EAST MALLING RESEARCH

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Evaluation of acaricides for control of blackcurrant gall mite 2004

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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……

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Summary

Two replicated field experiments were conducted at East Malling Research in 2004. One experiment compared the efficacy of 11 different programmes of foliar sprays of a suspension concentrate (liquid) formulation of sulphur (12.5 litres 800 g/l product/ha) with or without one or more sprays of Masai for control of blackcurrant gall mite. The other experiment compared the efficacy of a programme of 3 sprays of the label recommended dose (2 kg product/ha) of the dry flow formulation of sulphur Kumulus DF with the full dose (12.5 kg/ha) used in the first experiment. Sprays were applied at 1000 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 experiments are:

- Treatment with sulphur (12.5 l of 800 g/l SC in 1000 l water/ha) on 26 March 2004 at the late dormant growth stage of Ben Lomond gave approximately 66% control of gall mite galls.
- A supplementary spray of sulphur (at the same rate) or Masai (0.5 kg in 1000 l water/ha) at the first grape visible growth stage plus one or two additional sprays of Masai at the peak of mite emergence on 6-7 May or 14 or 21 days later, or with an additional spray of sulphur at this latter timing improved the reduction in the number of galls formed to 71-86%, but did still not give complete control.
- The best control was achieved by the late dormant spray of sulphur SC followed by five 1/3 rate sprays of sulphur SC spanning the mite emergence period which reduced the number of galls formed by 92%.
- Programmes of 3 sprays of sulphur 80 % w/w DF (Kumulus DF) at a dose of 2.0 or 12.5 kg in 1000 l water/ha at first grape visible on 15-16 April, at peak mite emergence on 6-7 May and 14 days later failed to reduce the number of galls formed by the end of the season. Catches of mites on miniature sticky traps indicated that, although these treatments reduced the total numbers of migrating mites by over 90%, they did not control the early part of the migration which occurred before the first spray was applied. Poor reduction in the numbers of galls can thus be attributed to the failure to control the mites in the early part of the migration period.
- Although Masai is probably slightly less effective than sulphur, use of Masai after the first grape visible growth stage may be preferable because of possible phytotoxic effects of sulphur.
- No obvious visual symptoms of phytotoxocity were observed in this experiment. However, the phytotoxicity of programmes of reduced rate sulphur sprays after the first grape visible growth stage needs to be investigated.

Introduction

The objectives of the work reported here were:

Experiment 1: To compare the efficacy of programmes of foliar sprays of sulphur, applied at the normal commercial dose rate of 10 kg ai/ha, and Masai for control of blackcurrant gall mite.

Experiment 2: To compare the efficacy of the label recommended dose of the sulphur formulation Kumulus with the higher dose normally used commercially.

Methods and materials

Site

Experiment 1: Two plantations at East Malling Research were used, one (KF288) for the assessments of pre and post season gall counts, the other (the northern half of 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.

Experiment 2: This was done in the southern half of KF281

Treatments

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

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

Treatment name	Exp.	Active substance	Product	Dose product (/ha)
Sulphur SC	1	Sulphur 800 g/l SC	Sulphur Flowable†	12.5 litre
Sulphur SC 1/3 rate	1	Sulphur 800 g/l SC	Sulphur Flowable†	4.2 litre
Masai	1	Tebufenpyrad 20% w/w WB	Masai	0.5 kg
Bond	1	450 g/l latex	Bond	700 ml
Sulphur DF	2	Sulphur 80% DF	Kumulus DF	12.5 kg
Sulphur DF low rate	2	Sulphur 80% DF low rate	Kumulus DF	2.0 kg
Agral	2	Non ionic wetter	Agral	0.01%

† United Phosphorus

Spray application

Sprays were applied with a Cooper Pegler CP 2000 knapsack sprayer fitted with a handlance in a spray volume of 1000 l/ha. 450 ml of sprayate was applied / bush.

Experimental design and layout

Experiment 1: For the pre and post season gall counts in KF288, a randomised complete block design with 16 replicate 1 bush plots was used. In the northern part of KF281, four miniature sticky traps were deployed on each of 4 replicate bushes in a randomised complete block design.

Experiment 2: A fully randomised design was used with 16 replicate 1 bush plots for each of the three treatments. For the spray treatments, one miniature sticky trap was deployed above a gall in each bush but in the untreated control plots, two sticky traps were deployed per plot.

Meteorological records

Wet and dry bulb temperature with whirling psychrometer, wind speed and direction before and after spraying. Full records available from HRI-EM 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 11 November 2003 in KF281 and on 26 January 2004 in KF288. End of experiment gall counts were done and after leaf fall on 30 November 2004.

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 L and M, the traps were set out on 26 March 2004 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 2 June 2004. For the other treatments, the traps were set on 7 April, as soon as catches were recorded on the controls. 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. ANOVA with covariance adjustment for the pre-season gall counts was done on the end of season gall counts after square root transformation of both variates.

Table 1. Treatments in gall mite acaricides efficacy experiments in 2004

Treatment & nemonic		Time of application of sprays				
		Late dormant	First grape visible	Peak emergence (Mid Flower)	Peak emergence plus 14 days (Late Flower)	Peak emergence plus 21 days (100% Fruit Set)
		26 March	15-16 April	6-7 May	20-21 May	27 May
		Experiment 1				
A	SSM0S	Sulphur SC	Sulphur SC	Masai	-	Sulphur SC
B	SSM0M	Sulphur SC	Sulphur SC	Masai	-	Masai
C	SSM00	Sulphur SC	Sulphur SC	Masai	-	-
D	SS0M0	Sulphur SC	Sulphur SC	-	Masai	-
E	SMM0S	Sulphur SC	Masai	Masai	-	Sulphur SC
F	SMM0M	Sulphur SC	Masai	Masai	-	Masai
G	SMM00	Sulphur SC	Masai	Masai	-	-
H	SM0M0	Sulphur SC	Masai	-	Masai	-
I	S0000	Sulphur SC	-	-	-	-
J	S+Bond0000	Sulphur SC + Bond	-	-	-	-
K	S prog	Sulphur SC	Programme of five 1/3 rate sulphur SC sprays on 5, 15, 30 April, 20 & 27 May‡			
L	Untreated	-				
		Experiment 2				
O	Kumulus low		Sulphur DF low†	Sulphur DF low†	Sulphur DF low†	
P	Kumlus		Sulphur DF	Sulphur DF	Sulphur DF	
N	Untreated	-	-	-	-	-
			-	-	-	-

† + 0.01% Agral

‡ Growth stages: 1 April - 2 leaves expanded, 15 April - 1st grape visible, 30 April - 1st Flower, 20 May - late flower, 27 May - 100% fruit set

Results

Gall mite migration 2004

The very first mites were captured in the miniature sticky traps on 5-7 April in the untreated control plots and a mean of 15.2 mites per gall was captured on 7-14 April 2004 (Figure 1). 50% emergence occurred on 27 April and the migration ceased on 20 May 2004. The dates of first, 5% and 50 % emergence predicted by the gall mite emergence model of Cross and Ridout (2001) were 1 April, 15 April and 29 April 2004 for the Met station in the Weald. These predicted dates are in close agreement with the actual dates.

Effects of treatments on numbers of mites captured in sticky traps

Experiment 1: All the spray treatments greatly reduced numbers of mites captured compared to the untreated control ($P<0.001$) (Tables 2 & 4). However, most of the effect appears to have been caused by the first sulphur spray applied in the late dormant period on 26 March. Comparing treatment I (dormant sulphur alone) with treatments A-H (dormant sulphur + additional sprays) suggests that the additional sprays did have some benefit but the differences for any individual treatment were not statistically significant. Treatment K (full dose sulphur on 26 March followed by the programme of five 1/3 dose sulphur sprays performed well. There was no evidence of benefit of addition of Bond to the 26 March sulphur spray.

Experiment 2: Both the high dose and the low (recommended dose) Kumulus treatments greatly reduced the numbers of migrating gall mites captured by > 90% but there was no statistically significant difference between the doses (Table 3 & 5).

Effects of treatments on end of season gall counts

Experiment 1: All the chemical treatments significantly ($P < 0.01$) reduced the end of season gall count compared to the untreated control (Table 6). The programme of sulphur sprays stood out as being the most effective treatment. The early sulphur followed by varying numbers of sulphur or Masai treatments (treatments A-H) all performed similarly. Masai performed similarly to sulphur for the latter sprays though the mean of the four treatments A-D which had sulphur as the second spray (mean = 3.33) was smaller than the mean of the 4 treatments E-H where Masai was the second spray (mean = 4.15). Though the values for all these treatments were lower than the mean for the single sulphur spray, the differences were not statistically significant at the $P = 0.01$ level indicating that the first sulphur spray gave the most benefit. There was no evidence of any significant benefit from addition of Bond.

Experiment 2: Neither the full dose or low dose Kumulus treatments significantly affected the end of season gall count (Table 7). The mite migration data (Table 3) suggests that the treatments were applied too late and that the early season part of the migration is of greatest importance. This finding is corroborated by the results of experiment 1.

Conclusions

- Treatment with sulphur (12.5 l of 800 g/l SC in 1000 l water/ha) on 26 March 2004 at the late dormant growth stage of Ben Lomond gave approximately 66% control of the numbers of gall mite galls that formed subsequently.
- A supplementary spray of sulphur (at the same rate) or Masai (0.5 kg in 1000 l water/ha) at the first grape visible growth stage, plus one or two additional sprays of Masai at the peak of mite emergence on 6-7 May or 14 or 21 days later, or with an additional spray of sulphur at this latter timing, improved the reduction in the number of galls formed to 71-86%, but did still not give complete control.
- The best control was achieved by the late dormant spray of sulphur SC followed by five 1/3 rate sprays of sulphur SC spanning the mite emergence period which reduced the number of galls formed by 92%.
- Programmes of 3 sprays of sulphur 80 % w/w DF (Kumulus DF) at a dose of 2.0 or 12.5 kg in 1000 l water/ha at first grape visible on 15-16 April, at peak mite emergence on 6-7 May and 14 days later failed to reduce the number of galls formed by the end of the season. Catches of mites on miniature sticky traps indicated that, although these treatments reduced the total numbers of migrating mites by over 90%, they did not control the early part of the migration which occurred before the first spray was applied. Poor reduction in the numbers of galls can thus be attributed to the failure to control the mites in the early part of the migration period.

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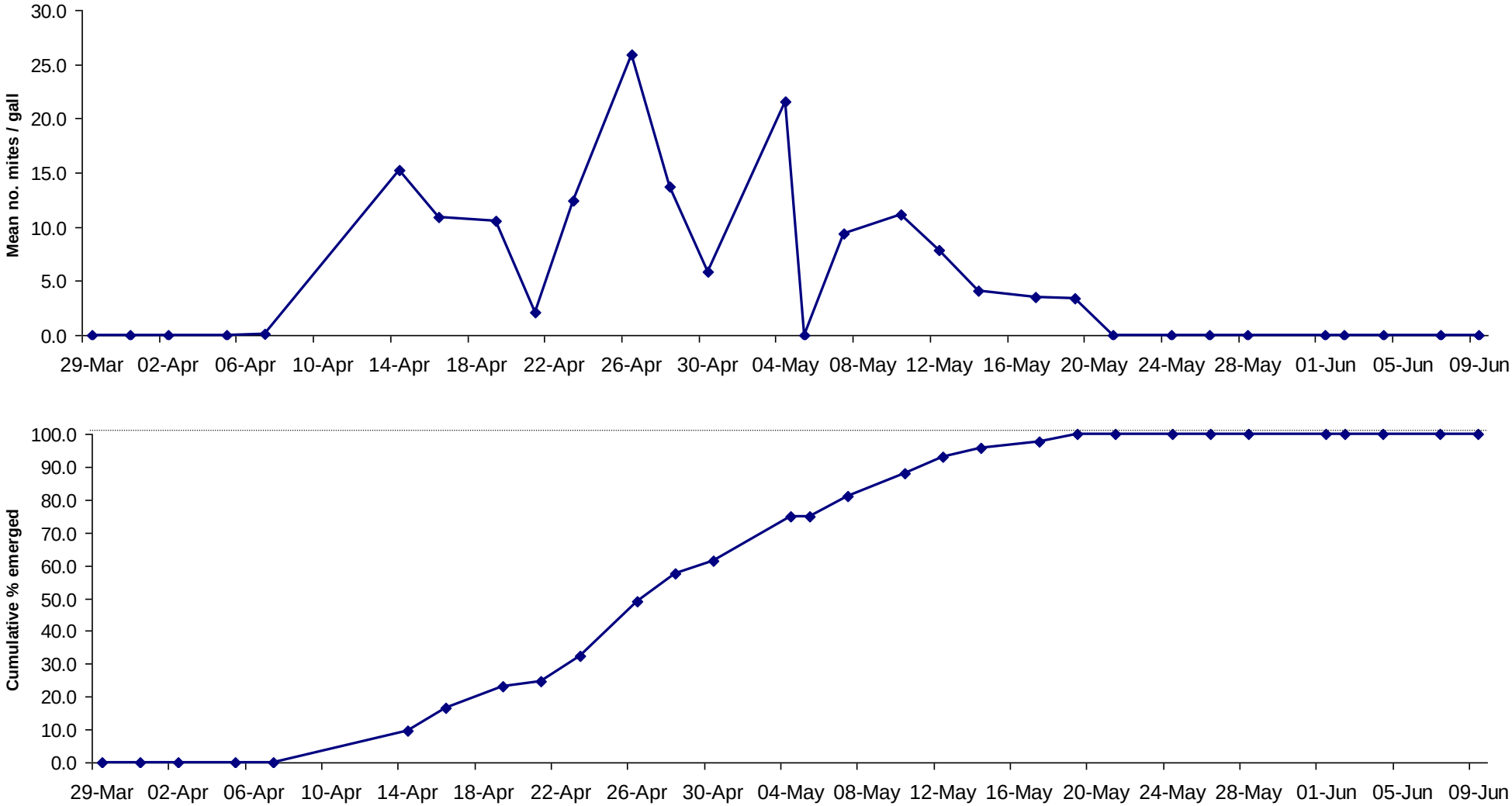

Figure 1. Mean number of gall mites captured per gall on the untreated control plots (upper graph) and cumulative % of the total number emerged (lower graph)

Table 2. Mean weekly number of mites captured per gall (upper table) and cumulative number (lower table) in experiment 1

Treatment		14 April	21 April	28 April	05-May	12-May	19-May	26-May	02-Jun	09-Jun
Weekly no.										
A	SSM0S	0.1	0.9	0.0	0.3	0.3	0.5	0.0	0.0	0.0
B	SSM0M	0.0	3.4	0.6	0.6	0.1	0.8	0.0	0.0	0.0
C	SSM00	0.0	0.3	1.2	0.3	0.3	1.6	0.0	0.0	0.0
D	SS0M0	0.1	0.0	1.6	0.2	0.8	0.3	0.0	0.0	0.0
E	SMM0S	0.1	1.1	1.9	0.3	0.3	0.5	0.0	0.0	0.0
F	SMM0M	0.7	13.3	0.1	0.5	0.3	0.0	0.0	0.0	0.0
G	SMM00	0.3	0.0	3.1	0.0	1.0	0.5	0.0	0.0	0.0
H	SM0M0	0.0	0.1	1.5	0.0	1.5	3.8	0.0	0.0	0.0
I	S0000	0.0	0.0	6.8	0.0	1.0	0.0	0.0	0.0	0.0
J	S+Bond0000	0.1	0.0	7.0	1.4	3.7	1.5	0.0	0.0	0.0
K	S prog	0.1	0.1	1.8	0.3	0.8	1.1	0.0	0.0	0.0
L	Untreated	15.2	23.5	52.1	27.4	28.4	11.0	0.0	0.0	0.0
Cumulative no.										
A	SSM0S	0.1	0.9	0.9	1.3	1.5	2.0	2.0	2.0	2.0
B	SSM0M	0.0	3.4	4.0	4.6	4.7	5.4	5.4	5.4	5.4
C	SSM00	0.0	0.3	1.4	1.8	2.1	3.7	3.7	3.7	3.7
D	SS0M0	0.1	0.1	1.8	1.9	2.7	3.0	3.0	3.0	3.0
E	SMM0S	0.1	1.1	3.1	3.4	3.6	4.1	4.1	4.1	4.1
F	SMM0M	0.7	14.0	14.1	14.6	14.9	14.9	14.9	14.9	14.9
G	SMM00	0.3	0.3	3.4	3.4	4.4	4.9	4.9	4.9	4.9
H	SM0M0	0.0	0.1	1.6	1.6	3.1	6.9	6.9	6.9	6.9
I	S	0.0	0.0	6.8	6.8	7.8	7.8	7.8	7.8	7.8
J	S+Bond	0.1	0.1	7.1	8.6	12.3	13.8	13.8	13.8	13.8
K	S prog	0.1	0.2	1.9	2.2	2.9	4.1	4.1	4.1	4.1
L	Untreated	15.2	38.7	90.8	118.1	146.5	157.5	157.5	157.5	157.5

Table 3. Mean weekly number of mites captured per gall (upper table) and cumulative number (lower table) in experiment 2

Treatment	14 April	21 April	28 April	05 May	12 May	19 May	26 May	02 Jun	09 Jun
Weekly no.									
O Kumulus low	16.6	0	0.3	0.0	0.1	0.5	0.0	0.0	0.0
P Kumlus	13.1	0.0	0.0	0.0	1.3	0.0	0.0	0.0	0.0
N Untreated	22.8	7.8	93.8	22.4	17.9	7.5	3.9	0.4	0.0
Cumulative no.									
O Kumulus low	16.5	16.6	16.9	16.9	17.00	17.50	17.50	17.50	17.50
P Kumlus	13.1	13.1	13.1	13.1	14.3	14.3	14.3	14.3	14.3
N Untreated	22.8	30.7	124.4	146.9	164.8	172.2	176.2	176.5	176.5

Table 4. Mean total (n) and mean $Log_{10}(n+1)$ total numbers of mites captured per gall from 7 April – 9 June 2004 in experiment 1.

Treatment		n	$Log_{10}(n+1)$
A	SSM0S	2.0	0.313
B	SSM0M	5.4	0.523
C	SSM00	3.7	0.368
D	SS0M0	3.0	0.323
E	SMM0S	4.1	0.498
F	SMM0M	14.9	0.523
G	SMM00	4.9	0.663
H	SM0M0	6.9	0.611
I	S0000	7.8	0.584
J	S+Bond0000	13.8	0.955
K	S prog	4.1	0.516
L	Untreated	157.5	1.792
		Fprob	<0.001
		SED (181 df) - Comparisons with control	0.154
		Other comparisons	0.178

Table 5. Mean total (n) and mean $Log_{10}(n+1)$ total numbers of mites captured per gall from 7 April – 9 June 2004 in experiment 2.

Treatment		n	$Log_{10}(n+1)$
O	Kumulus low	17.5	0.914
P	Kumlus	14.3	0.922
N	Untreated	176.5	2.059
		Fprob	<0.001
		SED (46 df) - Comparisons with control	0.167
		Other comparisons	0.192

Table 6. End of season gall counts per bush (n) and mean square root transformed count per bush (√n) on 30 November 2004 in experiment 1. Values have been covariance adjusted for the pre-season gall count.

Treatment		n	√n †
A	SSM0S	3.37	1.685 abc
B	SSM0M	3.62	1.708 abc
C	SSM00	3.53	1.800 abc
D	SS0M0	2.79	1.307 abc
E	SMM0S	4.09	1.735 abc
F	SMM0M	3.32	1.700 abc
G	SMM00	3.31	1.658 abc
H	SM0M0	5.88	2.366 c
I	S0000	6.82	2.362 c
J	S+Bond0000	4.60	2.005 bc
K	S prog	1.68	1.082 a
L	Untreated	20.18	4.170 d
		Fprob	<0.001
		SED (180 df) - Comparisons with control	0.2985
		Other comparisons	0.3447

† values with the same letter do mot differ significantly P = 0.1

Table 7. End of season gall counts per bush (n) and mean square root transformed count per bush (√n) on 30 November 2004 in experiment 1. Values have been covariance adjusted for the pre-season gall count.

Treatment		n	√n †
O	Kumulus low	288	15.76
P	Kumlus	286	15.58
N	Untreated	214	14.04
		Fprob	0.582
		SED (46 df)	1.805