EAST MALLING RESEARCH

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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Evaluation of acaricides for control of blackcurrant gall mite 2005

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J V Cross
East Malling Research

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……

Evaluation of acaricides for control of blackcurrant gall mite 2005

Summary

A replicated field experiment was conducted at East Malling Research in 2005 to compare the efficacy of 8 different programmes of foliar sprays of acaricides for control of blackcurrant gall mite. Treatments tested are tabulated below:

Late dormant 31 March 2005	First grape visible 12 April 2005	Other sprays applied at the end of flower on 31 May 2005 unless otherwise indicated
Sulphur SC	Sulphur SC	-
Sulphur SC	Sulphur SC	Masai
Sulphur SC	Sulphur SC	Masai + Sulphur SC 1/3 rate
Sulphur DF	Sulphur DF	Masai
Sulphur SC	Sulphur SC	Sulphur SC 1/3 rate
Sulphur SC	Sulphur SC	3 x Sulphur SC 1/3 rate†
Sulphur SC	Sulphur SC	3 sprays Sulphur SC 1/10 rate†
-	Acrinathrin	3 further sprays Acrinathrin†
Untreated†	-	-
† on 29 April, 12 May and 31 May 2005		

The full dose rates for application of the sprayable concentrate (SC) and dry flowable (DF) formulations of sulphur were 10 litres and 10 kg of 80% product respectively. Sprays were applied at 500 l/ha with a hand lance, which gave complete cover. The effects of the treatments were assessed by monitoring the numbers of mites emerging from galls that were able to migrate a distance of 5 cm to miniature sticky traps and by the number of galls which formed during the season relative to the numbers present at the outset. The main findings and conclusions of the experiment were:

- All the treatments tested controlled blackcurrant gall mite though the programme of 4 sprays of acrinathrin was less effective than the other treatments. The acrinathrin programme reduced end of season gall numbers by 38% and numbers of migrating mites by 77%.
- Two early sprays of flowable sulphur (at bud burst and first grape visible) reduced numbers of migrating mites by 92% and end of season gall numbers by 61%.
- Control of mites and galls by the dry flowable (DF) formulation of sulphur did not differ significantly from the degree of control with the suspension concentrate (SC) formulation.
- Addition at petal fall of a spray of Masai, of a single spray of sulphur at 1/3 rate, or of both did not significantly improve control over that achieved with the two early sprays of sulphur alone.
- Significantly improved control (85% and 97% for end of season gall numbers and total mites captured respectively) was obtained by addition to the bud burst and first grape visible sprays of a programme 3 1/3 rate sprays of sulphur at approximately 2 week intervals starting at the end of flowering.
- No improvement in control was obtained from a similar additional programme of sulphur sprays at the same times, but at 1/10 rate.

- No visual phytotoxicity symptoms were observed in this trial (variety Ben Lomond). Phytotoxicity of these treatments was investigated on Ben Hope and Ben Tirran in a separate trial in 2005.
- The dates of first, 5% and 50 % emergence predicted by the gall mite emergence model of Cross and Ridout (2001) were 30 March, 13 April and 2 May 2005 for the Met station in the Weald. These predicted dates were within 3 days of the actual dates.

Introduction

The overall objective of the experiment reported here was to evaluate the efficacy of programmes of foliar sprays of test products for control of blackcurrant gall mite (*Cecidophyopsis ribis*) and that the results will lead to a grower recommendation for gall mite control. Previous work has clearly shown that early season sprays of sulphur at the late dormant growth stage and at first grape emergence give good, though not complete, control of gall mite. Additional later sprays are needed to improve control, but sulphur, when applied at the full dose, has proved phytotoxic to some varieties of blackcurrants. The aim of this experiment was to evaluate the efficacy of various additional treatments to the standard initial 2 sprays of sulphur as follows:

- To evaluate the benefits of an additional spray of Masai or 1/3 rate sulphur at the end of flowering
- To evaluate the benefits of an additional spray of Masai in admixture with a 1/3 dose of sulphur at the end of flowering
- To compare the efficacy of a sulphur SC and sulphur WP product
- To evaluate the benefits of a programme of 3 additional sprays of sulphur at 1/3 or 1/10 dose
- An additional objective was to determine the efficacy of a programme of sprays of the pyrethroid acaricide acrinathrin

Methods and materials

Site

Two plantations at East Malling Research were used, one (KF288) for the assessments of pre and post season gall counts, the other (KF281) for the deployment of miniature sticky traps to monitor the migration of mites emerging from galls. KF 288 plantation (MR O.S. Explorer sheet 148 714 568) was planted on 26 March 2002. It consisted of 8 rows of 26 bushes of Ben Lomond. The plantation was artificially infested with gall mite on 28 March 2002 by tying a short length of shoot bearing a gall to one of the branches in each bush. KF 281 (MR O.S. Explorer sheet 148 714 568) consisted of 8 alternating rows of 26 bushes, 4 of Ben Lomond and 4 of Ben Tirran. It was planted on 14 March 2001. It was artificially infested with gall mite on 20 April 2001 in the same way. The row spacings in both plantations were 3.0 m and the spacing between bushes in row were 1.5 m, there being 2222 bushes/ha.

Treatments

Treatments were foliar sprays of acaricides as given in Table 1 overleaf. Products and their rates of application are given in Table 2 on page 6.

Table 1. Treatments in gall mite acaricides efficacy experiment 2005

Treatment and nemonic		Time of application of sprays		
		Late dormant 31 March 2005	**First grape visible 12 April 2005**	**Other sprays**
A	SL,SL	Sulphur SC	Sulphur SC	-
B	SL,SL,M	Sulphur SC	Sulphur SC	Masai at end of flower on 31 May 2005
C	SL,SL,M+1/3SL	Sulphur SC	Sulphur SC	Masai + Sulphur SC 1/3 rate at end of flower on 31 May 2005
D	SP,SP,M	Sulphur DF	Sulphur DF	Masai at end of flower on 31 May 2005
E	SL,SL,1/3SL	Sulphur SC	Sulphur SC	Sulphur SC 1/3 rate at end of flower on 31 May 2005
F	SL,SL,1/3SLx3	Sulphur SC	Sulphur SC	3 sprays Sulphur SC 1/3 rate on 29 April, 12 May and 31 May 2005
G	SL,SL,1/10SLx3	Sulphur SC	Sulphur SC	3 sprays Sulphur SC 1/10 rate on 29 April, 12 May and 31 May 2005
H	Acrinathrinx4	-	Acrinathrin	3 further sprays Acrinathrin on 29 April, 12 May and 31 May 2005
I	Untreated	Untreated†	-	-

Table 2. Products and their rates of application in experiments 1 and 2.

Treatment name	Active substance	Product	Dose product (/ha)
Sulphur SC	Sulphur 800 g/l SC	Sulphur Flowable†	10.0 litre
Sulphur SC 1/3 rate	Sulphur 800 g/l SC	Sulphur Flowable†	3.3 litre
Sulphur SC 1/10 rate	Sulphur 800 g/l SC	Sulphur Flowable†	1.0 litre
Sulphur DF	Sulphur 80% DF	Kumulus DF	12.5 kg
Masai	Tebufenpyrad 20% w/w WB	Masai	0.5 kg
Acrinathrin	Acrinathrin 75 g/l EW	-	600 ml

† United Phosphorus

Spray application

Sprays were applied with a Cooper Pegler CP 2000 knapsack sprayer fitted with a handlance in a spray volume of 500 l/ha. 225 ml of sprayate was applied / bush.

Experimental design and layout

For the pre and post season gall counts in KF288, the plantation was divided in to 2 balanced incomplete Latin squares with 8 replicates of the 9 treatments in each (16 replicates in total). Each plot was one bush (144 plots in total).

For the deployment of miniature sticky traps, 4 rows of Ben Lomond in plantation KF 281 were used. The plantation was divided in to four randomised blocks. Each plot was one bush (36 plots in total) 4 miniature sticky being deployed on each bush. The untreated control was double replicated (total of 32 miniature sticky traps deployed).

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. Full meteorological records were obtained from the EMR met station.

Assessments

Pre and post season gall counts: Counts of the numbers of galls on each bush were done in the dormant period before the experiments on 29 November 2004. End of experiment gall counts were done and after leaf fall on 14 November 2005.

Catches of migrating mites in miniature sticky traps: Miniature sticky traps were used to monitor the migration of gall mites from buds in each plot. For the untreated controls, the traps were set out on 14 March 2005 just before bud-burst of Ben Lomond. They were removed and replaced 3 times weekly and the number of gall mites captured on each

counted until the migration had ceased on 13 June 2005. The traps were removed and replaced and the number of gall mites captured on each counted weekly until the migration had ceased.

Phytotoxicity: When spraying and capping was done, the bushes were inspected for visual symptoms of phytotoxicity.

Statistical analysis

ANOVA of counts with $\log_{10}(n+1)$ transformation was done on the total numbers of mites captured per trap. Means were separated using a Duncan's multiple range test (P=0.05). ANOVA with covariance adjustment for the pre-season gall counts was done on the end of season gall counts after $\log_{10}(n+1)$ transformation of both variates.

Results

Gall mite migration 2005

The first mites were captured in the miniature sticky traps between 28 March – 4 April 2005 in the untreated control plots (mean of 2.8 mites per gall) (Figure 1). 5% emergence occurred on 16 April and 50% emergence occurred on 29 April and the migration ceased on 30 May 2005, though a very small number of mites were recorded in early June. The dates of first, 5% and 50 % emergence predicted by the gall mite emergence model of Cross and Ridout (2001) were 30 March, 13 April and 2 May 2005 for the Met station in the Weald. These predicted dates are in close agreement (within 3 days) with the actual dates.

Effects of treatments on numbers of mites captured in sticky traps

All the spray treatments significantly reduced total numbers of mites captured compared to the untreated control (F test for overall significance of effects of treatments, $P<0.001$) (Tables 3 & 4 and Figure 3). The reduction was by >92% for all treatments except the Acrinathrinx4 treatment (treatment H) which reduced total numbers captured by 77%. Treatment F (2 early sulphur then programme of three 1/3 rate sulphur sprays) stood out as being significantly the best treatment, though the reduction in gall mite numbers did not differ significantly from treatment E (two early sulphurs then I 1/3 rate sulphur at the end of flowering). Treatment G (two early sprays of sulphur plus 3 1/10 rate sulphur sprays after flowering was marginally, though significantly, less effective than treatment F where the 1/3 dose sulphur spray programme was used. No benefit from the Masai was apparent (e.g. treatments A versus B, or C versus E) nor benefit from using the dry flowable (DF) formulation of sulphur versus the sprayable concentrate (SC) formulation (B versus D). Indeed, no statistically significant benefit was achieved from any of the post flowering treatments except treatment F (three additional 1/3 rate sulphur sprays.

Effects of treatments on end of season gall counts

The analysis of variance of the $\log_{10}(n+1)$ transformed end of season gall counts, covariance adjusted for the pre-season count, showed highly significant treatment effects ($P<0.001$) and showed a similar pattern of effects as the total catches in the miniature

sticky traps. All the treatments except acrinathrin (treatment H) reduced end of season gall numbers compared to the untreated control. Treatment F (two early season sulphur sprays then a programme of 3 1/3 rate sulphur sprays) stood out as the most effective treatment, though it did not differ significantly from treatments B, D, E or G.

Conclusions

- All the treatments tested controlled blackcurrant gall mite though the programme of 4 sprays of acrinathrin was less effective than the other treatments. The acrinathrin programme reduced end of season gall numbers by 38% and numbers of migrating mites by 77%.
- Two early sprays of flowable sulphur (at bud burst and first grape visible) reduced numbers of migrating mites by 92% and end of season gall numbers by 61%.
- Control of mites and galls by the dry flowable (DF) formulation of sulphur did not differ significantly from the degree of control with the suspension concentrate (SC) formulation.
- Addition at petal fall of a spray of Masai, of a single spray of sulphur at 1/3 rate, or of both did not significantly improve control over that achieved with the two early sprays of sulphur alone.
- Significantly improved control (85% and 97% control for end of season gall numbers and total mites captured respectively) was obtained by addition to the bud burst and first grape visible sprays of a programme 3 1/3 rate sprays of sulphur at approximately 2 week intervals starting at the end of flowering.
- No improvement in control was obtained from an additional programme of sulphur sprays at the same times but at 1/10 rate.
- No visual phytotoxicity symptoms were observed in this trial (variety Ben Lomond). Phytotoxicity of these treatments was investigated on Ben Hope and Ben Tirran in a separate trial in 2005.
- The dates of first, 5% and 50 % emergence predicted by the gall mite emergence model of Cross and Ridout (2001) were 30 March, 13 April and 2 May 2005 for the Met station in the Weald. These predicted dates were within 3 days of the actual dates.

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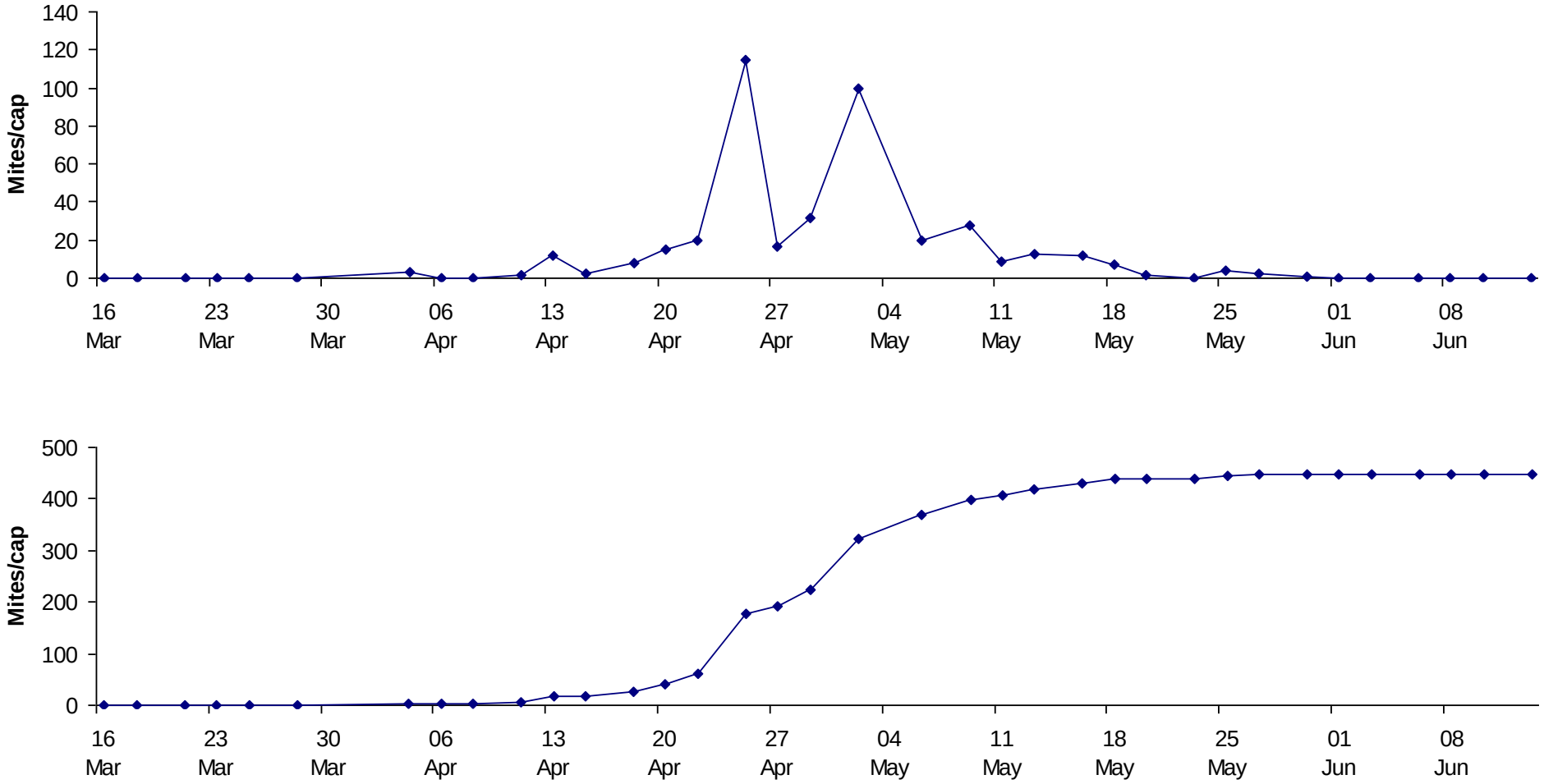

Figure 1. Mean number of gall mites captured per gall on the untreated control plots (upper graph) and cumulative total number emerged (lower graph)

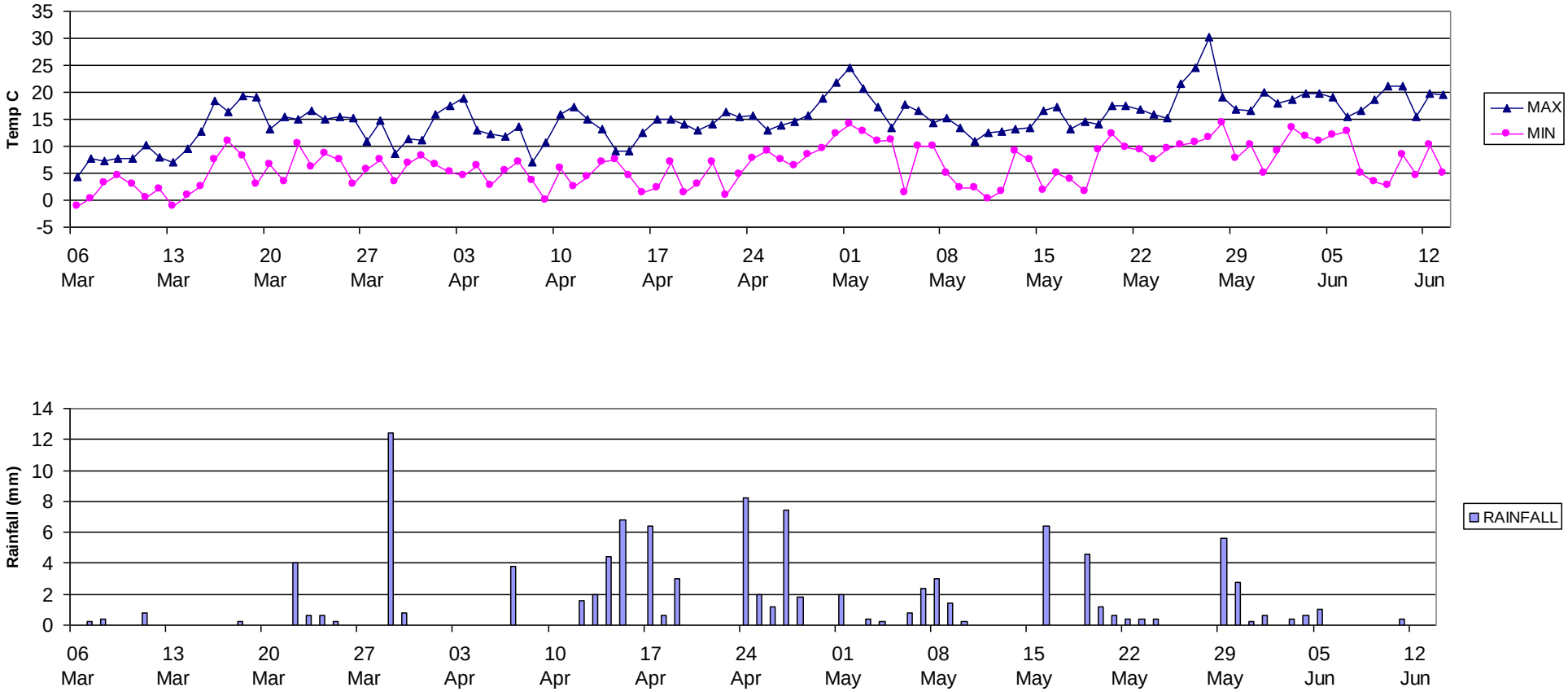

Figure 2. Maximum and minimum air temperature (ºC) (upper graph) and rainfall (mm) (lower graph) at East Malling Research

Table 3. Mean weekly number of mites captured per gall (upper table) and cumulative number (lower table) in experiment 1

Treatment		21 Mar	28 Mar	04 Apr	11 Apr	18 Apr	25 Apr	2 May	9 May	16 May	23 May	30 May	6 Jun
Weekly no.													
A	SL,SL	0.0	0.0	0.0	0.0	0.0	0.3	6.1	17.9	1.8	3.0	0.3	0.0
B	SL,SL,M	0.0	0.0	0.1	0.0	0.1	0.8	3.8	17.9	1.4	2.6	0.2	0.0
C	SL,SL,M+1/3SL	0.0	0.0	0.3	0.0	0.2	0.3	4.8	15.3	1.8	3.6	0.3	0.0
D	SP,SP,M	0.0	0.0	0.1	0.3	0.4	3.6	1.8	11.8	1.4	1.1	0.2	0.0
E	SL,SL,1/3SL	0.0	0.0	0.0	0.0	0.1	1.3	0.8	13.1	1.4	1.4	0.8	0.0
F	SL,SL,1/3SLx3	0.0	0.0	0.1	0.1	0.3	1.3	0.3	7.1	0.4	1.0	0.7	0.0
G	SL,SL,1/10SLx3	0.0	0.0	0.1	0.1	0.1	0.8	6.6	16.7	1.3	2.9	0.5	0.2
H	Acrinathrinx4	0.0	0.0	0.6	2.8	9.8	8.3	27.5	22.1	2.4	0.9	0.0	0.1
I	Untreated	0.0	0.0	2.8	1.6	22.2	150.2	147.1	74.2	33.4	8.9	6.9	0.2
Cumulative no.													
A	SL,SL	0.0	0.0	0.0	0.0	0.0	0.3	6.4	24.4	26.2	29.2	29.4	29.4
B	SL,SL,M	0.0	0.0	0.1	0.1	0.3	1.0	4.8	22.6	24.1	26.7	28.2	28.2
C	SL,SL,M+1/3SL	0.0	0.0	0.3	0.3	0.4	0.8	5.5	20.8	22.6	26.3	26.5	26.5
D	SP,SP,M	0.0	0.0	0.1	0.4	0.8	4.3	6.1	17.9	19.4	20.4	21.7	21.7
E	SL,SL,1/3SL	0.0	0.0	0.0	0.0	0.1	1.4	2.2	15.3	16.8	18.3	19.2	19.2
F	SL,SL,1/3SLx3	0.0	0.0	0.1	0.2	0.5	1.8	2.0	9.1	9.4	10.4	11.1	11.1
G	SL,SL,1/10SLx3	0.0	0.0	0.1	0.2	0.3	1.1	7.7	24.4	25.7	28.6	29.2	29.4
H	Acrinathrinx4	0.0	0.0	0.6	3.4	13.2	21.5	49.0	71.1	73.6	75.8	75.8	75.9
I	Untreated	0.0	0.0	2.8	4.4	26.6	176.8	323.9	398.0	431.5	440.4	447.3	447.5

Table 4. Mean total (n)‡ and mean $Log_{10}(n+1)$ total numbers of mites captured per gall from 7 April – 6 June 2005 in experiment 1.

Treatment		n‡	$Log_{10}(n+1)$†
A	SL,SL	21.7	1.356 c
B	SL,SL,M	19.8	1.318 c
C	SL,SL,M+1/3SL	20.6	1.335 c
D	SP,SP,M	17.8	1.275 c
E	SL,SL,1/3SL	15.4	1.216 cd
F	SL,SL,1/3SLx3	8.8	0.989 d
G	SL,SL,1/10SLx3	19.3	1.308 c
H	Acrinathrinx4	62.9	1.806 b
I	Untreated	277.3	2.444 a
		Fprob	<0.001
		SED (131 df) – Comparisons with control	0.0982
		Other comparisons	0.1134

‡Back-transformed values
†Means followed by the same letter do not differ significantly (Duncan's multiple range test, P = 0.05)

Table 5. End of season gall counts per bush (n)‡ and mean $Log_{10}(n+1)$ transformed count per bush on 14 November 2005. Values have been covariance adjusted for the pre-season gall count on 29 November 2004.

Treatment		n‡	$Log_{10}(n+1)$†
A	SL,SL	18.0	1.278 bc
B	SL,SL,M	15.8	1.224 bc
C	SL,SL,M+1/3SL	22.0	1.361 bc
D	SP,SP,M	11.1	1.082 cd
E	SL,SL,1/3SL	11.5	1.096 cd
F	SL,SL,1/3SLx3	6.9	0.900 d
G	SL,SL,1/10SLx3	10.7	1.067 cd
H	Acrinathrinx4	28.3	1.467 ab
I	Untreated	45.7	1.669 a
		Fprob	< 0.001
		SED (103 df)	0.1243
		LSD (P=0.05)	0.2465

‡Back-transformed values
†Values with the same letter do not differ significantly (Duncan's multiple range test P = 0.05)

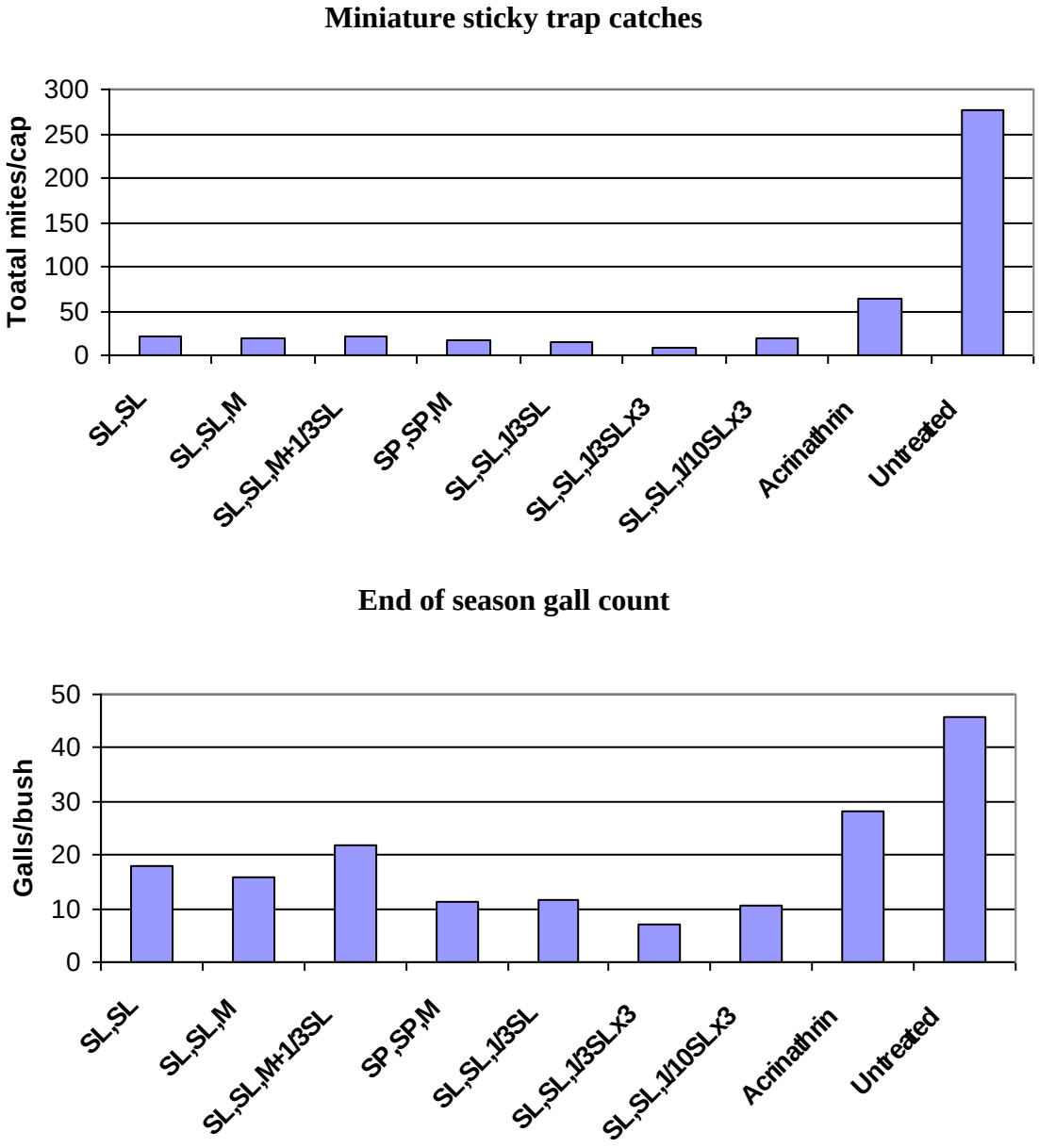

Figure 3. Mean total number of mites captured per gall (upper histogram) and end of season number of gall per bush (lower histogram). Values are back-transformed means from the analyses of variance and the end of season counts have been covariance adjusted for the pre-season gall count.