Project title	Chemical control and timing of application of insecticides for control of the capsid, *Lygus rugulipennis*, on strawberry
Project number:	SF 95
Project leader:	Dr Jean Fitzgerald East Malling Research New Road East Malling, Kent ME19 6BJ
Report:	Final Report, March 2010
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Key staff:	Dr Jean Fitzgerald Dr Chantelle Jay Mike Easterbrook Adrian Harris
Location of project:	East Malling Research
Project coordinator:	Paul Harrold
Date project commenced:	1 April 2008
Date project completed (or expected completion date):	31 March 2010
Key words:	capsids; *Lygus rugulipennis*; European tarnished plant bug; insecticides; spray timing; insect growth stage; strawberry; monitoring; Brigade; bifenthrin; Hallmark; lambda cyhalothrin; Calypso; thiacloprid; Gazelle; acetamiprid; Mainman; flonicamid; Steward; indoxacarb; Borneo; etoxazole.

The results and conclusions in this report are based on a series of experiments conducted over a one-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.

AUTHENTICATION

We declare that this work was done under our supervision according to the procedures described herein and that the report represents a true and accurate record of the results obtained.

Dr Jean D Fitzgerald
Project Leader
East Malling Research

Signature .... Date: 31 March 2010

Report authorised by:

Dr Christopher J Atkinson
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Headline

Brigade (bifenthrin) and Hallmark (lambda cyhalothrin) were the most effective products tested against European tarnished plant bug *Lygus rugulipennis*, although both are highly damaging to beneficial species and should be avoided within an IPM system

Background and expected deliverables

European tarnished plant bug, *Lygus rugulipennis*, is a serious pest on late season strawberries. Feeding by the pest on the developing flowers and fruits causes severe malformation. Over 50% of fruit may be downgraded as a result of capsid feeding in unsprayed crops. This pest overwinters in the adult stage, and populations develop on various flowering weed species in spring and early summer, with adults of this generation developing in June and July. The adults that develop on weeds migrate to flowering strawberries when the majority of weeds senesce, and eggs are laid in strawberry between July and September. Currently, no biocontrol agents are commercially available for *L. rugulipennis* so growers are reliant on insecticides to prevent damage to the crop. The most effective insecticide is considered to be Talstar/Brigade (the pyrethroid bifenthrin), but this should not be applied when the plants are flowering and so is difficult to use on everbearing strawberries. Pyrethroids are also damaging to biocontrol agents used against other pests in strawberry, such as *Phytoseiulus persimilis* (used against the spider mite *Tetranychus urticae*) and *Amblyseius cucumeris* (used against tarsonemid mites and thrips species), so is not compatible with IPM techniques. There is a SOLA for the use of Calypso (thiacloprid) against *L. rugulipennis*, but its use has not always given a significant reduction in fruit damage. This may be due to incorrect timing of application with respect to the developmental stages of the pest present; in HDC project SF 55 thiacloprid gave a significant reduction of nymphs but not of adults in a replicated field experiment.

The expected deliverables from this research were:

- an evaluation of the efficacy of selected insecticides against different life stages of the pest
- determination of the optimal application timing for the most effective compounds

Summary of the project and main conclusions

Large populations of *L. rugulipennis* develop on flowering weed species, and disperse to other plants, including flowering strawberry, when the weeds senesce. Overall populations are generally lower on strawberry than on the flowering weeds. For this reason, in year 1, three replicated experiments were conducted on weed plots to determine the efficacy of the chemical treatments and to compare the efficacy of timings targeted to different life stages on *L. rugulipennis* populations. Experiment 1 targeted 1st and 2nd instar *L. rugulipennis* nymphs, experiment 2 targeted 3rd–5th instar nymphs and experiment 3 targeted adults. Dates of application of pesticides were based on relative numbers of the different life stages recorded in tap samples of the plants. Treatments applied are shown in Table 1.

Table 1. Treatments in 2008. Sprays were applied at a volume rate of 1000 l/ha

Trt	Product	Parent company	Active ingredient	Dose rate product / ha
1.	Brigade	Belchim	bifenthrin 80g/l SC	300 ml
2.	Calypso	Bayer	thiacloprid 480g/l SC	250 ml
3.	Calypso +	Bayer	thiacloprid	250 ml
	Break Thru S240	PP Products	wetter	300 ml
4.	Gazelle	Certis	acetamiprid 20% w/w SP	375 g
5.	Mainman	Belchim	flonicamid 50% w/w WG	140 g
6.	Hallmark	Syngenta	lambda cyhalothrin 100g/l CS	75 ml
7.	Steward	DuPont	indoxacarb 30% w/w WG	250 g
8.	Borneo	Interfarm	etoxazole 110g/l SC	450 ml
9.	Untreated	-	-	-

The experimental design and full results from year 1 are reported in the Annual Report for SF 95. The main conclusions were:

- Applications of insecticides were successfully timed to target peaks in the different life stages of *L. rugulipennis* in this series of experiments
- There was a consistent pattern of results, with Brigade and Hallmark being the most effective treatments, giving the greatest reductions in overall numbers of *L. rugulipennis* of all developmental stages
- Calypso, Calypso + wetter and Gazelle significantly reduced *L. rugulipennis* numbers when compared with the control, but were not as effective as Brigade and Hallmark
- The untreated control had consistently higher numbers of *L. rugulipennis*
- Numbers of *L. rugulipennis* in the Borneo treatment were never significantly different from the control
- Although Mainman and Steward gave significant reductions in numbers compared to the control (for all except Steward in the experiment targeting the 3rd-5th instar nymphs),

numbers were significantly higher than in the Brigade, Calypso, Calypso + wetter, Gazelle and Hallmark treatments

- In the experiment targeting older nymphs, treatments appeared to be generally less effective at reducing numbers of *L. rugulipennis* than in the other two experiments, except for the most effective treatments, Brigade and Hallmark

Since there was no clear indication of differences in susceptibility of the different developmental stages of *L. rugulipennis* to the products tested, in 2009 the most effective materials identified in 2008 were assessed on everbearing strawberries when populations of the pest were present in the crop. In addition, an experimental product with reported activity against capsid bugs was included. The pesticides were applied on 28 July with the 2nd application of thiacloprid plus wetter being applied on 11 August.

Table 2. Treatments 2009. Sprays were applied at a volume rate of 1000 l/ha

Trt	Product	Parent company	Active ingredient	Dose rate product/ha
1.	Brigade	Belchim	bifenthrin 80g/l SC	300 ml
2.	Calypso	Bayer	thiacloprid 480g/l SC	250 ml
3.	Calypso +	Bayer	thiacloprid	250 ml
	Break Thru	PP Products	wetter	300 ml
4.	Calypso +	Bayer	thiacloprid	250 ml
	Break Thru (2 appln)	PP Products	wetter	300 ml
5.	Gazelle	Certis	acetamiprid 20% w/w SP	375 g
6.	HDCI 1	Coded product	-	-
7.	Untreated	-	-	-

Results showed that:

- Brigade (the pyrethroid bifenthrin) was effective at reducing *L. rugulipennis* numbers, with numbers reduced to close to zero in this treatment. With only one application, numbers of *L. rugulipennis* were still significantly lower than in any other treatment 23 days after application, highlighting the persistence of this product. However, the use of pyrethroids should be avoided in strawberry plantations that are using IPM strategies as they are damaging to beneficial arthropods
- Gazelle (acetamiprid) had no detectable effects on *L. rugulipennis* numbers
- The coded product HDCI 1 had no detectable effects on *L. rugulipennis* numbers overall
- Calypso (thiacloprid) + Break Thru (a wetter) applied twice was more effective than this treatment applied once, which in turn was more effective than Calypso alone
- Only Brigade reduced significantly the percentage fruit damage caused by *L. rugulipennis*

Conclusions

None of the insecticides tested in 2009 were as effective as the pyrethroid Brigade. Thus no alternative products for control of this pest were identified.

Financial benefits

Lygus rugulipennis is a serious pest on late season strawberries causing crop losses by feeding on developing fruits which become deformed and unmarketable. Over 50% of fruit may be downgraded as a result of capsid feeding in unsprayed crops. By providing growers with information on the effectiveness of timing of application against different life cycle stages and the relative efficacy of different treatments, this project aimed to enable growers to improve chemical control of *L. rugulipennis*. The project showed that there was no significant difference in efficacy of any of the products tested in 2008 on any developmental stage of the pest. In the 2009 experiment on strawberry, only the pyrethroid Brigade reduced the pest population to close to zero; no other effective material was identified.

Action points for growers

There are no immediate action points for growers

SCIENCE SECTION

Introduction

European tarnished plant bug, *Lygus rugulipennis*, is a serious pest on late season strawberries. Feeding by the pest on the developing fruits causes severe malformation of the fruit. Over 50% of fruit may be downgraded as a result of capsid feeding in unsprayed crops (Jay *et al*., 2004). This pest overwinters in the adult stage, and populations develop on various flowering weed species in spring and early summer, with adults of this generation developing in June and July. The adults that develop on weeds migrate to flowering strawberries when the majority of weeds senesce and eggs are laid in strawberry between July and September. In laboratory experiments (Easterbrook *et al*., 2003) the mean development time from egg lay to adulthood ranged from 66 days at a constant 15°C to 22 days at 25°C when *L. rugulipennis* was reared on groundsel, one of the weed species favoured by the pest. No eggs hatched below 10°C. Development times were slightly longer on strawberry at the same temperatures. The temperature at which overwintered adults become active was not recorded in these experiments. Thus the actual timing of colonisation of strawberry by *L. rugulipennis* cannot currently be predicted from temperature data alone, and careful monitoring of the crop and surrounding weeds is required by growers to determine if insecticide applications are required against the pest.

In the experiments undertaken by Easterbrook *et al*. (2003) the mean fecundity of *L. rugulipennis* at 20°C was shown to be 75 eggs per female. Thus there is the potential for a rapid increase in numbers of *L. rugulipennis* in the crop after the immigration of the adults from weeds. Nymphs and adults developing from the eggs laid on the strawberry plant, feed on the developing strawberry fruits and cause severe damage. The period from late July to late August is when most feeding damage is initiated; there is a 3-4 week interval between the initiation of damage and picking of the damaged fruit. As these insects are very mobile, significant fruit damage can be caused by low populations of the pest. However, previous research (Easterbrook, 2000; Jay *et al*., 2004) has shown a significant correlation between fruit damage and numbers of capsids present in the crop.

Currently, no biocontrol agents are commercially available for this pest so growers are reliant on insecticides to prevent damage to the crop. The most effective insecticide for use against *L. rugulipennis* is Talstar (bifenthrin), but this should not be applied when the plants are flowering as it is toxic to bees and so is difficult to use on everbearing strawberries. Talstar is also damaging to biocontrol agents used against other pests in strawberry, such as *Phytoseiulus persimilis* (used against *Tetranychus urticae*) and *Amblyseius cucumeris* (used against tarsonemid mites and thrips species), so is not compatible with IPM techniques. There is a SOLA for the use of thiacloprid (Calypso) against *L. rugulipennis*, but its use has not always given a significant reduction in fruit damage. This may be due to incorrect timing of application with respect to the developmental stages of the pest present; in HDC project SF 55, thiacloprid gave a significant reduction of nymphs but not of adults in a replicated field experiment (Fitzgerald, 2004). Insecticides with different modes of action may be more effective against the pest but have not been tested on strawberry in the UK; several have been shown to be effective against related capsid species in USA. Alternative chemical control techniques, or more effective timing of application of currently available techniques, are needed for this pest. Ideally insecticides used to control this pest should be compatible with overall IPM programmes for strawberry pests and be safe to apply during flowering of the crop.

Overall aim of the project

The overall aim of this project was to improve chemical control of *Lygus rugulipennis* in everbearer strawberry crops.

Summary of 2008 results

Large populations of *L. rugulipennis* develop on flowering weed species, and disperse to other plants, including flowering strawberry, when the weeds senesce. Overall populations are generally lower on strawberry than on the flowering weeds. For this reason in year 1 a replicated experiment was done on weed plots to determine the efficacy of the chemical treatments on *L. rugulipennis* populations. Timing of applications may be critical in determining the effectiveness of the treatments. For this reason, in year 1 of the project capsid population development within flowering weed plots was monitored and the proportion of each life stage present recorded. Chemical treatments were then applied to target the different life stages of the pest. Treatments were single sprays of individual pesticides applied with a motorised knapsack sprayer with a hand-lance at a volume rate of 1000 l/ha (Table 1).

Table 1. Treatments in 2008. Sprays were applied at a volume rate of 1000 l/ha

Trt	Product	Parent company	Active ingredient	Dose rate product / ha
1.	Brigade	Belchim	bifenthrin 80g/l SC	300 ml
2.	Calypso	Bayer	thiacloprid 480g/l SC	250 ml
3.	Calypso +	Bayer	thiacloprid	250 ml
	Break Thru S240	PP Products	wetter	300 ml
4.	Gazelle	Certis	acetamiprid 20% w/w SP	375 g
5.	Mainman	Belchim	flonicamid 50% w/w WG	140 g
6.	Hallmark	Syngenta	lambda cyhalothrin 100g/l CS	75 ml
7.	Steward	DuPont	indoxacarb 30% w/w WG	250 g
8.	Borneo	Interfarm	etoxazole 110g/l SC	450 ml
9.	Untreated	-	-	-

Only bifenthrin has full approval for use on strawberry and there is a SOLA for the use of thiacloprid. None of the other products currently has approval for use on strawberry.

Results of these experiments are reported in detail in the 2008 Annual report for this project. Overall conclusions were:

- The different life stages of *L. rugulipennis* were successfully targeted in this series of experiments
- There was a consistent pattern of results, with bifenthrin and lambda cyhalothrin being the best treatments, giving the greatest reductions overall in numbers of *L. rugulipennis* of all developmental stages
- thiacloprid, thiacloprid + wetter and acetamiprid significantly reduced *L. rugulipennis* numbers when compared with the control, but were not as effective as bifenthrin and lambda cyhalothrin
- The untreated control had consistently the highest numbers of *L. rugulipennis*
- Numbers of *L. rugulipennis* in the etoxazole treatment were never significantly different from the control
- Although flonicamid and indoxacarb gave significant reductions in numbers compared to the control (for all except indoxacarb in the experiment targeting the 3rd-5th instar nymphs), numbers were significantly higher than in the bifenthrin, thiacloprid, thiacloprid + wetter, acetamiprid and lambda cyhalothrin treatments

2009 experiment

Methods

Based on the results from year 1, and after discussion with HDC, it was decided that the products shown in Table 2 should be evaluated in 2009 on strawberry plots; these were products that showed most promise in the year 1 trials plus a new compound with reported potential against *L. rugulipennis*. The pyrethroid Brigade was used as a standard against which to measure the effectiveness of the other treatments.

Experimental design and layout

A one-year old strawberry planting of cultivar Evie 2 was used for this experiment at East Malling Research. The experiment was a randomised block design with five replicates of each treatment. Each plot was one strawberry bed, 0.8 m wide and 8.6 m long. Beds were 3 m apart to prevent any contamination from spray drift. Plots were 3 m apart in the bed.

Treatments

Six treatments and an untreated control were evaluated. Treatments are shown in Table 2.

Table 2. Treatments 2009. Sprays were applied at a volume rate of 1000 l/ha. The 2 applications of Calypso + Break Thru were applied 2 weeks apart

Trt	Product	Parent company	Active ingredient	Dose rate product/ha
1.	Brigade	Belchim	bifenthrin 80g/l SC	300 ml
2.	Calypso	Bayer	thiacloprid 480g/l SC	250 ml
3.	Calypso +	Bayer	thiacloprid	250 ml
	Break Thru	PP Products	wetter	300 ml
4.	Calypso +	Bayer	thiacloprid	250 ml
	Break Thru x 2 app	PP Products	wetter	300 ml
5.	Gazelle	Certis	acetamiprid 20% w/w SP	375 g
6.	HDCI 1	Coded product	-	-
7.	Untreated	-	-	-

Treatments were applied with a Birchmeier motorised knapsack sprayer with a hand-lance at a volume rate of 1000 l/ha (Table 2). The first application was made on 28 July 2009 and a second application of treatment 4 was made on 11 August 2009.

Meteorological records

Wet and dry bulb temperature, wind speed and direction were recorded before and after spraying. On 28 July 2009 the weather was hot and dry with a Southerly wind at a rate of 6 km/h at the start of the application rising to 11 km/h by the end of the application. The wet and dry bulb temperatures were 16 and 21℃ respectively at the start and 14 and 18℃ at the end of the spray period. On 11 August 2009 there was no wind at the start of the application and only a slight, South, South-West breeze at 2 km/h by the end of the period.

The wet and dry bulb temperatures were 18 and 22℃ respectively at the start and 20 and 26℃ at the end of the spray period.

Assessments of L. rugulipennis *numbers*

To assess the numbers of *L. rugulipennis* present, tap sampling was done over a 13 cm diameter white dish. Numbers of the different developmental stages of *L. rugulipennis* present were recorded and returned to the plants. Life stages were recorded in three categories: 1st - 2nd instar nymphs; 3rd - 5th instar nymphs and adults. Ten plants were tapped per plot on each occasion. A pre-treatment sample was done on 17 June 2009 to assess initial populations. Post-treatment samples were done 3 and 9 days after the first pesticide application on 31 July 2009 and 6 August 2090 and again 3 and 9 days after the second application of Calypso plus wetter on 14 August 2009 and 20 August 2009.

Assessments of fruit damage

Prior to each spray application 20 open flowers were marked to enable the timing of development from flower to ripe fruit to be made. This enabled fruit damage to be related to pest numbers in the crop at the time the fruits were developing and gives another indication of the effectiveness of the treatments. Labelled fruits from each of the two spray dates were checked weekly to assess the level of fruit development. When fruits had reached a pink blush to ripe stage, approximately four weeks after each spray, a full damage assessment was done on all of the plots. Five plants were randomly selected from each plot and all the fruits at the correct developmental stage were picked from each plant. At least 50 fruits were required for the assessment so when fewer fruits were available, the plant number was increased per plot. Fruit was picked on 27 August 2009 and 8 September 2009. Fruits were brought back to the laboratory and were initially graded into size categories (>35 mm, >25 mm and <25 mm). Fruits in each size category were then assessed for the typical *L. rugulipennis* fruit damage; categories were zero, low, medium and high (see Figure in Appendix).

Statistical analysis

Data was analysed and compared by ANOVA. A square root transformation was used to improve variance homogeneity throughout.

Quality assurance

East Malling Research is an officially recognised efficacy testing organisation (Certificate no. 0206). This work was done according to GEP quality standards and according to East Malling Quality Assurance (EMQA) procedures and requirements.

Results

Analysis of the pre-treatment samples showed no differences between treatment plots (Table 3), so numbers were similar across the planting. Since the post-treatment statistical analysis showed that there was no interaction between time of sampling and numbers of *L. rugulipennis* in the different treatments (i.e. although numbers changed over time these changes followed the same trend on the different sample dates regardless of treatment) overall analysis of numbers recorded in the first two and the second two samples (i.e. before and after the second application of Calypso + Break Thru) are presented in Tables 4 and 5.

Table 3. Pre-treatment numbers of different stages of *L. rugulipennis* in samples from treatment plots; means are square root transformed. No significant differences were found before treatment

Product	***L. rugulipennis* stage**			
	1-2	**3-5**	**Adults**	**Total**
Brigade	4.14	1.54	0.80	20.8
Calypso	4.10	2.10	0.40	22.2
Calypso + Break Thru	3.90	2.11	0.40	20.8
Calypso + Break Thru x 2 app	4.29	1.97	1.00	24.2
Gazelle	3.97	2.48	0.40	23.0
HDCI 1 coded product	4.15	2.55	1.40	26.2
Untreated	4.12	1.95	0.60	22.6

Table 4. Overall effect of insecticides on *L. rugulipennis* over first 2 sample dates; means are square root transformed. Numbers within a column followed by different letters are significantly different ($P<0.05$)

Product	***L. rugulipennis* stage**			
	1-2	**3-5**	**Adults**	**Total**
Brigade	0.10a	0.00a	0.10a	0.27a
Calypso	2.21c	3.01b	0.83b	4.11c
Calypso + Break Thru	1.56b	2.83b	0.70b	3.52b
Gazelle	2.05bc	2.94b	0.94b	3.89bc
HDCI 1 coded product	2.21c	2.84b	0.74b	3.75bc
Untreated	2.09bc	3.00b	0.62b	3.98bc

Results in Table 4 show that in the samples taken 3 and 9 days post-treatment, 1-2 instar *L. rugulipennis* were significantly lower than the control only in the Brigade treatment. However, numbers in the Calypso + Break Thru treatment were significantly lower than in the Calypso alone treatment. For the older nymphs and adults only the Brigade treatment had any significant effect on numbers. Looking at totals of all stages, only the Brigade treatment was significantly different from the control but numbers in the Calypso + Break Thru treatment were significantly lower than in the Calypso alone treatment.

Table 5. Overall effect of insecticides on *L. rugulipennis* over second 2 sample dates; means are square root transformed. Numbers within a column followed by different letters are significantly different (P<0.05)

Product	*L. rugulipennis* stage			
	1-2	3-5	Adults	Total
Brigade	0.96a	2.35a	1.57a	3.21a
Calypso	2.93b	4.15c	2.25b	5.67d
Calypso + Break Thru	2.78b	3.69bc	1.79b	5.08c
Calypso + Break Thru x 2 app	2.38b	3.03b	2.21b	4.50b
Gazelle	2.76b	3.71bc	2.26b	5.20cd
HDCI 1 coded product	1.96b	4.10bc	2.22b	5.11cd
Untreated	2.51b	3.53bc	2.28b	4.99bc

Results in Table 5 show that 1-2 instar nymphs were significantly different from the control only in the Brigade treatment in samples taken 3 and 9 days after the second Calypso + Break Thru application on 11 August. There was also a decreasing trend in numbers in the Calypso + Break Thru applied once and then this treatment applied twice; this decrease was not quite strong enough for standard statistical significance. For the older nymphs results were similar to those of 1-2 instars except that Calypso + Break Thru applied twice gave a significant reduction in numbers when compared to Calypso alone. Only Brigade significantly reduced numbers of *L. rugulipennis* adults. Looking at totals of all stages, only numbers in the Brigade treatment were significantly different from the control. However, there was evidence of numbers in the Calypso treatment being significantly higher than in the Calypso + Break Thru applied once, which was significantly higher than this treatment applied twice.

Mean back transformed numbers of the different stages of *L. rugulipennis* present on each post treatment sample date are shown in Tables 6-9.

Table 6. Mean numbers of different stages of *L. rugulipennis* in samples 3 days post first application of products (back transformed means)

Product	***L. rugulipennis* stage**		
	1-2	**3-5**	**Adults**
Brigade	0.0	0.0	0.0
Calypso	2.2	10.8	1.9
Calypso + Break Thru	1.5	8.5	0.9
Gazelle	2.2	10.3	1.0
HDCI 1 coded product	3.5	8.2	1.2
Untreated	2.8	10.4	0.9

Table 7. Mean numbers of different stages of *L. rugulipennis* in samples 9 days post first application of products (back transformed means)

Product	*L. rugulipennis* stage		
	1-2	3-5	Adults
Brigade	0.04	0.0	0.04
Calypso	8.6	7.5	0.1
Calypso + Break Thru	3.6	7.5	0.2
Gazelle	7.0	7.1	0.7
HDCI 1 coded product	6.6	7.9	0.2
Untreated	6.3	7.8	0.1

Table 8. Mean numbers of different stages of *L. rugulipennis* in samples 3 days post second application of Calypso + Break Thru (back transformed means)

Product	*L. rugulipennis* stage		
	1-2	3-5	Adults
Brigade	0.4	5.9	2.3
Calypso	12.7	15.2	3.5
Calypso + Break Thru	9.4	11.9	2.1
Calypso + Break Thru x 2 app	4.6	9.3	3.5
Gazelle	7.8	14.1	3.1
HDCI 1 coded product	4.2	14.0	2.4
Untreated	7.6	11.2	3.1

Table 9. Mean numbers of different stages of *L. rugulipennis* in samples 9 days post second application of Calypso + Break Thru (back transformed means)

Product	*L. rugulipennis* stage		
	1-2	3-5	Adults
Brigade	1.7	5.2	2.7
Calypso	5.3	19.3	7.0
Calypso + Break Thru	6.3	15.4	4.5
Calypso + Break Thru x 2 app	6.9	9.1	6.6
Gazelle	7.5	13.4	7.6
HDCI 1 coded product	3.5	20.0	8.4
Untreated	5.2	13.9	7.8

The percentage of ripe fruit showing symptoms of damage by *L. rugulipennis* is shown in Figure 2 in the Appendix to this report. There was a significant reduction in damage in the Brigade treatment, but no differences between the other treatments. Percentage damage in the Brigade treatment in the no/low damage categories was 74% compared with 46% in the control.

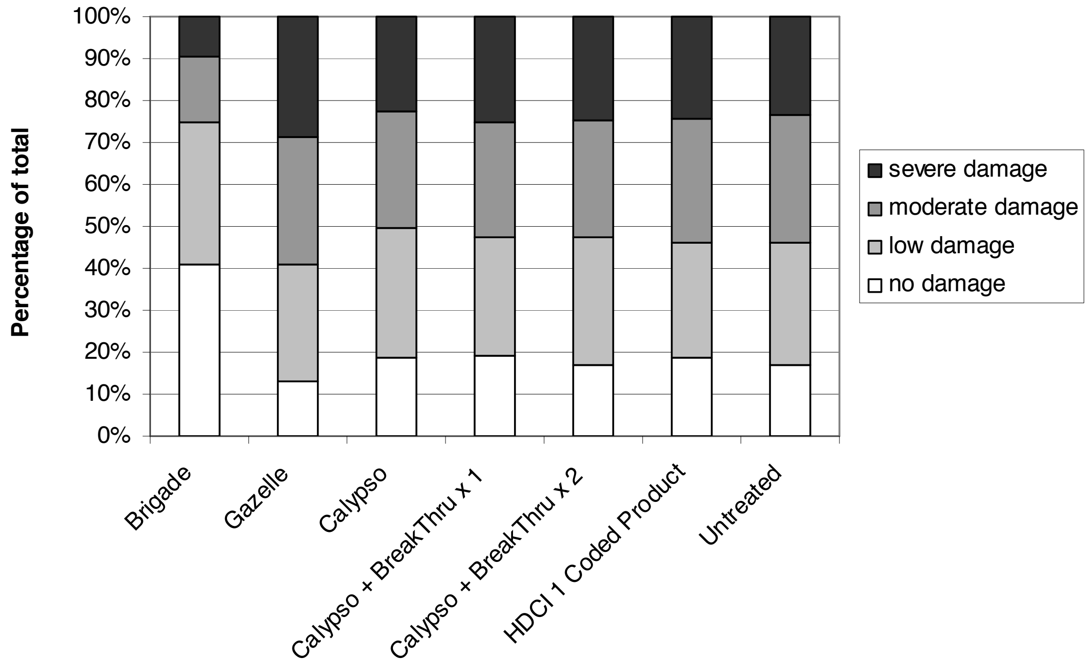

Figure 1. Percentage of all fruit picked (all size categories) showing symptoms of *L. rugulipennis* damage

Conclusions

These results show that:

- Brigade (the pyrethroid bifenthrin) was effective at reducing *L. rugulipennis* numbers, with numbers reduced to close to zero in this treatment. With only one application, numbers of *L. rugulipennis* were still significantly lower than in any other treatment 23 days after application, highlighting the persistence of this product. However, the use of pyrethroids should be avoided in strawberry plantations that are using IPM strategies as they are damaging to beneficial arthropods
- Gazelle (acetamiprid) had no detectable effects on *L. rugulipennis* numbers
- The coded product HDCI 1 had no detectable effects on *L. rugulipennis* numbers overall
- Calypso (thiacloprid) + Break Thru (a wetter) applied twice was more effective than this treatment applied once, which in turn was more effective than Calypso alone
- Only Brigade reduced significantly the percentage fruit damage caused by *L. rugulipennis*
- It is not clear why the tested compounds were less effective in year 2 than in year 1. It is possible that on the waxy strawberry plants coverage was not as good as on the weeds in year 1

Technology transfer

Fitzgerald, J.D. (2009). Chemical control and timing of application of insecticides for control of the capsid, *Lygus rugulipennis*, on strawberry SF 95. Article for HDC News

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APPENDIX

Examples of *Lygus rugulipennis* fruit damage categories as used in this report