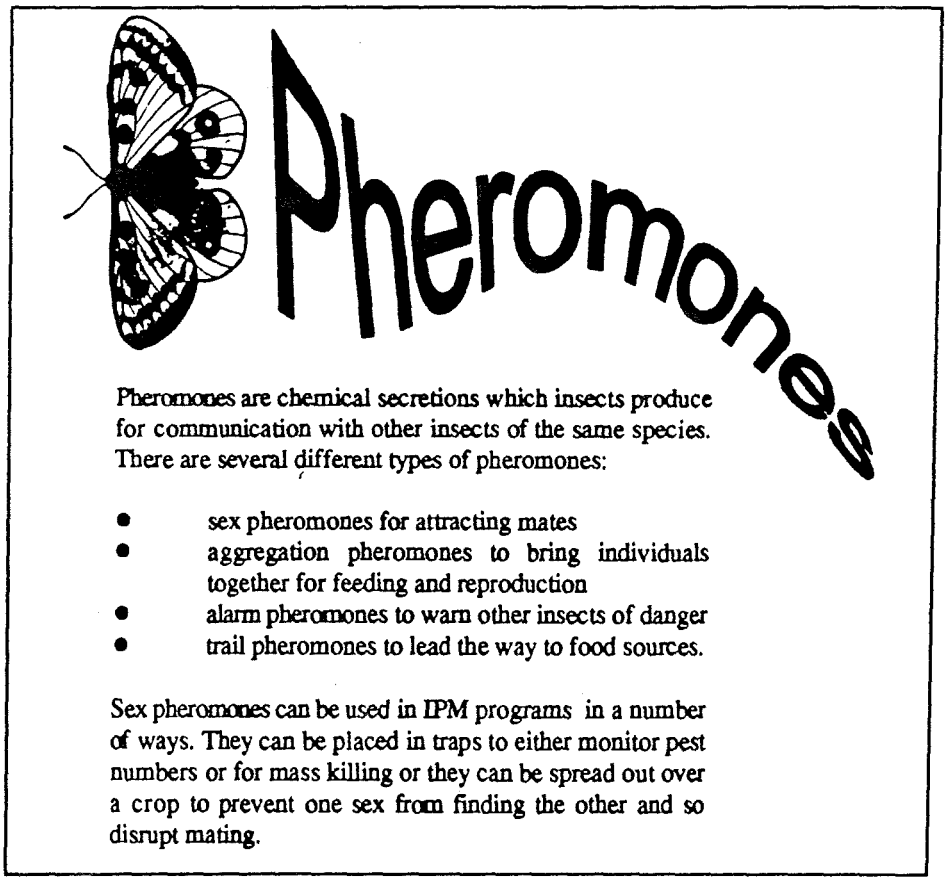
It is important that the full potential of egg parasitoids for mass rearing and inundative release be assessed as possible tools for use in an IPM program. The Chinese have developed an artificial rearing system for an *Anastatus* wasp parasitoid to control lychee stinkbug in lychees and longans. With seasonal releases of the wasp, they can usually avoid spraying for stinkbug, which supports assessing the potential of the Australian *Anastatus* as a biological control of FSB.

Other research conducted by Harry Fay links the level of damage on carambola fruit to crop phenology. The level of damage rises rapidly as the main crop is developing and levels off to a constant, and suggests that the spray program should begin before the last flowers are finished to prevent early damage. Since the level of damage reaches a plateau, it may be more cost effective to stop spraying early and lose the late part of the crop unless the late fruit attracts premium prices. This type of research may provide a short term solution or backup technology if a good FSB monitoring method can not be developed to rationalise spraying.

3.3 Semiochemical and Pheromone Research
Dr Chris Moore, Principal Chemist, QDPI Yeerongpilly

Chris Moore defined semiochemicals as "smells" which insects sense all the time and which influence their behaviour; and pheromones as a special case where the "smell" actually originates from the insects themselves. If research can identify and synthesise the pheromones which male FSB produce, female FSB could be attracted to monitoring traps or trap crops where they could be sprayed. Chris has been working with Geoff Waite to identify the chemicals which the insects blend to produce pheromones. Five of the six chemicals traced have been identified. Future research will investigate the possibility of using pheromones to attract FSB to traps for monitoring or spraying but this will not be possible until the sixth component of the pheromone blend is identified.

Similar research has been conducted to find out if the fruit of FSB host trees exude volatile chemicals which attract the insects to that fruit. So far very few fruit volatiles have been detected on host plants and since the host range is so large, Chris doubts he will find a selective chemical which attracts the FSB to any one plant.



4 Recommendations and Conclusion

Participants were given time to add more ideas to their cards after the presentations. They then broke into two groups of 8 - 10 and pinned all their cards onto a board and sorted them into 'like ideas'. Each group derived a short descriptive heading for their card themes and reported these issues back to the plenary session. A full list of participant generated ideas in provided in Appendix 3.

The plenary group discussed the issues highlighted by each group and made recommendations to address the question of improving FSB management. The major issues and associated recommendations are as follows.

4.1 Overall Goal

Participants suggested that an effort to improve growers' monitoring skills was critical for the successful implementation of research results for improved FSB management.

4.2 Recommendations

Development of an IPM program (long term)

> *That the Sunshine Coast resolution to increase the HRDC levy from 3 cents to 6 cents per tray be adopted. If these additional funds are not sufficient to fund the project "Ecology, Behaviour and Management of FSB" then the AAGF arrange to contribute $15 000/year to that project.*
>
> *That priority be given by QFVG to survey Queensland growers of all crops about extent of damage and cost caused by FSB.*

Improve management knowledge

> *That researchers advise growers how they can assist with research (eg. record observations, allow use of their orchard for study).*
>
> *That research results be published in "Talking Avocados" and included in AVOMAN.*

Address social issues

> *That liaison with environmental groups be established through Landcare, QDPI, CTPM (long term) & QFVG (short term) to reduce the pressure to ban endosulfan.*

Maintain good spray program

> *That a multi-industry information sharing workshop be held in August 1995.*

4.3 Conclusion

Several participants commented that they had learnt a lot from the presentations given by the research scientists and, although initially unsure of how they could contribute, were pleased that the meeting was able to generate some constructive recommendations. John Bolton, president of the AAGF thanked all those who attended and assured the meeting that the recommendations from the workshop would be provided to the AAGF executive for discussion and consideration.

Appendix 1: Workshop Timetable

Fruitspotting BUG WORKSHOP
Queensland Fruit and Vegetable Growers
Tuesday, September 14, 1994

AGENDA

9.00 am	Welcome (Rod Glass, R&D Coordinator, QFVG) Introductions
9.15	Presentations:
	Geoff Waite: *Fruitspotting bug as a pest of tropical fruit tree crops* (30 mins)
	Harry Fay: *North Queensland species of fruitspotting bugs and their parasitoids* (15 mins)
	Chris Moore: *Research into fruitspotting bug pheromones and fruit volatiles* (10 mins)
10.30	Morning tea
10.45	Group exercise:
	"What role can producers play in improving management of fruitspotting bug?"
11.30	Reporting back of major recommendations
12.00	Close meeting

Appendix 2: List of Participants

Workshop Participants

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Appendix 3: Pinboarding card contents

Group 1

1.1
Explore research funding options including levy
Grower contribution to funding
Who is going to fund future projects?

1.2
Develop an IPM system for avocado
Alternative natural chemicals
- botanical insecticides
IPM
- monitoring
- selective chemicals
- natural predators
IPM
Improved monitoring procedures

1.3
Support pheromone research
- monitoring
- pheromones
- decrease pesticide application
Pheromone development

1.4
More cooperation between farmers and researchers
Communication between Q.D.P.I. and growers
IPM
By feeding information back to research group by monitoring
Easier transfer of information between growers and researchers
Technology transfer
- more grower participation!
By more meetings like this
Need for growers to aid technical people and time
Pool data from growers
- monitoring
- spray schedules
- damage/loss

1.5
Provide growers with information on biology so they can check
Are the bugs affected by periods of wet or dry weather?
Become more aware of bug habits
What is the optimum temperature for their breeding
FSB
- When are they most active?
- Which months?
FSB

1.6
Growers need information on host trees so can check
Host trees to attract FSB away from orchards
Need a list of host trees so we can check
Host plants
- overwintering
- source of population
Look for host trees and spray

1.7
Communicate our situation to green movement
Dialogue with green movement to help them understand chemicals & their controlled usage
How do we protect the right to use chemicals?
Radicals can tip chemical into rivers to stop farmers spraying????
What are the main objections to endosulfan?

1.8
Establish wasp breeding and release system
Need for further research for predators
Wasps
Urgent need for large numbers of egg predators so we can release

1.9
Survey growers
Damage & cost to growers

1.10
Maintain good spray program
Continue spraying at regular intervals

Group 2

2.1
Growers to lobby/arrange funding for FSB
Give more research $ to Harry immediately
Allowing more money for research specifically for FSB
Producers should encourage the development of insectaries
Extra grade of fruit so FSB damage is sold - levy
Fund research
Value adding for reject fruit - S. Oils. Pulp
Levy

2.2
Improved management knowledge
Best spraying conditions
e.g. Midday, late afternoon etc.
What time of day is best time for spraying
Correct dosage of endosulfan
Where we have Fuerte and Hass together (top working slowly) - Hass almost untouched - Fuerte badly stung.....any answer?
Intelligent use of appropriate chemicals at appropriate times
Spraying before flowering complete
Checking calibration of sprayers and effectiveness of coverage
Pruning effects

2.3
Address social issues
Safe chemical storage and use to reduce bad publicity
Co-operation from neighbours regarding crop hygiene
Producers must encourage legislation to enforce orchard hygiene
Change odour of endosulfan
The issue of feral orchards & home gardens
Grower ownership of research projects

2.4
Improve monitoring skills
Producers must learn to distinguish between FSB damage and Queensland fruit fly damage
Monitoring for damage and eggs
Establishing hot spots
Learn to monitor FSB activity in the orchard
What time of day do FSB attack fruit?

2.5
Research topics to be addressed
Camphor laurel tree
What or which trees host FSB?
Sterilising males
Develop a repellent
Are there any mechanical means of capturing FSB?
Trichogramma wasp
Sodium silicate