Project Title: **Evaluation of insecticides for the control of pear sucker eggs and nymphs 2006**

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Authentication

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

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Signature

Date .....

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Grower summary

TF162b

Evaluation of insecticides for the control of pear sucker eggs and nymphs 2006

Final report 2006

Headline

- A field trial in 2006 corroborated previous results that Envidor and Karamate are the most effective treatments for control of pear sucker of a wide range of treatments tested.

Background and deliverables

Pear sucker is the most damaging pest of pears and is difficult to control, being resistant to many broad-spectrum insecticides. This experiment was conducted to determine the efficacy of a wide range of foliar spray treatments on nymphs and the viability of eggs.

Summary of the project and main conclusions

A replicated orchard experiment was done from 12 July to 16 August 2006 to evaluate the efficacy of two foliar sprays of Hallmark (90 ml/ha), Insegar (600 g/ha), Envidor (600 ml/ha), Dimilin Flo+Agral (300 + 500 ml/ha), Karamate (5.6 kg/ha), Tracer (250 ml/ha), Elvaron Multi (2.25 kg/ha) versus four sprays of sulphur 800 g/l SC (3.0 l/ha), magnesium sulphate + sulphur + Agral (7.5 kg + 3 l + 250 ml/ha) and Agral (500 ml/ha) for control of pear sucker eggs and nymphs. A double-replicated untreated control was also included. Applications (500 l/ha) for the two spray treatments were applied on 12 and 26 July. Applications for the 4 spray treatments were applied on 12, 17, 26 July and 2 August 2006. Pear sucker egg and nymph populations were determined on 18 July, 2 August and 16 August, 6, 21 and 35 days after the first treatment. Populations of predators were also determined on the same dates by beat sampling.

Mean numbers of eggs on the untreated plots declined from very high numbers (38/leaf) at the start of the experiment to 0.8 per leaf 35 days later at the end of the experiment. Total nymph numbers declined from 0.7 per leaf to 0.1 per leaf over the same period. The reason for this decline is unclear, but one possible cause was predation by anthocorids and other natural enemies, though only small numbers of anthocorids and other predators were found by beat sampling. Little rainfall occurred and maximum daily temperatures were quite high (> 25 ˚C) for the first two weeks of the experiment. The decline in numbers undermined the power of the experiment to discriminate between less effective treatments.
None of the treatments had any significant effects on numbers of eggs. Only Envidor and Karamate had significant effects on pear sucker nymphs, giving moderate control. No visual symptoms of phytotoxicity were observed.

This work corroborates results of a similar experiment in 2005 that showed that Envidor is an effective new treatment for pear sucker (though slow acting) and that Karamate is an effective treatment. Several of the other treatments showed moderate activity.

Financial benefits

Pear sucker is the most important pest of pears and the UK industry typically spends £100-200 per ha per annum (total >£200k per annum) controlling it. When the pest is not controlled effectively the result can be very severe crop losses and death of trees. The loss of Mitac means that the UK industry no longer has an effective treatment for curative control. The identification of more effective control methods will be of major commercial benefit.

Action points for growers

- Envidor and Karamate were shown to be effective treatments for insecticidal control of pear sucker in this experiment and these materials should be used as part of an Integrated Pear Sucker management programme.

Science Section

Evaluation of insecticides for the control of pear sucker eggs and nymphs 2006

Summary

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Mean numbers of eggs on the untreated plots declined from very high numbers (38/leaf) at the start of the experiment to 0.8/leaf 35 days later at the end of the experiment. Total nymph numbers declined from 0.7 /leaf to 0.1/leaf over the same period. The reason for this decline is unclear, but one possible cause was predation by anthocorids and other natural enemies, though only small numbers of anthocorids and other predators were found by beat sampling. Little rainfall occurred and maximum daily temperatures were quite high (> 25 ˚C) for the first two weeks of the experiment. The decline in numbers undermined the power of the experiment to discriminate between less effective treatments.

None of the treatments had any significant effects on numbers of eggs. Only Envidor and Karamate had significant effects on pear sucker nymphs giving moderate control. No visual symptoms of phytotoxicity were observed.

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Introduction

The objective of this trial was to evaluate the efficacy of 10 products applied in two or four sprays for control of pear sucker eggs and nymphs and, if present in sufficient numbers, the effects of the treatments on anthocorid predatory bugs.

Methods and materials

A small plot replicated experiment comparing foliar sprays of the products tested was done in a commercial apple orchard in Kent, England between July and September 2006.

Site

The experiment was done in part of No.14 young pear orchard at Broadwater Farm, East Malling, Kent which had been identified as being suitably infested with pear sucker. The

orchard was located at NGR TQ686 560 (OS Landranger Sheet 188). The experimental plot comprised 5 rows of approximately 80 pear trees of the variety Conference. Two rows of Conference were used for the treatment plots. The tree spacing in the row was 1.8 m and row spacing was 4 m giving a tree density of 1389 trees/ha.

Treatments

Treatments were two sprays or four sprays of 10 different pesticide products, plus a double replicated untreated control, as given in the Table 1 below. Sprays for the two-spray treatments were applied on 12 and 26 July 2006. The treatments comprising of four sprays were applied on 12, 17, 26 July and 2 August 2006.

Spray application

Sprays were applied in a volume of 500 l/ha with a Birchmier motorised air-assisted sprayer with a red micron restrictor giving a flow rate from the sprayer of 6.8 ml s^{-1}. Each tree was sprayed for 55 seconds delivering a volume of 373 ml of spray solution per tree. The amounts of sprayate remaining in the spray tank after each treatment application was measured so that the dose applied to each plot could be checked. This showed that volumes of sprayate applied per treatment were within 10% of required dose. The area was cordoned off for the duration of the experiment so that no maintenance sprays were applied to that area by the grower.

Experimental design and layout

A randomised complete block experimental design with 4 replicate plots of each treatment was used. All the plots in a block were arranged end to end in one row. There were two blocks in each row. Plots consisted of 2 adjacent sprayed dwarf pear trees in a row. Each plot was separated from the next in the row by 2 unsprayed guard trees. There were 2 unsprayed guard rows between the treated rows to minimise interplot contamination by spray drift.

Meteorological records

Wet and dry bulb temperature, wind speed and direction were recorded before and after spraying. Full meteorological records for the trial duration were available from the EMR official Met office station approximately 5 km away.

Table 1. Treatments

Treatment	Active substance and formulation	Product	Product dose /ha	No. of sprays†
1	lambda-cyhalothrin 100 g/l CS	Hallmark with Zeon Technology	90 ml	2
2	fenoxycarb 25% w/w WG	Insegar	600 g	2
3	sulphur 800 g/l SC	Sulphur	3.0 l	4
4	spirodiclofen 240 SC	Envidor	0.6 l	2
5	diflubenzuron 480 g/l SC + non-ionic wetter	Dimilin Flo + Agral	300 ml + 500 ml	2
6	mancozeb 75% w/w WG	Karamate Dry Flo	5.6 kg	2
7	spinosad 480 g/l SC	Tracer	250 ml	2
8	tolylfluanid 50.5% w/w WG	Elvaron Multi	2.25 kg	4
9	magnesium sulphate + sulphur 800 g/l SC + non-ionic wetter	Epsom salts + Sulphur + Agral	7.5 kg + 3 l + 250 ml	4
10	non-ionic wetter	Agral	500 ml	2
11	untreated (double replicated)	-	-	-

† 2 spray treatments applied on 12 and 26 July, 4 spray treatments applied on 12, 17, 26 July and 2 August

Assessments

An overall assessment of pear sucker levels on the untreated guard rows was carried out on 13 July 2006, one day after the first date of spray application. Assessments of pear sucker and natural enemy populations were made on all plots on 18 July, 2 August and 16 August, six, 21 and 35 days after the date of the first spray application. Note that at the first assessment date only one spray had been applied to all plots six days earlier. At the second assessment on 2 August, the two spray treatments (A, B, D, E, F, G, J) had received both their applications 15 and seven days earlier but the four spray treatments (C, H, I) had only received three applications, the last application being made immediately after sampling.

Pear sucker: Assessments concentrated on determining effects of treatments on eggs and young nymphs. Adults are highly mobile and assessment (by beating) unlikely to be meaningful in a small plot experiment. On each sampling occasion, one sample of 15 leaves selected from the shoots and one sample of 15 rosette leaves was taken from each of the two sprayed trees in each plot. Counts of pear sucker eggs (newly laid, semi-mature and mature) and nymphs of each life stage were made under a binocular microscope in the laboratory. Both sides of each leaf were examined.

Natural enemies: Numbers of anthocorid eggs were counted on each leaf sample collected for pear sucker assessment. Numbers of anthocorid adults and nymphs and of other pear sucker predators were assessed on each sampling occasion by beat sampling each sprayed tree in each plot using the standard beating method (0.25 m^{-2} tray).

Phytotoxicity: Determination of the phytotoxic effects of the treatments was not a central aim of this work. However, plots were inspected for any visual signs of phytotoxicity from the treatments on each sampling occasion.

Experimental Approval, crop destruction and grower compensation

No crop destruction was required as all the products had full or non-crop destruct experimental approvals (all treatments except Envidor were approved for use on pears and Envidor had an Experimental Permit).

Statistical analysis

Data was collated in Excel spread sheets, plot total numbers of eggs and nymphs calculated and analysis of variance conducted after $\log_{10}(n+1)$ transformation to stabilise variances. Means were separated using Tukey's HSD test (95% confidence intervals).

Quality assurance

This work was done according to EMQA procedures and requirements (experiment GEP06/015).

Results

Mean numbers of eggs per 30 leaves on the untreated control plots declined from 1133 (day 1 sample from untreated guard trees) to 127 to 27 to 25 per 30 leaves at 1, 6, 21 and 35 days after the first sprays were applied (Tables 2, 3 & 4, Figure 1). The reason for this decline is unclear, but one possible cause is predation by anthocorids and other natural enemies. Little rainfall occurred ($\leq$ 2mm on any one day) between 12 July when sprays were first applied and 11 August, though moderate rain (12.2 mm total) occurred on 12-13 August (Appendix 1). Also, maximum daily temperatures were quite high (> 25 ˚C) between 16 and 30 July 2006. These conditions appeared ideal for pear sucker, but nevertheless numbers declined. The analyses of variance of the $\log_{10}(n+1)$ transformed total numbers of eggs showed that there were no statistically significant treatment effects at any of the treatment dates. Thus, none of the treatments had any demonstrable effects on egg numbers.

Mean numbers of nymphs (total of all instars) per 30 leaves on the untreated control plots declined from 21.2 (day 1 sample from untreated guard trees) to 7.3 to 2.9 to 2.9 per 30 leaves at 1, 6, 21 and 35 days, respectively, after the first sprays were applied (Tables 2, 3 & 4, Figure 2). Again, the reason for this decline is unclear, but could be due to predation by natural enemies. The analyses of variance of the $\log_{10}(n+1)$ transformed total numbers of nymphs at the first assessment on 18 July (six days after the first spray date) showed no statistically significant treatment effects (Figure 2). However, it is interesting to note that the Envidor and Karamate gave the lowest mean values. Similar analysis at the second assessment showed highly significant treatment effects (P = 0.016). Separation of means by Tukey's HSD test showed that none of the treatments had significantly smaller total numbers of nymphs than the untreated control. Indeed, Agral, Elvaron Multi, Dimilin and Hallmark had significantly greater numbers than the untreated control, with Hallmark having the greatest numbers. A partial explanation for these effects is that some of the treatments, notably Hallmark, adversely affected predators. It is also interesting to note that the mean value for the Karamate was the smallest. The analysis of the log transformed total nymph data at the third assessment showed strong treatment effects (P = 0.004). Envidor and Karamate stood out as the most effective treatments. Hallmark and Dimilin had significantly greater numbers of nymphs compared to the untreated control.

Only very small numbers of anthocorid eggs were recorded on the leaf samples with no obvious treatment differences (Table 5). Numbers of predatory insects found by beat sampling were small and did not show any consistent treatment effects (Tables 6, 7 & 8). It is suspected that the plot size was too small to allow sufficiently large beat samples to be collected to reveal any possible treatment effects.

No visual symptoms of phytotoxicity were observed.

Conclusions

- Mean numbers of eggs on the untreated plots declined from very high numbers (38/leaf) at the start of the experiment to 0.8/leaf 35 days later at the end of the experiment.
- Total nymph numbers declined from 0.7 /leaf to 0.1/leaf over the same period.
- The reason for this decline is unclear, but one possible cause was predation by anthocorids and other natural enemies, though only small numbers of anthocorid and other predators were found by beat sampling.
- Little rainfall occurred and maximum daily temperatures were quite high (> 25 ˚C) for the first two weeks of the experiment.
- The decline in pear sucker numbers undermined the power of the experiment to discriminate between treatments.
- None of the treatments had any significant effects on the numbers of eggs.

- Only Envidor and Karamate had significant effects on pear sucker nymphs giving moderate control.
- No visual symptoms of phytotoxicity were observed.

Acknowledgements

We are grateful to Peter Checkley, Howard Chapman Ltd, Broadwater Farm, for providing the trial site, and to Lia Mckinnon, Chelsea Eby and Peter Sipos, EMR, who assisted with the sampling and counts.

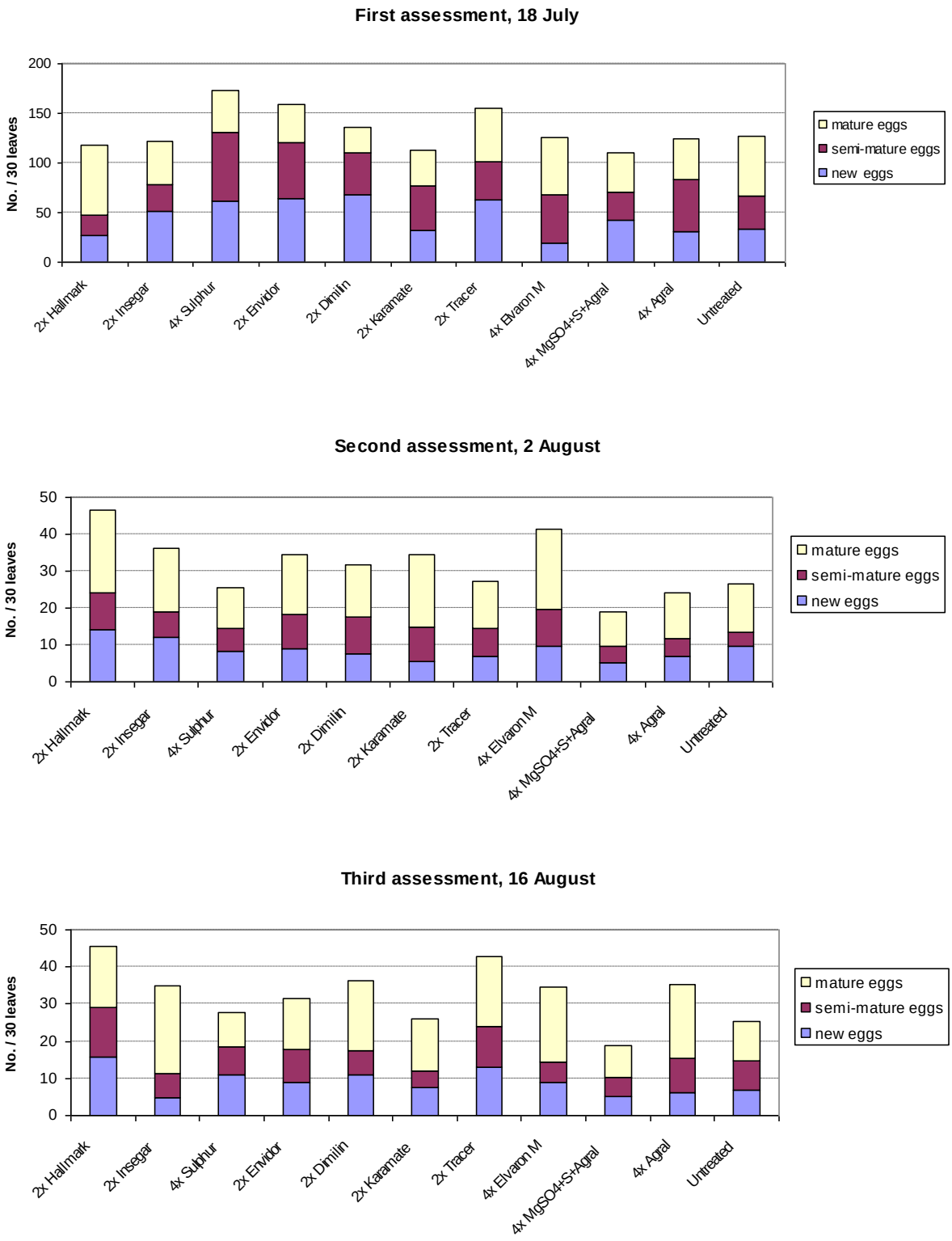

Figure 1. Mean numbers of eggs recorded per 30 leaves at the three assessments. Note that sprays for the treatments which had 2 sprays were applied on 12 and 26 July, sprays for the 4 spray treatments were applied on 12, 17, 26 July and 2 August 2006. There were no significant treatment differences.

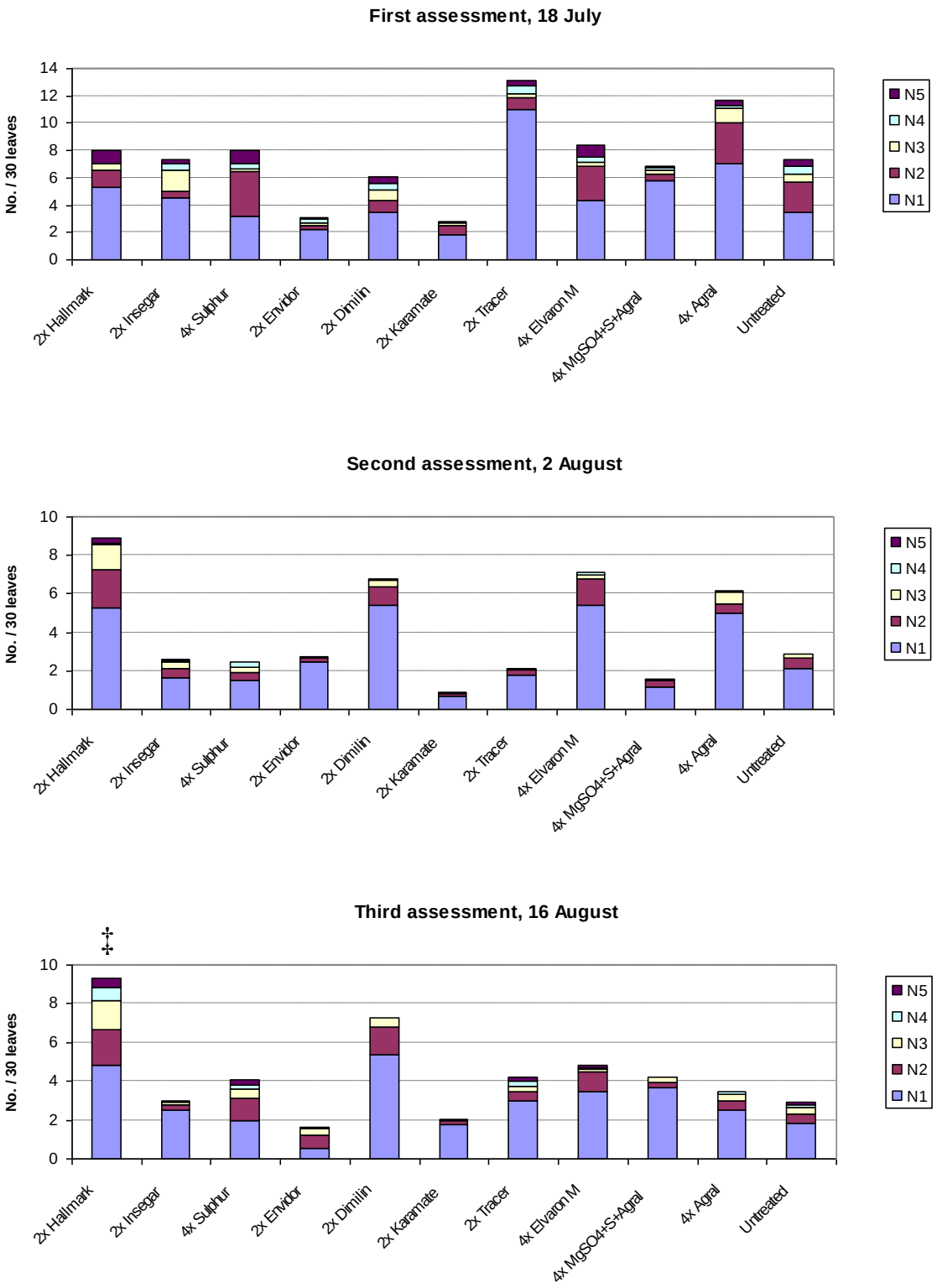

Figure 2. Mean numbers of pear sucker nymphs recorded per 30 leaves at the three assessments. N1-N5 are the five successive nymphal instars. Note that applications for the treatments which had 2 sprays were applied on 12 and 26 July, applications for the 4 spray treatments were applied on 12, 17, 26 July and 2 August. ‡ Significantly greater than control (P = 0.05).

Table 2. Mean numbers of pear sucker eggs and nymphs per 30 leaves recorded at the first assessment on 18 July 2006.

Treatment	New eggs	Semi-mature eggs	Mature eggs	Total eggs	1st instar nymphs	2nd instar nymphs	3rd instar nymphs	4th instar nymphs	5th instar nymphs	Total nymphs
1. 2x Hallmark	26.5	21.3	70.5	118.2	5.31	1.25	0.47	0.00	0.94	7.97
2 .2x Insegar	51.1	27.5	43.1	121.7	4.53	0.47	1.56	0.47	0.31	7.34
3. 4x Sulphur	61.7	68.5	42.3	172.5	3.17	3.33	0.17	0.33	1.00	8.00
4. 2x Envidor	64.4	56.6	38.4	159.4	2.19	0.31	0.16	0.31	0.16	3.13
5. 2x Dimilin	68.3	41.9	25.8	135.9	3.44	0.94	0.78	0.47	0.47	6.09
6. 2x Karamate	32.3	44.3	36.0	112.6	1.88	0.62	0.16	0.16	0.00	2.81
7. 2x Tracer	63.3	38.5	53.2	155.0	11.05	0.79	0.32	0.63	0.32	13.10
8. 4x Elvaron M	19.8	48.3	57.9	126.0	4.37	2.50	0.31	0.31	0.94	8.44
9. 4x $MgSO_4$+S+Agral	42.7	28.0	39.2	109.8	5.78	0.47	0.31	0.16	0.16	6.88
10. Agral	31.4	52.5	40.6	124.5	7.03	2.97	1.09	0.16	0.47	11.72
11. Untreated	32.8	33.8	60.3	126.9	3.46	2.20	0.63	0.55	0.47	7.31
Fprob†				0.900						0.090

†Analysis of variance of $\log_{10}(n+1)$ transformed data

Table 3. Mean numbers of pear sucker eggs and nymphs per 30 leaves recorded at the second assessment on 2 August 2006.

Treatment	New eggs	Semi-mature eggs	Mature eggs	Total eggs	1st instar nymphs	2nd instar nymphs	3rd instar nymphs	4th instar nymphs	5th instar nymphs	Total nymphs†	
1. 2x Hallmark	14.13	10.00	22.44	46.56	5.25	2.00	1.31	0.06	0.31	8.94	a
2 .2x Insegar	12.00	6.81	17.25	36.06	1.63	0.50	0.38	0.06	0.06	2.63	bc
3. 4x Sulphur	8.31	6.00	11.12	25.44	1.50	0.44	0.25	0.25	0.06	2.50	c
4. 2x Envidor	9.06	9.31	16.19	34.56	2.44	0.25	0.06	0.00	0.00	2.75	c
5. 2x Dimilin	7.75	9.75	14.13	31.63	5.44	0.94	0.31	0.13	0.00	6.81	ab
6. 2x Karamate	5.38	9.56	19.38	34.31	0.69	0.13	0.06	0.00	0.00	0.88	c
7. 2x Tracer	6.81	7.69	12.69	27.19	1.81	0.25	0.00	0.06	0.00	2.13	c
8. 4x Elvaron M	9.53	10.22	21.66	41.41	5.44	1.38	0.19	0.13	0.00	7.13	ab
9. 4x $MgSO_4$+S+Agral	5.13	4.56	9.25	18.94	1.19	0.31	0.06	0.00	0.00	1.56	c
10. Agral	6.75	4.81	12.69	24.25	5.00	0.50	0.56	0.06	0.06	6.19	ab
11. Untreated	9.53	4.06	13.06	26.66	2.09	0.56	0.19	0.03	0.00	2.88	c
Fprob‡				0.081						0.016	

‡ Analysis of variance of $\log_{10}(n+1)$ transformed data

† Means followed by the same letter do not differ significantly in a Tukey's (confidence interval = 95%) of $\log_{10}(n+1)$ transformed data

Table 4. Mean numbers of pear sucker eggs and nymphs per 30 leaves recorded at the third assessment on 16 August 2006.

Treatment	New eggs	Semi-mature eggs	Mature eggs	Total eggs	1st instar nymphs	2nd instar nymphs	3rd instar nymphs	4th instar nymphs	5th instar nymphs	Total nymphs†
1. 2x Hallmark	15.75	13.50	16.44	45.69	4.81	1.88	1.50	0.63	0.50	9.31 a
2 .2x Insegar	4.63	6.63	23.81	35.06	2.50	0.31	0.13	0.06	0.00	3.00 cd
3. 4x Sulphur	11.06	7.56	9.00	27.62	2.00	1.13	0.50	0.19	0.25	4.06 bc
4. 2x Envidor	8.94	9.00	13.56	31.50	0.56	0.69	0.31	0.06	0.00	1.63 d
5. 2x Dimilin	10.94	6.69	18.81	36.44	5.38	1.44	0.44	0.00	0.06	7.31 ab
6. 2x Karamate	7.69	4.38	13.94	26.00	1.75	0.25	0.06	0.00	0.00	2.06 d
7. 2x Tracer	13.13	11.00	18.75	42.88	3.00	0.50	0.25	0.25	0.19	4.19 bc
8. 4x Elvaron M	9.00	5.50	20.19	34.69	3.50	1.00	0.13	0.06	0.13	4.81 c
9. 4x $MgSO_4$+S+Agral	5.00	5.42	8.25	18.67	3.67	0.25	0.33	0.00	0.00	4.25 c
10. Agral	6.06	9.31	19.81	35.19	2.50	0.50	0.31	0.13	0.00	3.44 c
11. Untreated	6.88	7.91	10.44	25.22	1.84	0.50	0.28	0.16	0.13	2.91 c
Fprob‡				0.326						0.004

‡ Analysis of variance of $\log_{10}(n+1)$ transformed data

† Means followed by the same letter do not differ significantly in a Tukey's (confidence interval = 95%) of $\log_{10}(n+1)$ transformed data

Table 5. Mean numbers of anthocorid eggs recorded per 30 leaves.

Treatment	18 July	2 August	16 August
1. 2x Hallmark	0.02	0.06	0.06
2 .2x Insegar	0.15	0.00	0.00
3. 4x Sulphur	0.08	1.00	0.63
4. 2x Envidor	0.03	0.06	0.31
5. 2x Dimilin	0.05	0.38	0.13
6. 2x Karamate	0.01	0.00	0.00
7. 2x Tracer	0.17	0.00	0.31
8. 4x Elvaron M	0.06	0.06	0.06
9. 4x $MgSO_4$+S+Agral	0.13	0.44	0.00
10. Agral	0.02	0.31	0.13
11. Untreated	0.05	0.16	0.03

Table 6. Mean numbers of predators found per beat sample at the first assessment on 18 July 2006

Treatment	Ants	Spiders	Anthocorids			Earwigs	Ladybirds	Lacewing		Syrphid larvae	Soldier beetles
			Adults	Nymph	Total			Adults	Larvae		
1. Hallmark	2.25	0.13	0.13	0.13	0.25	0.00	0.13	0.00	0.00	0.00	0.00
2. Insegar	1.50	0.00	0.00	0.38	0.38	0.25	0.13	0.00	0.00	0.13	0.00
3. Sulphur	3.63	0.13	0.38	0.38	0.75	0.38	0.25	0.00	0.00	0.00	0.00
4. Envidor	2.50	0.25	0.13	0.25	0.38	0.13	0.25	0.00	0.00	0.00	0.00
5. Dimilin	1.00	0.13	0.00	0.25	0.25	0.25	0.13	0.00	0.00	0.00	0.00
6. Karamate	2.00	0.25	0.13	0.00	0.13	0.50	0.00	0.00	0.00	0.00	0.00
7. Tracer	1.50	0.25	0.13	0.25	0.38	0.00	0.00	0.00	0.13	0.00	0.13
8. Elvaron	5.00	0.63	0.13	0.38	0.50	0.13	0.00	0.13	0.00	0.00	0.00
9. Epsom salts	3.88	0.63	0.13	0.00	0.13	0.38	0.00	0.00	0.00	0.00	0.00
10. Agral	2.75	0.13	0.13	0.25	0.38	0.88	0.00	0.00	0.00	0.00	0.00
11. untreated	2.63	0.31	0.13	0.19	0.31	0.38	0.06	0.00	0.00	0.00	0.00

Table 7. Mean numbers of predators found per beat sample at the second assessment on 2 August 2006

			Anthocorids					Lacewing			
Treatment	Ants	Spiders	Adults	Nymph	Total	Earwigs	Ladybirds	Adults	Larvae	Syrphid larvae	Soldier beetles
1. Hallmark	0.50	0.00	0.13	0.00	0.13	0.13	0.00	0.25	0.13	0.00	0.00
2. Insegar	1.88	0.38	0.00	0.00	0.00	0.13	0.00	0.25	0.00	0.00	0.00
3. Sulphur	1.00	0.13	0.00	0.00	0.00	0.00	0.00	0.25	0.13	0.00	0.00
4. Envidor	2.38	0.13	0.00	0.00	0.00	0.00	0.00	0.25	0.13	0.00	0.00
5. Dimilin	1.75	0.63	0.00	0.00	0.00	0.38	0.00	0.38	0.00	0.00	0.00
6. Karamate	1.13	0.38	0.00	0.00	0.00	0.13	0.00	0.13	0.25	0.00	0.00
7. Tracer	1.38	0.13	0.00	0.00	0.00	0.00	0.13	0.38	0.25	0.00	0.00
8. Elvaron	2.38	0.00	0.00	0.00	0.00	0.25	0.13	0.13	0.00	0.00	0.00
9. Epsom salts	2.50	0.25	0.00	0.00	0.00	0.25	0.00	0.50	0.13	0.00	0.00
10. Agral	1.88	0.00	0.13	0.00	0.13	0.00	0.00	0.38	0.63	0.00	0.00
11. untreated	1.69	0.38	0.00	0.00	0.00	0.19	0.00	0.19	0.13	0.00	0.00

Table 8. Mean numbers of predators found per beat sample at the third assessment on 16 August 2006

			Anthocorids					Lacewing			
Treatment	Ants	Spiders	Adults	Nymph	Total	Earwigs	Ladybirds	Adults	Larvae	Syrphid larvae	Soldier beetles
1. Hallmark	1.13	0.13	0.00	0.00	0.00	0.38	0.00	0.25	0.00	0.00	0.00
2. Insegar	2.00	0.25	0.00	0.00	0.00	0.00	0.25	0.50	0.00	0.00	0.00
3. Sulphur	1.25	0.25	0.13	0.00	0.13	0.13	0.13	0.88	0.00	0.00	0.00
4. Envidor	1.50	0.50	0.00	0.00	0.00	0.13	0.13	1.00	0.00	0.00	0.00
5. Dimilin	3.50	0.63	0.25	0.00	0.25	0.00	0.50	0.63	0.00	0.00	0.00
6. Karamate	0.75	0.13	0.00	0.00	0.00	0.00	0.25	0.38	0.13	0.00	0.00
7. Tracer	1.00	0.50	0.00	0.00	0.00	0.00	0.38	1.38	0.00	0.00	0.00
8. Elvaron	1.50	0.63	0.00	0.00	0.00	0.38	0.38	0.63	0.13	0.00	0.00
9. Epsom salts	1.00	0.38	0.00	0.00	0.00	0.25	0.25	1.38	0.00	0.00	0.00
10. Agral	2.25	0.75	0.00	0.00	0.00	0.00	0.13	1.25	0.00	0.00	0.00
11. untreated	0.69	0.63	0.06	0.00	0.06	0.19	0.44	1.13	0.06	0.00	0.00

Appendix 1. Daily met records form the Met Station at EMR.

Date (2006)	Temp Max ˚C	Temp Min ˚C	Rainfall (mm)	Sunshine (hours)
12 Jul	27.1	10.8	0	14.5
13 Jul	22.5	12.6	0	5.5
14 Jul	20.1	12.6	0	11
15 Jul	22.8	15.4	0	9.8
16 Jul	27.6	15.1	0	12.9
17 Jul	30.2	14.1	0	13.7
18 Jul	30.2	12.6	0	15.1
19 Jul	33.5	16.3	0	12.5
20 Jul	29.7	18.1	0	8.8
21 Jul	31.1	15.7	0.6	12.7
22 Jul	29.5	18.6	1.2	2.6
23 Jul	26.8	15.9	0	9.9
24 Jul	27.7	14.4	0.2	10.3
25 Jul	31.3	14.9	1.4	9.6
26 Jul	32.3	17	0	8.8
27 Jul	28.8	17	0	7.7
28 Jul	28.9	15.8	0	12.3
29 Jul	26	14.6	0.2	10.7
30 Jul	25.7	18.9	0	8.3
31 Jul	23.4	15.4	0.6	6.9
1 Aug	24.1	14.7	0	8
2 Aug	22	14.5	2	4.1
3 Aug	17.9	14.2	0	1.3
4 Aug	20.8	12.9	0	2.7
5 Aug	26.3	9.4	0	11.6
6 Aug	28.7	12	1	5.1
7 Aug	22.1	16.5	1.2	0.9
8 Aug	24.5	12	0.2	10.5
9 Aug	23.2	16	0	6.5
10 Aug	22.6	12.6	0	5.3
11 Aug	19.7	12.2	1.6	3.3
12 Aug	18.2	14.1	9	0.8
13 Aug	19.3	12.9	3.2	3.1
14 Aug	16.9	13.6	1.4	0
15 Aug	22.2	12.5	0.2	6.9
16 Aug	22.2	10.4	7	8.2