Project title:	Blackcurrants: Evaluation of chemicals to control Sawfly
Project number:	SF 012 (GSK206)
Project leader:	J V Cross, East Malling Research
Report:	Final report, 2006

Report to

GlaxoSmithKline/HDC research fund
c/o James Wickham
Nine Oaks
Harpers farm
Goudhurst
Kent TN17 1JU

Tel: 01580 211127

HRI Contract Manager

Mr Ian Hardie
East Malling Research
East Malling
West Malling
Kent ME19 6BJ

Tel: 01732 843833
Fax: 01732 849067

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Principal Scientists

J. V. Cross MA, MBPR, FRES (Author of report)
A Harris MSc
G Arnold BA, MSc, CStat (Biometrician)

Authentication

I declare that 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.

Signed…………………………………………………………..
J. V. Cross

Dated………………………………………………………………

East Malling Research is an officially recognised efficacy testing organisation (Certification No. ORETO 043)

Evaluation of insecticides for the control of blackcurrant sawfly 2006

Disclaimer

The results and conclusions in this report may be based on an investigation conducted over one year. Therefore, care must be taken with the interpretation of the results.

GROWER SUMMARY

Headline

- Lorsban, Tracer and Calypso provided almost complete control of blackcurrant sawfly in this insecticide evaluation trial in commercial blackcurrants.

Background and expected deliverables

Blackcurrant sawfly, *Nematus olfaciens* Benson, is a widespread and common pest of blackcurrant in the UK.

There are at least two generations per annum in the UK. First generation adults appear in late April and May and lay eggs on blackcurrant leaves, mainly on the undersides and frequently in the lower parts of the bushes. Larvae feed in May and June, passing through four (males) or five (females) instar stages. The active pre-pupal stage then deserts the bush and spins a cocoon in the soil in order to pupate. The next generation of adults emerges from late June onwards and the second brood of larvae feeds in July and August. Occasionally there may be a third generation. Pre-pupae of the final brood overwinter in their cocoons, pupating in the spring.

Blackcurrant sawfly has increased in abundance in commercial blackcurrant plantations in some areas of the UK, presumably due to changes in patterns of insecticide use, in particular a reduction in the use of broad-spectrum insecticides after flowering when the pest is active. Alternative, more selective and environmentally safe chemical treatments need to be identified to control the pest.

The experiment reported here was done to evaluate the efficacy of single foliar sprays of eight insecticides for control of blackcurrant sawfly.

Summary of the project and main conclusions

The experiment was done in a heavily infested blackcurrant plantation (cv. Ben Avon) at Hamrow Farm, Whissonsett, Norfolk (by kind agreement of Mr Neville Stangroom). It was located at NGR TG 921 254. It consisted of 46 rows of Ben Hope and 47 rows of Ben Avon. The rows were >300 m long. Five adjacent half rows of Ben Avon were left unsprayed with insecticide by the grower for the trial (southern half of rows 12-16, counting from western edge). The row spacing was 3.0 m. The plantation was planted in early spring 2004.

Treatments were single foliar sprays of eight insecticidal products applied on 9 June 2006 (summarised in the treatment table below).

Treatments

	Active substance and formulation	Product	Product dose (/ha)
	Bacillus thuringiensis 32000 IU/mg WG	Dipel DF	1.0 kg
	chlorpyrifos 75% w/w WG	Lorsban WG	1.0 kg
	methoxyfenozide 240 g/l SC	Runner	600 ml
	fenoxycarb 25% w/w WG	Insegar	600 g
	spinosad 480 g/l SC	Tracer	200 ml
	lambda cyhalothrin 100 g/l CS	Hallmark with Zeon Technology	75 ml
	diflubenzuron 480 g/l SC	Dimilin Flo‡	75 ml‡
	thiacloprid 480 g/l SC	Calypso	375 ml
	untreated		
	untreated		
‡ The recommended rate for Dimilin Flo on blackcurrants is 300 ml in 2000 l water /ha. As only 500 l water was applied, the dose applied was 75 ml.			

Of these substances tested, chlorpyrifos, spinosad and diflubenzuron are approved on outdoor and protected blackcurrants, Bacillus thuringiensis, lambda-cyhalothrin and thiacloprid are approved on only outdoor blackcurrants, methoxyfenozide is approved on only blackcurrants in propagation and fenoxycarb is not approved on blackcurrants at all. It should be noted that although chlorpyrifos is approved on blackcurrants, the product used in this trial (Lorsban) was not approved at the time of writing this report.

Sprays were applied with a Birchmeier motorised air-assisted knapsack sprayer in a spray volume of 500 l/ha. A randomised complete block experiment design with five replicates was used. Plots consisted of a 6.5m length of row. Plots were end to end in two rows, with an unsprayed guard row on each side and in between.

Assessments were made in the field three days and seven days after treatment. On each of 10 bushes in the centre of each plot, a random sample of 10 leaves was taken from the lower part (<0.5 m) of the bush where the larval infestation was concentrated. On two of the 10 leaves, the numbers of viable eggs and the numbers of small (<7mm), medium sized (7-12 mm body length) and large (>12 mm body length) larvae were counted on each leaf. The percentage of the leaf area removed by sawfly caterpillar feeding was estimated on each of these two leaves.

None of the treatments reduced egg numbers significantly compared to the untreated control. The Lorsban (chlorpyrifos) and Tracer treatments eliminated or virtually eliminated all larvae (> 99.7% control) and the Calypso treatment was also highly effective (97% control). Hallmark and Dimilin Flo gave partial (~70%) control but Insegar, Runner and Dipel were completely ineffective. The same treatment effects were apparent at the second assessment 7 DAT.

It should be noted that a considerable degree of leaf feeding damage had already occurred before the trial began. The degree of larval feeding damage reflected the degree of efficacy of the treatments at both assessments. Ineffective treatments had a similar % leaf area eaten to the untreated control (see Science Section). Feeding damage was significantly reduced by the Lorsban (chlorpyrifos), Tracer and Calypso treatments. Hallmark and Dimilin Flo gave intermediate results.

Main conclusions

- Lorsban (chlorpyrifos) gave complete control of blackcurrant sawfly larvae and Tracer and Calypso nearly complete control, by 3 days after treatment. Control endured, neonate larvae dying as they emerged from eggs, until at least 7 days after treatment, when the trial was terminated.
- Hallmark and Dimilin Flo gave approximately 70% control of larvae.
- Dipel, Insegar and Runner were completely ineffective.

Financial benefits

Blackcurrant sawfly is a major pest of blackcurrants and can only currently be controlled using conventional insecticides. If present in significant numbers within the crop, bushes can be very quickly defoliated leading to a reduction in growth, yield and quality. Rapid and effective control of the pest will not only reduce yield losses in the year of damage, but will also improve bush growth and yields produced in subsequent seasons.

Action points for growers

- Growers should monitor carefully for the presence of blackcurrant sawfly eggs and larvae on the undersides of leaves within blackcurrant plantations.

- Monitoring should be done in April/May and again in July/August.

- When the pest is found, application of a control substance should be made without delay, targeting the undersides of the leaves.

- Chlorpyrifos products, spinosad (Tracer) and thiacloprid (Calypso) offer good control, if applied to the undersides of the leaves.

SCIENCE SECTION

Introduction

Blackcurrant sawfly, *Nematus olfaciens* Benson, is a widespread and common pest of blackcurrant in the UK. There are at least two generations per annum in the UK First generation adults appear in late April and May and lay eggs on blackcurrant leaves, mainly on the undersides and frequently in the lower parts of the bushes. Larvae feed in May and June, passing through four (males) or five (females) instar stages. The active pre-pupal stage then deserts the bush and spins a cocoon in the soil in order to pupate. The next generation of adults emerges from late June onwards and the second brood of larvae feeds in July and August. Occasionally there may be a third generation. Pre-pupae of the final brood overwinter in their cocoons, pupating in the spring. Blackcurrant sawfly has increased in abundance in commercial blackcurrant plantations in some areas of the UK, presumably due to changes in patterns of insecticide use, in particular a reduction in the use of broad-spectrum insecticides after flowering when the pest is active. Alternative, more selective and environmentally safe chemical treatments need to be identified to control the pest.

The experiment reported here was done to evaluate the efficacy of single foliar sprays of eight insecticides for control of blackcurrant sawfly.

Methods and materials

Site

The experiment was done in a heavily infested blackcurrant plantation (cv. Ben Avon) at Hamrow Farm, Whissonsett, Norfolk (by kind agreement of Mr Neville Stangroom). It was located at NGR TG 921 254. It consisted of 46 rows of Ben Hope and 47 rows of Ben Avon. The rows were >300 m long. Five adjacent half rows of Ben Avon were left unsprayed with insecticide by the grower for the trial (southern half of rows 12-16, counting from western edge). The row spacing was 3.0 m. The plantation was planted in early spring 2004.

Treatments

Treatments were single foliar sprays of eight insecticidal products applied on 9 June 2006 (Table 1).

Table 1. Treatments

	Active substance and formulation	**Product**	**Product dose (/ha)**
	Bacillus thuringiensis 32000 IU/mg WG	Dipel DF	1.0 kg
	chlorpyrifos 75% w/w WG	Lorsban WG	1.0 kg
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	untreated		
	untreated		
‡ The recommended rate for Dimilin Flo on blackcurrants is 300 ml in 2000 l water /ha. As			

only 500 l water was applied, the dose applied was 75 ml.

Spray application
Sprays were applied with a Birchmeier motorised air-assisted knapsack sprayer in a spray volume of 500 l/ha.

Experimental design and layout
A randomised complete block experiment design with five replicates was used. Plots consisted of a 6.5m length of row. Plots were end to end in two rows, with an unsprayed guard row on each side and in between.

Meteorological records
Wet and dry bulb air temperatures were measured with a whirling psychrometer, and wind speed with a hand held cup anemometer at 2m height before and after spraying.

Assessments
Assessments were made in the field 3 days and 7 days after treatment. On each of 10 bushes in the centre of each plot, a random sample of 10 leaves was taken from the lower part (<0.5 m) of the bush where the larval infestation was concentrated. On two of the 10 leaves, the numbers of viable eggs and the numbers of small (<7mm), medium sized (7-12 mm body length) and large (>12 mm body length) larvae were counted on each leaf. The percentage of the leaf area removed by sawfly caterpillar feeding was estimated on each of these two leaves.

Statistical analysis
ANOVA of counts, after square root transformation to stabilise variances, was done on the total numbers of larvae and of eggs on the 100 leaves sampled per plot for each assessment and on the percentages of leaf areas eaten by sawfly larvae after angular transformation. Data for treatments 2 (Lorsban) and 5 (Tracer) were excluded from the analyses of larvae because the data for those treatments contained all or mainly values. Means were separated using a Duncan's multiple range test (P=0.05).

Results

Effects of treatments on eggs
There was an average of 25.1 viable eggs/100 leaves on the untreated control plots at the first assessment on 12 June 3 DAT (Table 2, Figure 1). Mean values for all individual treatments were smaller but differences were not statistically significant. However, it is interesting to note that the smallest number were present on the Insegar treated plots. At the second assessment on 15-16 June 7 DAT, numbers had declined to 7/100 leaves on the untreated control but were very variable between treatments.

Treatment effects were statistically significant but Lorsban had significantly more eggs than the untreated control. None of the treatments reduced egg numbers significantly compared to the untreated control but again, smallest numbers were found on the Insegar treated plots, indicating that this treatment may have had some ovicidal effect.

Effects of treatments on larvae
Treatment effects were highly significant statistically at both the first and second assessments, 3 and 7 DAT (Table 3, Figure 1). At the first assessment there was a mean of 85.3 larvae/100 leaves on the untreated control plots. The Lorsban and Tracer treatments eliminated or virtually eliminated all larvae (> 99.7% control) and the Calypso treatment was also highly effective (97% control). Hallmark and Dimilin Flo gave partial (~70%) control but Insegar, Runner and Dipel were completely ineffective.

The same treatment effects were apparent at the second assessment 7 DAT. Mean larval numbers on the untreated control were similar to the first assessment. Lorsban gave complete control and Calypso and Tracer nearly complete control. Hallmark and Dimilin were partially effective (68-78% control) and Insegar, Runner and Dipel were completely ineffective.

At the first assessment, on average 28% of larvae were in the small size category (<7 mm body length), 48% of larvae were medium sized ((7-12 mm) and 24% of larvae were large sized (>12mm body length) (Table 4). There were no obvious differences in size distribution, accepting that the highly effective treatments had too few larvae to determine the size distribution of survivors.

At the second assessment, similar distribution of larval sizes were apparent, except fro the Dimilin treatment, where 86% of larvae were small. Considerable numbers of very young, newly hatched larvae were observed on the plots that received this treatment.

Table 2. Mean numbers (n) and mean square root numbers (√n) of viable eggs/100 leaves 3 and 7 days after treatment (DAT)

Product	12 June 2006 (3 DAT)		15-16 June 2006(7 DAT)		
	n	√n	n	√n	
Dipel	10.2	3.14	5.8	2.13	ab
Lorsban	14.6	3.56	17.8	4.12	c
Runner	10.0	3.13	10.2	3.13	bc
Insegar	9.4	2.95	2.2	1.14	a
Tracer	10.2	3.07	12.0	3.21	bc
Hallmark	14.4	3.68	7.8	2.69	abc
Dimilin Flo	11.6	3.32	11.2	3.17	bc
Calypso	17.4	4.11	7.6	2.72	abc
Untreated	25.1	4.57	7.0	2.51	ab
Fprob		0.334		0.006	
SED (37 df)†		0.730		0.560	
SED (37 df)‡		0.843		0.646	
LSD (P=0.05)†		1.479		1.134	
LSD (P=0.05)‡		1.708		1.309	

Note: Means followed by the same letter do not differ significantly (Duncan's Multiple range test P=0.05) †Comparisons with control ‡Other comparisons

Table 3. Mean numbers (n) and mean square root numbers (√n) of larvae/100 leaves 3 and 7 days after treatment (DAT)

Product	12 June 2006 (3 DAT)			15-16 June 2006(7 DAT)		
	n	√n		n	√n	
Dipel	89.2	9.32	b	131.8	11.33	a
Lorsban	0.0	0.00	a#	0.0	0.00	c#
Runner	111.8	10.53	b	135.2	11.47	a
Insegar	110.0	10.20	b	134.6	11.38	a
Tracer	0.2	0.20	a#	2.6	1.37	c#
Hallmark	26.2	5.00	a	31.2	5.52	b
Dimilin Flo	28.4	5.19	a	21.8	4.55	b
Calypso	2.6	0.72	a	0.4	0.28	c
Untreated	85.3	9.06	b	97.9	9.70	a
Fprob		<0.001			<0.001	
SED (37 df)†		0.869			0.991	
SED (37 df)‡		1.004			1.144	
LSD (P=0.05)†		1.778			2.026	
LSD (P=0.05)‡		2.053			2.340	

Note: Means followed by the same letter do not differ significantly (Duncan's Multiple range test P=0.05) †Comparisons with control ‡Other comparisons #Excluded from ANOVA

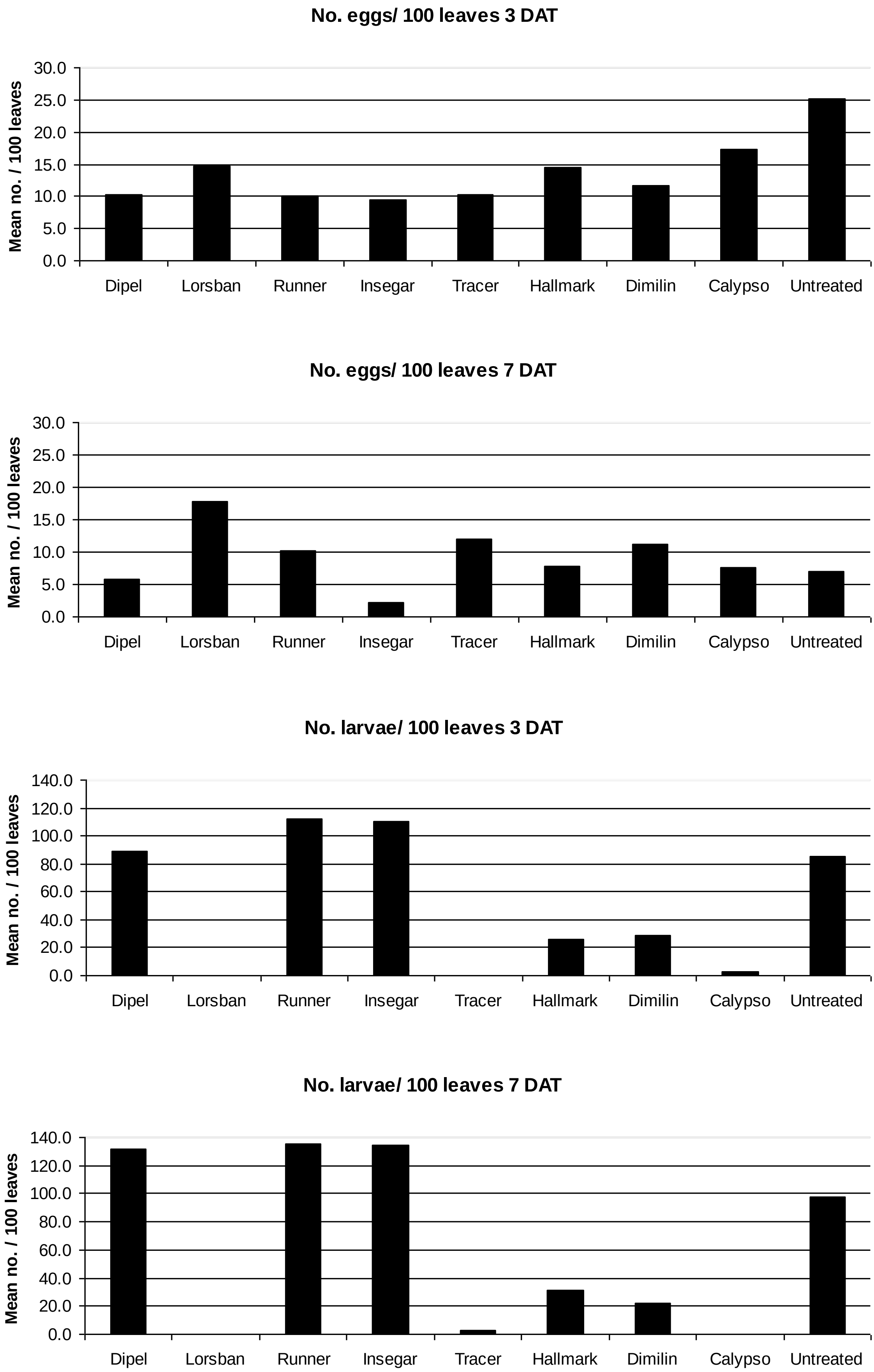

Figure 1. Mean numbers of eggs and larvae / 100 leaves at the first and second assessments 3 DAT and 7 DAT.

Table 4. Total number and % larvae in small (<7mm), medium (7-12 mm) and large (>12 mm) body size categories.

Trt No	Product	Total number larvae per 20 leaves						% larvae					
		12 June 2006 (3 DAT)			15-16 June 2006 (7 DAT)			12 June 2006 (3 DAT)			15-16 June 2006 (7 DAT)		
		Small	Medium	Large	Small	Medium	Large	Small	Medium	Large	Small	Medium	Large
1	Dipel	25	52	19	38	58	53	26	54	20	26	39	36
2	Lorsban	0	0	0	0	0	0						
3	Runner	31	64	32	32	71	69	24	50	25	19	41	40
4	Insegar	29	62	36	14	47	87	23	49	28	9	32	59
5	Tracer	0	0	0	1	0	0						
6	Hallmark	12	16	9	9	7	30	32	43	24	20	15	65
7	Dimilin Flo	11	14	6	37	3	3	35	45	19	86	7	7
8	Calypso	0	0	0	1	0	0						
9	Untreated	31	46	25	38	38	57	30	45	25	28	28	44

Larval feeding damage

Note that a considerable degree of leaf feeding damage had already occurred before the trial began. The degree of larval feeding damage reflected the degree of efficacy of the treatments at both assessments. Ineffective treatments had a similar % leaf area eaten to the untreated control (Table 5). Feeding damage was significantly reduced by the Lorsban, Tracer and Calypso treatments. Hallmark and Dimilin Flo gave intermediate results.

Table 5. Mean angular transformed % leaf area eaten by sawfly caterpillar feeding 3 and 7 days after treatment (DAT)

Trt No	Product	12 June 2006 (3 DAT)		15-16 June 2006 (7 DAT)	
1	Dipel	19.95	a	24.66	a
2	Lorsban	8.69	b	8.04	b
3	Runner	20.05	a	29.02	a
4	Insegar	19.46	a	25.73	a
5	Tracer	8.11	b	9.04	b
6	Hallmark	12.23	ab	15.01	b
7	Dimilin Flo	12.75	ab	11.24	b
8	Calypso	8.74	b	7.38	b
9	Untreated	18.46	a	23.63	a
	Fprob	<0.001		<0.001	
	SED (37 df)†	2.732		2.993	
	SED (37 df)‡	3.154		3.456	
	LSD (P=0.05)†	5.535		6.064	
	LSD (P=0.05)‡	6.391		7.002	

† Comparisons with control ‡ Other comparisons # Excluded from ANOVA

Note: Means followed by the same letter do not differ significantly (Duncan's Multiple range test P=0.05)

Conclusions

- Lorsban gave complete control of blackcurrant sawfly larvae and Tracer and Calypso nearly complete control, by 3 days after treatment. Control endured, neonate larvae dying as they emerged from eggs, until at least 7 days after treatment, when the trial was terminated.
- Hallmark and Dimilin Flo gave approximately 70% control of larvae.
- Dipel, Insegar and Runner were completely ineffective.

Acknowledgements

We are most grateful to Neville Stangroom for hosting this trial on his farm and to Rob Saunders and Tom Maynard for advice about the selection of treatments. Thanks to Adrian Harris, Peter Shaw, Chelsea Eby and Lia Mckinnon, East Malling Research, who assisted with the practical work.