AV401

Fruit spotting bug in avocados

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Queensland Department of Primary Industries

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FRUITSPOTTING BUG IN AVOCADOS

G.K. Waite

Technical Summary

(i) Pheromones: Research continued in the quest to find the identity of the remaining unknown chemical components of the male-produced pheromone of the banana spotting bug Amblypelta lutescens. Although progress was inhibited somewhat by the continuing disappointing malaise of the bug rearing system, some success was achieved by the identification of the fifth of the six apparent components. Due to the possible commercial sensitivity of the information and the need to determine the exact optical isomer of the compound identified, its structure and identity cannot be revealed at this time. Further samples of the pheromone are required to further this process which will be addressed in a succeeding project. The rearing difficulties with A. lutescens are even more pronounced with A. nitida and no further progress was possible with this species. Practical application of the results from the pheromone work is still some way off and depends on the identification and synthesis of the multi-component pheromone.

(ii) Reduced rate pyrethroid trial: Due to the nonavailability of a suitable avocado orchard in which to conduct this trial, it was carried out in macadamias. Although assessment of the true level of fruitspotting bug damage suffered by the nuts was clouded by quite severe hail damage (which imparts a symptom very similar to FSB damage) in October, a couple of assessments were made which indicated that low doses of pyrethroid insecticides might provide acceptable control of the pest without induction of secondary pests in macadamias. In addition, a small group of trees on the Maroochy Horticultural Research Station were sprayed X times with cyfluthrin (Bulldock) at the reduced rate of 15 mls per litre of water (normal rate is 25 mls per litre). While latania scale numbers remained low for the season, tea red spider mite numbers increased significantly and caused noticeable bronzing of leaves. A control group of trees situated 100 metres away and left unsprayed remained mite free. This result was not unexpected and similar effects have been noted when the preferred chemical endosulfan is used. The chemical company which marketss Bulldock has expressed its intentions to register that pyrethroid for use in avocados. If this happens then every effort should be made to adapt its use to fit into an IPM system.

(iii) Fruitspotting bug susceptibility of fruit in relation to its phenological phase: No clear indicaton of a change in susceptibility to FSB attack as fruit matured and oil content increased was found in experiments designed to test the hypothesis that damage to avocados ceases when the fruit reaches a certain stage of maturity. Although it was not possible to continue the experiment past April 10, more than 50% of individuals of both species caged on fruit and offered green beans as an alternative food source, continued to feed on the avocado fruit on that date. A better method of measuring the attractiveness of maturing fruit is required in order to confirm or deny these findings. Observation of natural bug populations and tagging of damaged fruit would reflect actual bug feeding behaviour more closely and this approach will be pursued in future research. If a cut-off date can be determined, then growers may be spared a couple of late season sprays which are sometimes applied as an insurance against late attack.

(iv) Fruitspotting bug rearing: Although this aspect was not designated as a specific goal of the project, the difficulty experienced in rearing large numbers of bugs in the insectary is reflected in the limited success of some of the experimental areas addressed, notably that involving the identification of the pheromones. A. lutescens has always been easier to rear than A. nitida but low laboratory populations of both species, compounded by unusually low wild populations in the field which provided a low base from which to commence rearing, resulted in few pheromone extractions being carried out on the former and none on A. nitida.

Industry Summary

Previous research on fruitspotting bugs has shown that males of both species produce a complex of six chemicals which are suspected to be pheromones. For *A. lutescens*, four of these six were identified almost immediately, but the remaining two remained a mystery. During the conduct of this project, the fifth component was identified, leaving only one whose identity is not known. This needs to be finalised so that experimental blends can be manufactured and tested.

The situation with respect to *A. nitida* has not changed due to a shortage of males from which to extract the pheromone. Future research needs to concentrate on the rearing procedure for both species but especially for *A. nitida* so that sufficient bugs are available for the extraction of large amounts of pheromone which will enable the relevant GCMS and other analyses to take place.

Experiments conducted to determine the efficacy of low rates of pyrethroid insecticides on the bugs and the side effects of the chemicals within the orchard showed that good control of fruitspotting bugs is possible. The expected upsurge in Latania scale numbers did not eventuate but tea red spider mite populations increased to levels which produced noticeable bronzing on the leaves. Trees which were left unsprayed did not have any mites associated with them. Despite the development of significant mite populations on the sprayed trees, this is not too different to what occurs when endosulfan is used as that chemical, although it is regarded as being relatively safe to predators, often triggers tea red spider mite outbreaks through its apparent effect on *Stethorus*, the mite- feeding ladybird. These results have implications in the ongoing development of the avocado IPM system which is in danger of being set back through the treatened withdrawal of endosulfan.

That fruitspotting bugs generally prefer to feed on and so damage green fruit has been recognised for a long time. Observations have suggested that there is a point in the maturation process of the fruit when it is no longer attractive to the mobile adult bugs and they cease to visit the host tree and to feed on the fruit. Of course, nymphs arising from eggs laid by visiting adults are marooned on the tree because they are flightless, and continue to feed on the fruit even as it matures. Damage caused as a result is usually insignificant and control of those bugs is probably not necessary. The point at which the adults cease to be attracted to the fruit is of interest because if it can be pinpointed, then sprays which are presently applied after that time may be dispensed with and growers could be confident that no further damage will occur. The experiments conducted to determine this were not successful, most likely because of the technique used. Future attempts to determine the cut-off date should employ observational records of on-tree damage rather than caging bugs on fruit and more or less forcing them to feed even if, under natural circumstances, they would not be inclined to do so.

Mass rearing of fruitspotting bugs continued to be a problem. Provision of fresh water did not improve survival while adding to the labour component. Fresh green beans are the only viable food source as they are well-liked by the bugs and available all year round. Cage populations and humidity are two factors which may be critical to success and I have a suspicion that natural sunlight may also play an important role since bugs do spend time basking. A range of culturing conditions which include variations of these critical factors needs to be experimented with in order to maximize bug production for a variety of studies but especially for the pheromone determinations

Fruitspotting Bug in Avocados

G.K. Waite
Principal Entomologist

Introduction

The two species of fruitspotting bug, *Amblypelta nitida* and *Amblypelta lutescens lutescens* cause severe damage to avocados grown along the tropical and subtropical east coastal region of Queensland and New South Wales. Relatively low numbers of these insects appear to cause damage far out of proportion to what might be expected from observable numbers. That this is in fact so is not certain, due to the extreme difficulty in finding the bugs in the trees. Usually, bug presence is noted only after damage appears on the fruit. Because of the difficulty in monitoring for the presence of the bugs, growers apply prophylactic sprays to ensure that excessive damage does not occur. While this is effective, the chemical used, endosulfan, is under threat of being withdrawn. Such an occurrence, while it would not be disastrous for the industry, would be deleterious to the general pest management thrust in avocados, since endosulfan is a preferred IPM- friendly insecticide, being relatively kind to the beneficial organisms which regulate the populations of other pest species , especially of mites and scales. A number of alternative insecticides control fruitspotting bugs very effectively, but because of their broad spectrum of activity, they cause outbreaks of these secondary pests. Observations on these aspects and details of them are discussed by Waite et al (1993 and 1994).

Over the last fifteen years, much experience and knowledge regarding various aspects of the behaviour, host preferences and natural enemies of the bugs has been accumulated (Waite et al 1993 and 1994, Fay and Huwer 1993). However, much remains to be discovered and this will only be achieved through a concerted effort. In addition, considerable progress has been made towards determing the pheromone complex of *A. lutescens* (Aldrich et al 1993).On the expectation that a significant project concerning fruitspotting bugs would be funded in 1995-96, the Sunshine Coast Avocado Growers' Association provided funds for some preliminary work to be carried out on fruitspotting bugs in avocados.

This minor project set out to look at five aspects. Four of these were practically oriented while the fifth was a necessary objective within the context of furthering the pheromone research. These topics were :

(1) Identification of the remaining unknown components of the *A. lutescens* complex and obtaining sufficient of the pheromone from *A. nitida* to commence positive identification of the major component.

(2) The potential of reduced rates of synthetic pyrethroid insecticides to be used in IPM systems where fruitspotting bugs are a major problem, as an alternative to the threatened endosulfan.

(3) The effect of synthetic pyrethroids on the secondary pests of mites and scales.

(4) The effect of fruit phenology on the propensity of fruitspotting bugs to attack it.

(5) Rearing techniques for fruitspotting bugs.

Materials and Methods

(1) Pheromone identification

Wild fruitspotting bugs of both species were collected from unsprayed orchards on the Maroochy Horticultural Research Station and used to start an insectary culture. When numbers of males exceeded fifteen, they were placed into the glass collection chamber and the pheromone extracted as described by Aldrich et al (1993). Once collected and extracted from the charcoal medium, the material was forwarded to Dr. C.J. Moore at the QDPI Animal Research Institute at Yeerongpilly. Here it was subjected to GCMS analysis.

(2) Alternative chemical trial

Because of the unavailability of suitable avocado orchards in which to carry out this trial, it was done in macadamias on the Maroochy Horticultural Research Station. Reduced rates (10mls/100litres of water) of the synthetic pyrethroids beta-cyfluthrin (Bulldock) and fenvalerate (Hallmark) were compared with beta-cyfluthrin (25mls/100 litres water) and the threatened endosulfan (150 mls/100 litres water). Applications were made as high volume sprays via a hand-held lance with approximately 20 litres of spray applied to each tree. Sprays were applied on Oct. 12, Oct. 31, Nov. 11 and Dec. 22.

Immature macadamia nuts fall when damaged by fruitspotting bugs. Thirty fallen green nuts per tree were sampled on Oct. 11, Oct. 20, Nov. 10, Nov. 18, Nov.25, Dec. 2, Dec. 9, and on Feb. 20 and dissected to determine if they had been damaged by fruitspotting bugs. These samples were taken pretreatment and at regular intervals throughout the susceptible period. The final harvest assessment was made on Feb. 20. Thirty nuts were picked from each tree. Each husk was removed and assessed and each nut was cracked individually and damage status of the kernel noted. In addition to bug damage, an assessment was made on scale incidence and mite damage to the husks at final harvest. This was done on the basis of presence or absence.

(3) Side-effect of reduced rates of pyrethroids on scales and mites

Hass and Fuerte avocado trees on the Maroochy Horticultural Research Station were sprayed on a regular basis with beta- cyfluthrin at the rate of 25mls/100 litres water for fruitspotting bug control. This chemical is registered for use against fruitspotting bugs in macadamias at 50 mls/100 litres water for normal severe infestations. Datum trees of the cultivar Hass were monitored for numbers of latania scale and tea red spider mite every two to three weeks. Scales were counted *in situ* on tree terminals. Mite samples consisted of ten leaves picked randomly from each of ten trees for a total of 100 leaves per sample. These leaves were then inspected under a stereomicroscope and the number of mites and their eggs were counted.

(4) Non-attractive phenological stage of fruit determination

Single adult fruitspotting bugs (both male and female) were caged on individual Fuerte fruit still attached to the tree at intervals of 7 - 14 days from Feb 8 to April 10, the period during which the fruit is maturing and at which time it was thought that fruitspotting bugs would gradually become less attracted to it and eventually, not feed on it. Each bug was offered an alternative food source in the form of a green French bean. Bugs were allowed to remain on the fruit for three days after which they were removed and the fruit and the bean were assessed for damage. The number of feeding punctures on each was noted.

On each date on which bugs were caged on fruit, five fruit were harvested and a dry matter determination was carried out to characterise the state of maturity of the fruit. Dry matter is a good indicator of oil content and hence fruit maturity.

(5) Mass rearing of fruitspotting bugs

Various aspects of fruitspotting bug research require access to large numbers of bugs, especially the pheromone determinations. While good numbers can sometimes be reared, it has not been possible to consistently produce the large numbers required using the present pheromone extraction technique. Green French beans have been shown over the years to be a reasonably satisfactory food for the bugs. Using these for food and clear plastic containers as cages, two alternative methods were tried in order to rear the bugs more consistently. Bugs were provided with supplemental fresh water or denied water, and beans were either sterilised in sodium hypochlorite or just washed in water to which had been added detergent.

Results and Discussion

Pheromone identification

Although bug production from the insectary culture was limited for the season, sufficient males were produced to enable some pheromone extractions to be made for *A. lutescens*. Subsequent GCMS analysis of these extracts enabled tentative identification by Dr. C.J. Moore of the fifth chemical component of the six previously found to constitute the total complex. The other four had previously been identified in earlier work involving Dr. J. Aldrich of the USDA Beltsville Laboratory. The exact chemical structure and isometry of the fifth component are still being elucidated by Dr. Moore. With only one component of the *A. lutescens* complex to be identified, we are hopeful that a rough blend of the pheromone suitable for laboratory and subsequent field testing might be available in the near future.

With respect to *A. nitida*, it has always been more difficult to rear in the insectary than *A. lutescens* and the study season was no exception. The spring - summer of 1994 - 95 was unusual in that wild bug populations were uncharacteristically low. This state of affairs was exacerbated by poor fruit production on the lychees and longans on the Research Station from which good collections are normally made. Thus, insufficient male bugs of this species were available to carry out any pheromone extractions and no progress has been made on its pheromone components.

Future research in this area of fruitspotting bug ecology and behaviour will focus on finalising the pheromone makeup of both species and developing a reliable monitoring system which employs those chemicals. It is to be hoped that the industries which desperately require such a system will adequately fund the research so that real progress towards a practical solution to the fruitspotting bug problem can be made.

Alternative chemical control

As noted in the previous section, this trial was conducted in macadamias because of the unavailability of suitable avocados. Bug damage was measured by cutting the husks from green nuts and examining the inner surface for the typical lesions caused by the feeding of bugs. Pretreatment damage was not significantly different between trees included in the various treatments. Early in the season, a hail storm inflicted considerable damage which was manifest as lesions on the inside of the husk which looked very similar to fruitspotting bug damage. Hence the damage assessment for some of the collection dates following this event was an overestimate on the part of the inexperienced casual assistant employed to do the assessment and this data was not considered in the final assessment. Table 1 shows the pretreatment, an intermediate and the final harvest assessment of damage to nuts. Severe fruitspotting bug damage of up to 58% was detected in all trees pretreatment and levels were not significantly different. On Nov. 10, after two spray applications had been made, damage to nuts in all the insecticide treatments was reduced to very low levels (3% - 8%) and chemical treatments were not significantly different from one another. All of these were significantly different from the control where damage had reached 72%. Husk damage at final harvest was again significantly different for the insecticide treatments over the control but there was no difference between those treatments. The same was true for kernel damage. These data indicate that the low rates of pyrethroid used were as effective at controlling fruitspotting bugs as the full pyrethroid rate and the recommended endosulfan.

The ratings for mite incidence showed that all of the chemical treatments had significantly more mite damage than the unsprayed control, and those treatments were not different from one another in this respect (Table 2). For scale incidence, the three pyrethroid treatments were significantly different to endosulfan and the control (Table 2), though the population levels reached were not high and were certainly not a significant commercial problem. Although mite incidence for all of the chemical treatments was not significantly different, the trends on means are interesting and give an indication as to what might happen on avocados. The full rate of fenvalerate produced a higher mite incidence than the low rates which in turn were higher than endosulfan.

Table 1 Percent damage to macadamia husks and kernels caused by fruitspotting bugs

Treatment	Husk damage pretreat.	Husk damage Nov. 10	Husk dam. final	Kernel dam. final
fenvalerate 10 mls/100L	9.8a	2.4a	2.8a	0.6a
b-cyfluthrin 10 mls/100L	12.3a	1.8a	2.4a	0.8a
b-cyfluthrin 25 mls/100L	11.8a	1.0a	0.8a	0.6a
endosulfan 150 mls/100L	12.0a	1.2a	1.6a	1.2a
control	17.3a	21.6b	9.6b	6.6b

Numbers followed by the same letter are not significantly different (5%).

Table 2 Flat mite and latania scale incidence (% nuts infested) at harvest on macadamias under various insecticide treatments

Treatment	Mite incidence	Latania scale incidence
fenvalerate 10 mls/100L	13.2a	3.6a
b-cyfluthrin 10 mls/100L	13.4a	3.2a
b-cyfluthrin 25 mls/100L	18.0a	3.4a
endosulfan 150 mls/100L	10.6a	2.2ab
control	0.8b	0.0b

Numbers followed by the same letter are not significantly different (5%).

Side-effect of reduced rates

In addition to the extra observations made and discussed in the previous trial, avocado trees which were being treated on a regular basis with beta-cyfluthrin at the rate of 25 mls/100litres water, were monitored for the incidence of latania scale and tea red spider mite. Monitoring was commenced in January to allow a reasonable time for potential populations to become established. Prior to the commencement of the pyrethroid sprays, the trees were sprayed six times at approximately fortnightly intervals with endosulfan. Pyrethroid sprays commenced on Dec. 12. Despite the application of six sprays of beta-cyfluthrin at fortnightly intervals, latania scales did not become numerous and reached average populations of only 0.7 to 2.7 scales per terminal (Table 3). Such infestation levels present no threat to the tree, nor cosmetically, to the fruit. In addition, a low level of host insects such as this serves as a useful reservoir for the effective parasitoids such as *Aphytis* spp. The undesirable effect of high Latania scale infestations as shown in Figure 1 where terminal growth can be killed and fruit covered in scale, seem to have been avoided by using the lower rate of beta-cyfluthrin.

On the other hand, tea red spider mite commenced to increase right from the start of sampling on Jan. 9, just two weeks after the first pyrethroid application. Infestation levels increased from a low on that date of an average of 1.6 mites per leaf with 50% of leaves infested, to a high on Feb. 27 of 33.4 mites per leaf and 85% of leaves infested. Three weeks later, after spraying had ceased the mite population had dropped to 15.5 per leaf but 87% of leaves remained infested (Table 3). The reduction in mite numbers at the end of the sampling period was most likely a result of the denaturing of the leaf surface caused by the continuous feeding of relatively high populations of mites over the period of about ten weeks. Predatory mites and ladybirds which might be expected to control the pest mites under unsprayed conditions, were not active due to the frequent spraying of the pyrethroid.

In addition to the replicated samples taken from the Hass trees, the opportunity was taken to sample leaves from a Fuerte tree in the same orchard and some unsprayed Fuerte trees in an adjacent orchard. These trees were sampled on three occasions from Feb.10 to Mar. 16. Fuerte is less susceptible to tea red spider mite than is Hass, and populations tend not to reach the extremely high levels attained in Hass. Nevertheless, significant populations were induced on the pyrethroid-sprayed Fuerte tree so that on Mar. 16, 100% of leaves sampled were infested with an average of 18.5 mites per leaf, while the unsprayed trees had no mites at all on any of the sample dates. Having shown that pyrethroid sprays can induce mite infestations, it must be said that endosulfan is not entirely without side-effects where this pest is concerned, primarily because the major predator is the Coccinellid *Stethorus punctipes* which seems to be severely affected by that chemical. In contrast to scale pests, tea red spider mite, which inhabits the upper surface of the leaf, is easily controlled chemically with the miticide fenbutatin-oxide.

Figure 1 "Severe scale infestation with resultant terminal shoot death due to pyrethroid sprays on avocado"

Table 3 Average tea red spider mite and latania scale numbers on pyrethroid-sprayed and unsprayed Hass avocado trees

Date	Mite active stages per leaf	Mite eggs	% leaves infested	Latania scales
Jan. 1	1.6	7.4	50	
Jan.23				1.11
Jan.27	10.9	51.1	71.5	
Feb.2				1.34
Feb.10	19.9	21.5	89.0	
Feb.20				1.48
Feb.27	33.4	14.0	85.0	
Mar.20	15.5	52.6	87.0	

Moves are underway to have beta-cyfluthrin registered for use in avocados. The rate registered will most likely be 25mls/100 litres water. In that case, given the results of these trials, lower rates which appear to be quite effective against the bugs as well as being less likely to cause side effects, will possibly be recommended in the context of IPM systems. Growers will need to be aware that the "IPM-friendliness" of the lower rates may not be to the extent of endosulfan, and that spray frequency may need to be tempered to account for this. Of course, this strategy makes it all the more imperative that a reliable monitoring system be developed and the pheromone and host volatile research should be fast-tracked in order to address this requirement!

Non-attractive phenological stage of fruit

Fruitspotting bugs are primarily pests of green fruit because that is the phenological stage of fruit development which they prefer to feed on. That is not to say that under some circumstances they will not feed on mature fruit, but given a choice and opportunity, they will always prefer the green stages. Observations made in several crops over many seasons suggest that it should be possible to determine what the window of susceptibility is, so that outside of this period sprays need not be applied. For avocados, this susceptibility window appears to extend from fruitset in September-October through to April-May. However, it may be that damage inflicted after March is insignificant and so growers could save a couple of sprays at that time of the season.

The experiment conducted on Fuerte, an early maturing cultivar, was not successful in demonstrating this due possibly to the method employed. While bugs caged on individual fruit were provided with an alternative food source in the form of a green bean, it seemed to be less attractive to them than the avocado fruit, even at the later stages of fruit development when it was expected feeding would cease. The results (Table 4) show that a significant number of bugs fed on the fruit and few fed on the beans on every date of caging and so no clear indication of a relationship between fruit maturity and attractiveness to fruitspotting bugs was established. For most of the experiment, the fruit was immature ie. the dry matter content was less than 21% (corresponding to 12% oil). However, even when maturity set in around the end of March, feeding frequency did not drop off as had been expected.

In retrospect, it seems that a better way of measuring attractiveness to the bugs and thus pinpointing the cessation of attractiveness, would be to mark or remove damaged fruit as it occurs on the tree naturally, and to note when such damage ceases. This approach will be employed in future research on this topic. A determination will be required for each cultivar, since there is a wide variation in the maturity dates of the different cultivars. Some, such as Hass and Wurtz may be stored on the tree as mature fruit to feed into the market as prices increase late in the year. Mature fruit retained on the tree in this manner might be considered to be at risk from fruitspotting bugs during the spring period. In reality, they are probably not at risk although some growers would spray to protect them. Data is required to support or deny this hypothesis.

Table 4 Feeding frequency of *A. nitida* and *A. lutescens* on maturing Fuerte fruit and green beans

	A. nitida		*A. lutescens*	
Date/oil content	Feed marks fruit	Feed marks bean	Feed marks fruit	Feed marks bean
Feb. 2 17.74%	4.3	0.0	2.5	0.0
Feb. 16 17.90%	21.3	0.6	21.0	13.4
Mar. 1 17.53%	13.0	0.0	11.0	0.0
Mar. 15 18.84$	8.0	0.0	9.0	8.0
Mar. 22 19.70%	12.0	0.6	6.0	13.0
Mar. 29 20.70%	13.0	3.0	9.5	9.5
April 4 21.95%	6.5	5.3	12.0	1.3
April 10 22.97%	8.6	0.0	6.8	1.0

Mass rearing of fruitspotting bugs

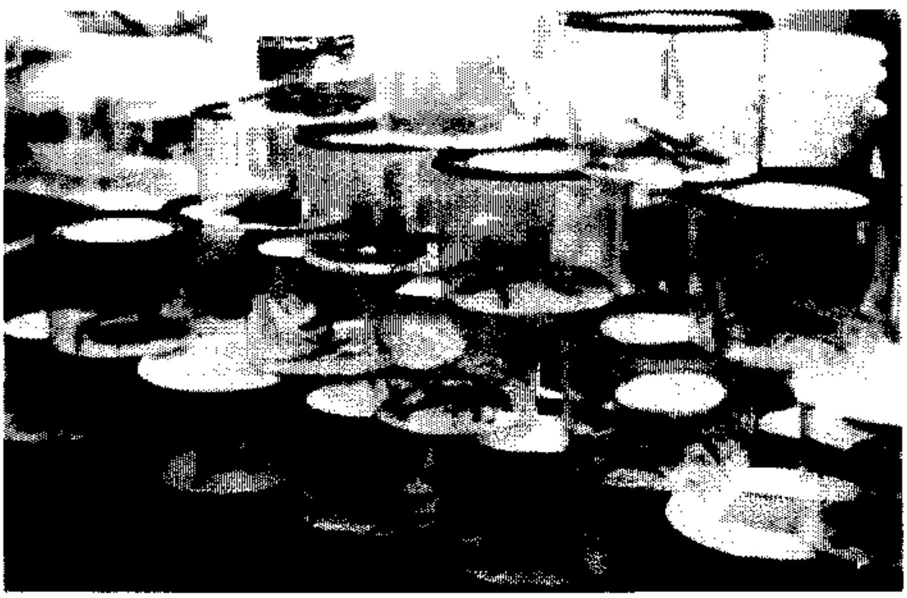
The 1994-95 season was one when wild fruitspotting bugs were in short supply and adults were not continuously available to feed into the production system. With poor maturation percentages in the culture, difficulty was experienced in maintaining numbers due mainly to the now familiar high mortality which afflicts second and third instar nymphs. Despite these problems, enough males were available to enable sufficient pheromone extract for analysis so that some progress was possible in the pheromone identification phase as described previously.

With respect to the different treatments experimented with, their was no noticeable benefit in providing fresh, free water via a dental wick. Bugs were observed to feed from it occasionally, but in the end, survival was not improved. Because the dental wick became slimy after a week, it had to be replaced and this was an additional chore which added to the time taken to care for the culture.

Sterilisation of the beans with sodium hypochlorite was found to be beneficial in that it prevented the onset of rots which were common at times, depending on the source of the beans. The relatively high temperature and humidity of the insectary and cages promoted fungal growth. However, if possible, we would like to dispense with the need to sterilise, since there is a suspicion that the chlorine generated by the hypochlorite might be having an effect on the bugs.

The food source used for rearing these bugs has been and remains French beans. This is a convenient food, available all the year round and relatively cheap. However, it seems to be not entirely satisfactory given the mortality of the young nymphs. We have always considered that a more satisfactory food source would probably increase the rearing success of the bugs. However, experience has shown that the bugs generally were not too interested in excised fruit at the correct phenological phase of their normal commercial hosts when these were trialed as alternative food sources. *A. lutescens* continued to do better than *A. nitida* under the conditions set up (Figure 2). For *A. lutescens,* moving second instar nymphs onto papaw plants to enable them to develop beyond those early risk-prone stages, was a moderate success, but eventually floundered because of the demise of the plants on which they were fed and a lack of new plants coming on. However, this is a promising technique if the tree supply problem can be overcome. Considerable expense will be involved in achieving this and of course it is most applicable to *A. lutescens*. *A. nitida* does not feed on papaw naturally, and neither does it feed on the actual vegetative tissue of any conveniently available plant. However, there are indications that it may be able to be reared on papaw, indicating just how adaptable to alternative hosts these bugs are. To maintain a continuous supply of suitable potted plants in fruit would be impossible. The reality is then, that for now we must use beans as the major food source and must develop a cage system which is more friendly to the bugs as well as being easily managed by casual laboratory assistants. Experiments aimed at achieving this objective are being conducted.

Figure 2 Insectary culture of fruitspotting bugs



Extension of research findings

This report has been supplied to the Sunshine Coast Avocado Growers' Association who provided the initial funding for the project. Growers will also be made made aware of the outcomes of the project through an article being prepared for "Talking Avocados". Although none of the results will be immediately useable by the industry, the aims of obtaining some preliminary data in order to set the scene for further research in a broader-based project was achieved.

One aspect which will be particularly welcomed is the breakthrough in the identification of the fifth pheromone component for *A. lutescens*. Given the generally difficult nature of the research, this outcome alone has made the project of just one year's duration, worthwhile.

Directions for future research

Fruitspotting bugs have been recognised as major pests of so many crops over the last two decades that a major effort is obviously required to find out more about their behaviour and ecological relationships. Only by discovering how the bugs operate in the common environment which includes their natural habitat and the modified habitat of commercial orchards and urban backyards, can a management plan be devised which addresses the needs of the commercial producer as well those of the community around the orchards and which will accommodate the changing expectations of a more aware society. Progress is likely to be slow because the pests have shown themselves to be very difficult to work with, but as has been pointed out on many previous occasions, the sooner a dedicated effort is made to address the problem, the sooner a solution will be found.

REFERENCES

Aldrich, J.A., Waite, G.K., Moore, C.J., Payne, J.A., Lusby, W.R. and Kochansky, J.P. (1993). Male - specific volatiles from nearctic and Australasian true bugs (Heteroptera:Coreidae and Alydidae). Journal of Chemical Ecology 19 (12): 2767 - 2781

Fay, H.A.C. and Huwer, R.K. (1993). Egg parasitoids collected from *Amblypelta lutescens lutescens* (Distant) (Hemiptera: Coreidae) in north Queensland. Journal of the Australian Entomological Society 32 : 365-367.

Waite, G.K., Fay, H. and Rogers, J (1993). Fruitspotting bug in north-eastern Australia: Workshop Report 8-9 July 1993. CRC for Tropical Pest Management, Brisbane Australia. ISSN 1320-6990.

Waite, G.K., Fay, H., Moore, C. and Wilson, L. (1994). Fruitspotting Bug Workshop Report: 13 September 1994. CRC for Tropical Pest Management, Brisbane Australia.