SCEPTREPLUS

Final Trial Report

Trial code:	SP 20
Title:	Initial screening of efficacy and crop safety of novel products for the control of gall mite on blackcurrant
Crop	Blackcurrant
Target	Gall mite (*Cecidophyopsis ribis*)
Lead researcher:	Adrian Harris
Organisation:	NIAB EMR
Period:	February 2018 to March 2019
Report date:	31 March 2019
Report author:	Adrian Harris
ORETO Number: (certificate should be attached)	18/010 certificate No: 411

I the undersigned, hereby declare that the work was performed according to the procedures herein described and that this report is an accurate and faithful record of the results obtained

20 May 2019

Date Authors signature

Introduction
The aim of the trial was to evaluate the efficacy of programmes of foliar sprays of test products for control of blackcurrant gall mite (*Cecidophyopsis ribis).*

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. A gall mite acaricide trial, to evaluate novel acaricides for control of gall mite and including a confirmatory validation of the standard sulphur treatments is proposed.

Methods
A replicated small plot experiment was done in the commercial plantation of cv Ben Vane to evaluate the efficacy of post-blossom sprays of 11 test products for control of blackcurrant gall mite, compared to an untreated control, a water only and the industry standard of 2 early sulphur sprays. The sprays were applied on 05 April, 18 April, 17 May, 23 May and 02 June. The number of each spray applied was based on the company recommendations for each product. To assess the efficacy of the treatments, the number of galls pre-bud break and post-leaf drop were recorded. The seasonal migration of the gall mites from galls was monitored weekly in 2018 using miniature sticky traps in an infested commercial blackcurrant plantation (cv Ben Vane). Additional monitoring was done in an infested plantation of cv Ben Tirran at NIAB EMR for comparison.

Results
The migration of gall mites in the commercial crop of cv Ben Vane had finished by 17 May 2018 while on Ben Tirran at NIAB EMR it continued until 19 June. Since the experimental treatments were applied to the crop post-flowering this meant that the gall mite migration was over when the sprays were applied. Of the 14 treatments only Treatment 3, the industry standard treatment of 2 early sulphur applications, had any significant effect in reducing the number of galls by the end of the season (Table 1).

Table 1. Analysis of the pre-bud break and post-leaf drop gall numbers. The data were Poisson distributed and therefore required square root transformation before Analysis of Variance using the pre-spray gall count as a covariate. The same lower case letter denotes that treatments are not significantly different from each other.

Treatment	Timing of application*					13 Mar Pre-bud break	30 Oct Post-leaf drop	30 Oct / 13 Mar	√ Covariate
	A	B	C	D	E				
1 Untreated						8.61	18.78	2.18	3.31 a
2 Water only			●	●	●	2.83	19.33	6.82	3.64 a
3 Headland Sulphur	●	●				3.17	3.61	1.14	1.46 b
4 Kumulus DF			●	●	●	4.56	14.61	3.21	3.12 a
5 Masai			●			8.00	17.00	2.13	3.29 a
6 Kumulus DF			●			10.06	17.17	1.71	3.17 a
7 AHDB9945			●	●	●	7.61	9.06	1.19	2.40 a
8 Envidor			●			7.56	37.44	4.96	4.93 a
9 AHDB 9989			●	●		12.67	14.11	1.11	2.35 a
10 AHDB 9931			●	●	●	7.39	19.00	2.57	3.39 a
11 AHDB 9944			●			2.94	6.89	2.34	2.19 a
12 AHDB 9970			●	●	●	12.00	17.50	1.46	2.74 a
13 AHDB 9951			●			9.78	23.50	2.40	3.58 a
14 AHDB 9929			●	●	●	3.11	13.72	4.41	3.05 a
								F. prob (d.f. = 167)	0.089
								SED	0.90
								LSD	1.79

*A: 5% mite emergence on 05/04/18 B: 50% mite emergence on 18/04/18 C: Just post flowering on17/05/18 D: 6 days after C on 23/05/18 E: 02/06/18

Conclusions

- The duration of gall mite migration may vary depending on plantation and cultivar
- The industry standard of two early sprays of sulphur provided good control of gall mite on the variety Ben Vane
- These products require further evaluation plus sprays of full and reduced dose sulphur at the start and peak of migration which may occur during flowering

Science Section

Objectives

The overall objective was to evaluate the efficacy of programmes of foliar sprays of test products applied post-flowering for control of blackcurrant gall mite (*Cecidophyopsis ribis)*.

Trial conduct

UK regulatory guidelines were followed but EPPO guidelines took precedence. The following EPPO guidelines were followed:

Relevant EPPO guideline(s)		**Variation from EPPO**
PP 1/152(3)	Design and analysis of efficacy evaluation trials	None
PP 1/135(3)	Phytotoxicity assessment	None
PP 1/181(3)	Conduct and reporting of efficacy evaluation trials including GEP	None

There were no deviations from EPPO guidance:

Test site

Item	**Details**
Location address	Stephen Wickham – Harpers Farm, Goudhurst, TN17 1 JU,
Crop	Blackcurrant
Cultivar	Ben Vane.
Soil or substrate type	Soilscape 18 slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils
Agronomic practice	LR Suntory advised
Prior history of site	Blackcurrant

Trial design

Item	**Details**
Trial design:	randomised complete block design
Number of replicates:	6
Row spacing:	3 m
Plot size: (w x l)	2.5 m x 3 m
Plot size: (m^2)	7.5 m^2
Number of plants per plot:	5
Leaf Wall Area calculations	N/A

Treatment details

Treatment code	AHDB Code	Active substance	Product name/ manufacturers code	Formulation batch number	Content of active substance in product	Formulation type	Adjuvant
01	N/A	Untreated	NA	Untreated	-		None
02	N/A	Water only	NA	Water only	-		None
03	Authorised	Sulphur	Kumulus DF BASF	48740088Q0	80%	WDG	None
04	Authorised	Sulphur	Kumulus DF BASF	48740088Q0	80%	WDG	None
05	Authorised	Tebufenpyrad	Masai	81092147GB11 14	20%	WP	None
06	Authorised	Sulphur	Kumulus DF BASF	48740088Q0	80 %	WDG	None
07	AHDB 9945	N/D	N/D	N/D	N/D	N/D	None
08	Authorised	Spirodiclofen	Envidor	EMAL017842	240g/l	SC	None
09	AHDB 9989	N/D	N/D	N/D	N/D	N/D	None
10	AHDB 9931	N/D	N/D	N/D	N/D	N/D	None
11	AHDB 9944	N/D	N/D	N/D	N/D	N/D	None
12	AHDB 9970	N/D	N/D	N/D	N/D	N/D	None
13	AHDB 9951	N/D	N/D	N/D	N/D	N/D	None
14	AHDB 9929	N/D	N/D	N/D	N/D	N/D	None

Application schedule

Treatment number	Treatment: product name or AHDB code	Rate of active substance (ml or g a.s./ha)	Rate of product (l or kg/ha)	Application timing code
01	Neg Control			
02	Water Only			
03	Kumulus DF BASF	80%	10 kg	A B
04	Kumulus DF BASF	80%	1 kg	C D E
05	Masai	20%	1.5 kg	C
06	Kumulus DF BASF	80 %	10 kg	C
07	AHDB 9945	N/D	1l/ha	C D E
08	Envidor	240g/l	0.4 l/ha	C
09	AHDB 9989	N/D	0.5 l/ha	C D E
10	AHDB 9931	N/D	8 l/ha	C D E
11	AHDB 9944	N/D	1 l	C
12	AHDB 9970	N/D	8 l	C D E
13	AHDB 9951	N/D	0.3 l	C
14	AHDB 9929	N/D	1.25 ml	C D E

Application details

	Application A	Application B	Application C	Application D	Application E
Application date	05/04/18	18/04/18	17/05/18	23/05/18	02/06/18
Time of day	10:55	18:15	9:45	12:00	7:55
Crop growth stage (Max, min average BBCH)	09	61	71	78	79
Crop height (cm)	1 m	1 m	1 m	1 m	1 m
Crop coverage (%)	N/A	N/A	N/A	N/A	N/A
Application Method	Mist blower	Mist blower	Mist blower	Mist blower	Mist blower
Application Placement	Crop	Crop	Crop	Crop	Crop
Application equipment	Birchmeier B245	Birchmeier B245	Birchmeier B245	Birchmeier B245	Birchmeier B245
Nozzle pressure	N/A	N/A	N/A	N/A	N/A
Nozzle type	N/A	N/A	N/A	N/A	N/A
Nozzle size	N/A	N/A	N/A	N/A	N/A
Application water volume l/ha	500	500	500	500	500
Temperature of air-shade (°C)	9.5	18	18	18	18
Relative humidity (%)	90	70	95	95	95
Wind speed range (m/s)	0.14-0.69	0.58-0.64	0.28-0.86	0.33-0.88	0.00-0.19
Dew presence (Y/N)	N	N	N	N	N
Temperature of soil-2-5 cm (°C)	N/A	N/A	N/A	N/A	N/A
Wetness of soil-2-5 cm	N/A	N/A	N/A	N/A	N/A
Cloud cover (%)	N/A	N/A	N/A	N/A	N/A

Untreated levels of pests/pathogens at application and through the assessment period

Common name	Scientific Name	EPPO Code	Infestation level pre-application	Infestation level at start of assessment period	Infestation level at end of assessment period
Blackcurrant Gall mite	*Cecidophyopsis ribis*	ERPHRI	8.61	8.61	18.76

Assessment details

In order to monitor the mite migration, a total of 20 miniature sticky cap traps were set 5 cm above galls on cv Ben Tirran at NIAB EMR, and on cv Ben Vane at the experimental site. These were monitored every 3 days at NIAB EMR, and at weekly intervals on additional marked untreated plots at the experimental site.

At the experimental site the number of galls per bush were recorded pre-spray, the number of galls per bush were counted again in the autumn post leaf drop.

Crop development was recorded throughout the trial.

The bushes were inspected for visual signs of phytotoxicity 7 days after each spray application was applied.

	Evaluation Timing (DA)*				
Evaluation date	**After conventional insecticides**	**After Bio-insecticides**	**Crop Growth Stage (BBCH)**	**Evaluation type (efficacy, phytotox)**	**Assessment**
13/03/18	0	N/A	0	Efficacy	Gall counts
12/04/18	7 days	N/A	09	Phytotoxicity	Visual
23/04/18	8 days	N/A	61	Phytotoxicity	Visual
24/05/18	7 days	N/A	71	Phytotoxicity	Visual
01/06/18	9 days	N/A	78	Phytotoxicity	Visual
08/06/18	6 days	N/A	79	Phytotoxicity	Visual
30/10/18	N/A	N/A	0	Efficacy	Gall counts

* DA – days after application
N/A – not applicable

Statistical analysis

The data were Poisson distributed and therefore required square root transformation before Analysis of Variance using the pre-spray gall count as a covariate could be conducted.

Results

Gall mite monitoring

Mites were monitored using 20 miniature sticky traps. Monitoring started at two sites on 26 February 2018. Due to technical issues with the double-sided tape in the traps, the start of the migration was missed, and the first mites were caught at NIAB EMR on 23 April (Figure 1) and the final mite was caught on the 19 June.

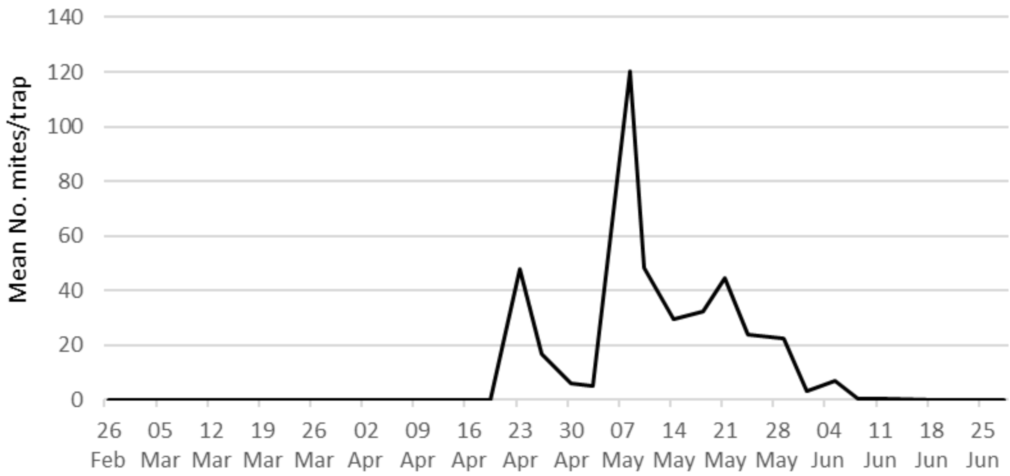


Figure 1. Mean number of gall mites per trap on cv Ben Tirran at NIAB EMR

The first mite was caught at Harpers Farm on 19 April 2018 (Figure 2) and the final mite was caught on 17 May.

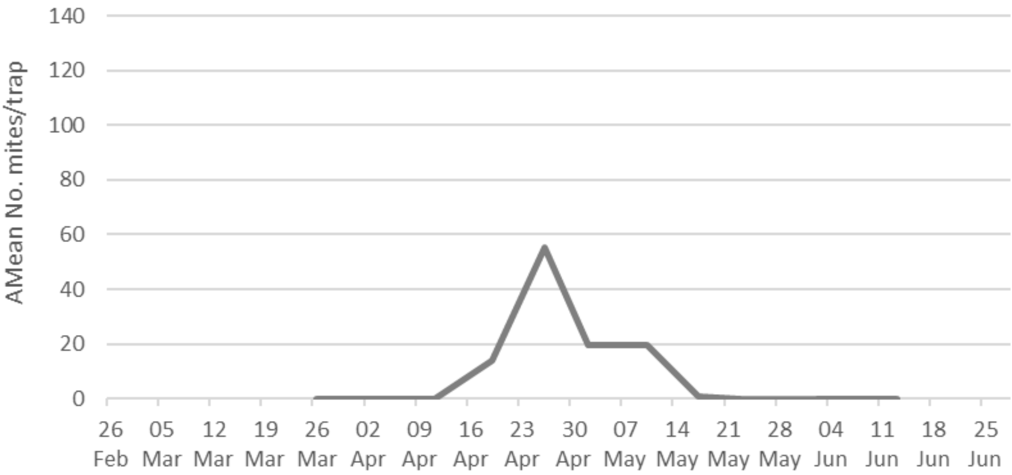


Figure 2. Mean number of gall mites per trap on cv Ben Vane at Harpers Farm

The mean number of mites per trap were much higher at NIAB EMR on cv Ben Tirran (Figure 3) than on cv Ben Vane at Harpers Farm (Figure 4). The migration at Harpers Farm had finished by 17 May 2018.

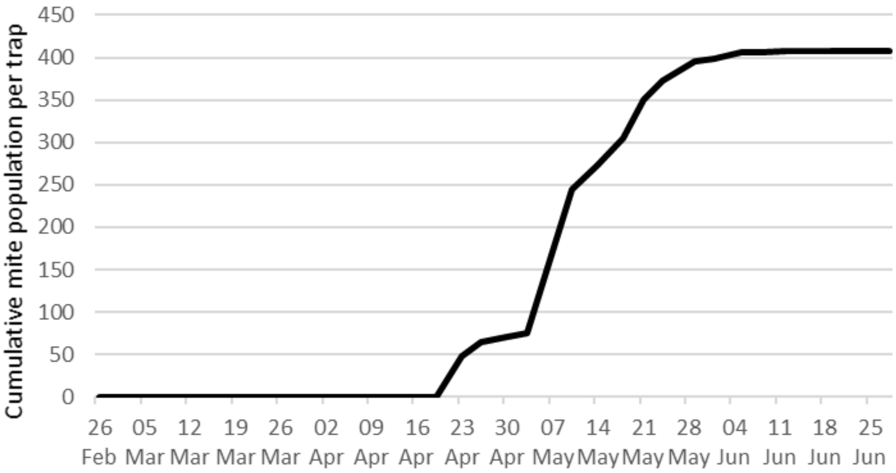


Figure 3. Mean cumulative number of gall mites per trap on cv Ben Tirran (at NIAB EMR).

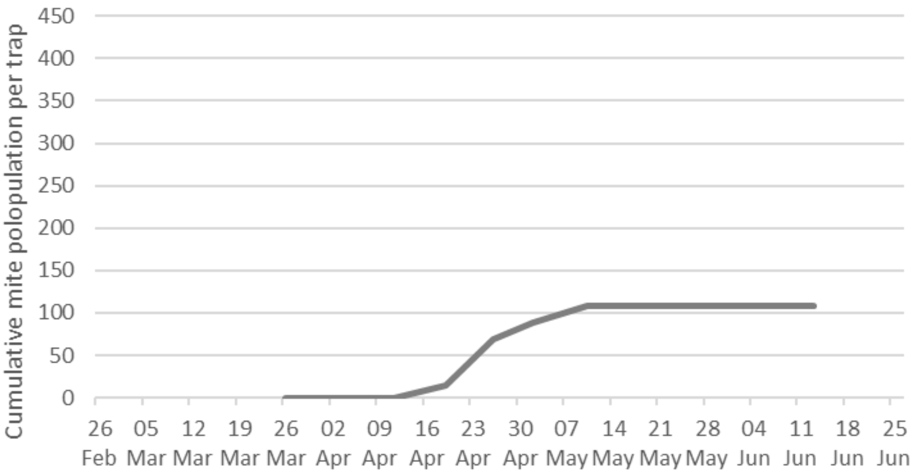


Figure 4. Mean cumulative number of gall mites per trap on cv Ben Vane (at Harpers Farm).

Phytotoxicity

No symptoms of phytotoxicity were evident 7 days after any of the applications.

Spray Trial Efficacy

No mites were caught on cv Ben Vane after 17 May, therefore the experimental treatments were inadvertently sprayed after the end of the mite migration.

The number of galls per bush were recorded pre–bud break and post-Leaf drop for the middle three bushes of the five bush plots. The rate of population increase was calculated by dividing the number of galls post-leaf drop by the number of galls pre–bud break. The data were Poisson-distributed so required square root transformation before analysis, using the number of galls pre-bud break as a co–variate for Analysis of Variance. Of the 14 treatments, only Treatment 3, the industry standard treatment of two early Sulphur applications, had any significant effect in reducing the number of galls by the end of the growing season (Table 1 and Figure 5).

Table 1. Analysis of the numbers of galls pre-bud break and post-leaf drop. The data were Poisson-distributed and therefore required square root transformation before Analysis of Variance using the numbers of galls pre-bud burst as a covariate. The same lower case letter denotes that treatments were not significantly different from each other.

Treatment	Treatment applications					Assessments		Number of galls Post-leaf drop Pre-bud burst	√ Covariate
	05 Apr A 5% Migration	18 Apr B 50% Migration	17 May C Post Flower	23 May D C + 10	02 Jun E D + 10	13 Mar Pre -bud break	30 Oct Post -leaf drop		
1 Untreated						8.61	18.78	2.18	3.31 a
2 Water only			●	●	●	2.83	19.33	6.82	3.64 a
3 Headland Sulphur	●	●				3.17	3.61	1.14	1.46 b
4 Kumulus DF			●	●	●	4.56	14.61	3.21	3.12 a
5 Masai			●			8.00	17.00	2.13	3.29 a
6 Kumulus DF			●			10.06	17.17	1.71	3.17 a
7 AHDB9945			●	●	●	7.61	9.06	1.19	2.40 a
8 Envidor			●			7.56	37.44	4.96	4.93 a
9 AHDB 9989			●	●		12.67	14.11	1.11	2.35 a
10 AHDB 9931			●	●	●	7.39	19.00	2.57	3.39 a
11 AHDB 9944			●			2.94	6.89	2.34	2.19 a
12 AHDB 9970			●	●	●	12.00	17.50	1.46	2.74 a
13 AHDB 9951			●			9.78	23.50	2.40	3.58 a
14 AHDB 9929			●	●	●	3.11	13.72	4.41	3.05 a
								F. prob (d.f. = 167)	0.089
								SED	0.90
								LSD	1.79

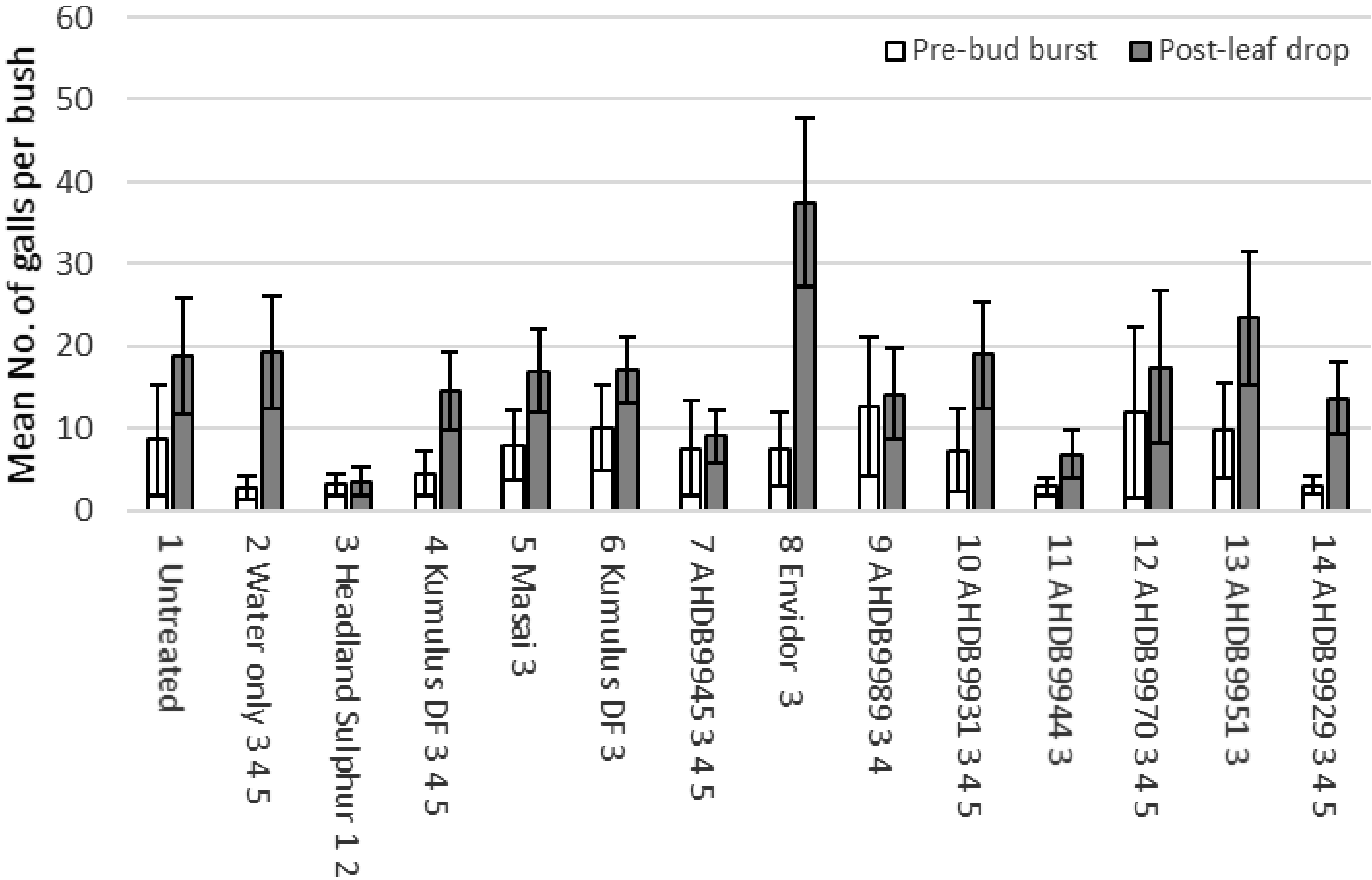


Figure 5. Pre-bud burst and post-leaf drop numbers of galls per bush per plot with standard error bars

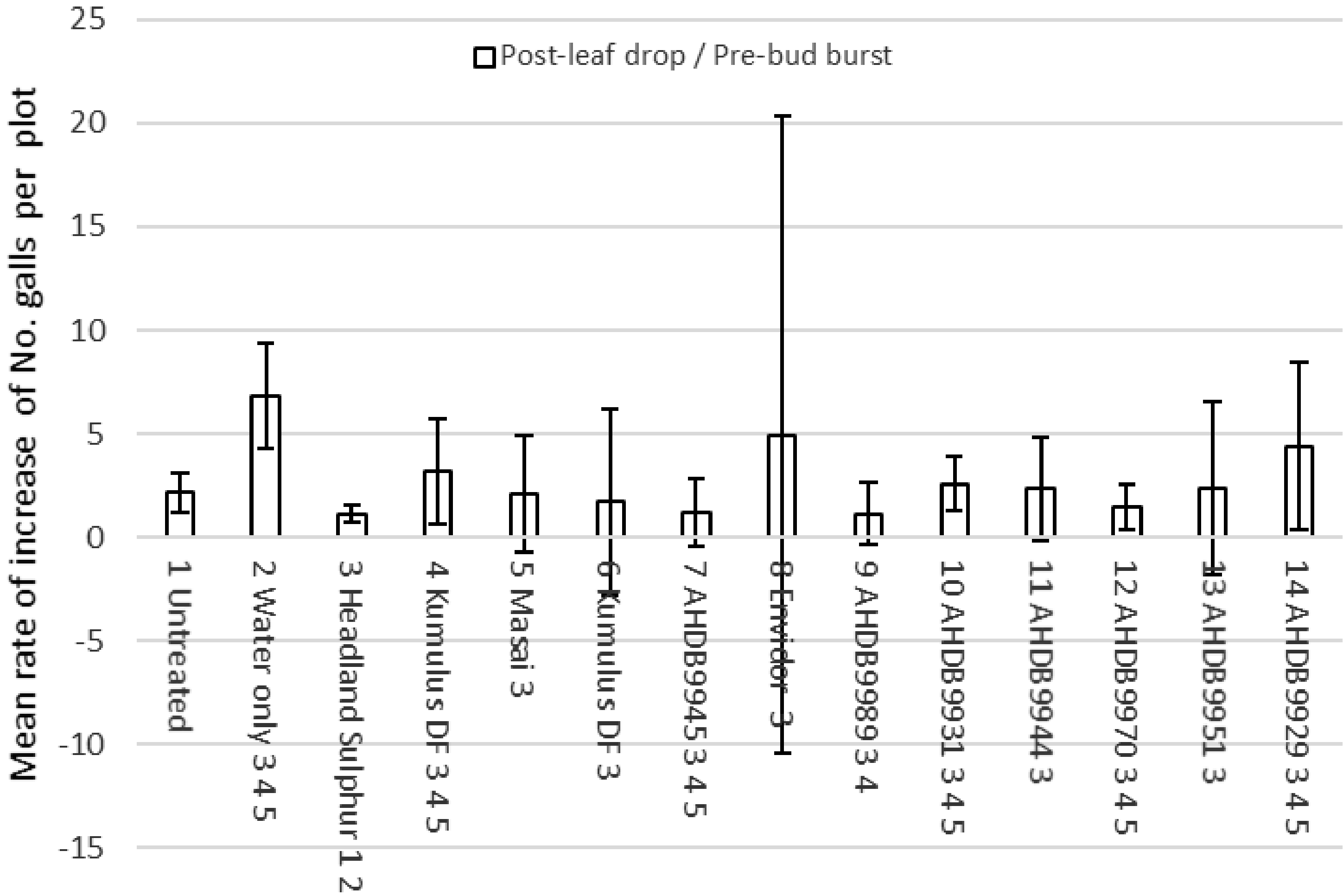


Figure 6. Rate of population increase (numbers of galls post-leaf drop divided by numbers of galls pre-bud burst) with standard error bars

Discussion

Unfortunately the beginning of the gall mite migration at both sites (NIAB EMR and Harpers Farm) was missed, but was predicted to occur simultaneously at both sites in week 7 (12-18 February 2018) by the LR Suntory blackcurrant gall mite emergence model run by the AHBD in conjunction with FAST. However, the migration in cv Ben Vane at Harpers Farm where the trial was done occurred mainly before and during flowering, no mites were caught after 17 May, therefore the experimental treatments were inadvertently sprayed after the end of the mite migration. Thus, the treatments only caught the end of the migration and not the main part, which is the likely reason that they were not efficacious.

Application of sprays during flowering of blackcurrant is normally avoided because insecticides used in the past (endosulfan, fenpropathrin) were harmful to bees and because of the desire to avoid spraying during flowering because of possible adverse effects on fruit set. But the route to improved gall mite control may be through applying bee- and flower-safe sprays at the peak of migration, which usually occurs during flowering (except on late-flowering varieties like Ben Tirran). Several of the materials tested may not pose a risk to bees and may be efficacious if used during flowering.

Sulphur sprays have been restricted to very early growth stages because of the risks of phytotoxicity when applied after the first ‘grape visible’ growth stage (Cross and Harris, 2005). In this trial, sprays of sulphur SC at 10 kg a.i. per ha were applied at ‘first grape visible’ and/or just post-blossom to replicated plots of Baldwin, Ben Lomond, Ben Gairn, Ben Hope and Ben Tirran. Sprays applied post-blossom (in warm conditions) were phytotoxic to Ben Gairn and Baldwin, causing leaf scorch and yield reductions, but had little or no significant effect on the other varieties. Further work is needed to test newer varieties for their susceptibility to sulphur, this would allow continued use of sulphur for the control of gall mite. It may be that sulphur sprays could be applied later (e.g. during flowering) on some varieties.

The migration at NIAB EMR on cv Ben Tirran continued for 30 days longer than on cv Ben Vane at Harpers Farm. Gall mite control is likely to be more difficult if the migration is of longer duration, depending on when shoot extension growth ceases, as gall mites can only enter buds when they are at the earliest stage of formation.

Further work is needed to monitor the migration of gall mites on different blackcurrant cultivars, preferably at the same geographic location to remove any effect of local climate on the migration data. The spray trial should be repeated, applying the treatments at the 5% and 50% points in the migration to give the active ingredients the optimum chance to have an effect on gall mites and including sulphur sprays at full and reduced doses. Products with known harmful effects on bees should probably be excluded. Further work is also needed on the phytotoxic effects of sulphur applied at different doses and growth stages to the full range of commercially-grown blackcurrant varieties.

Take home messages

- The duration of gall mite migration may vary depending on plantation and cultivar
- Two early sprays of sulphur provide good control of gall mite on cv Ben Vane
- Further work is needed to evaluate the products plus full and reduced doses of sulphur at the start and peak of migration, which may occur during flowering,

and to evaluate the phytotoxic effects of sulphur on the full range of commercially-grown blackcurrant varieties at later growth stages.

Acknowledgements

We would like to thank AHDB for funding and supporting this project and for the financial and in kind contributions from the crop protection manufactures and distributors involved with the SCEPTREplus programme as listed below:
Agrii, Alpha Biocontrol Ltd, Andermatt, Arysta Lifescience, BASF, Bayer, Belchim, Bionema Limited, Certis Europe, Dow, DuPont, Eden Research, Fargro Limited, FMC, Gowan, Interfarm, Lallemand Plant Care, Novozymes, Oro Agri, Russell IPM, Sumitomo Chemicals, Syngenta, UPL.

We would also like to thank Stephen Wickham at Harpers Farm for hosting the trial and LR Suntory for advice and support.

References

Cross, J. V. & Harris, A. L. 2005f. Tests of the phytotoxicity of sulphur to blackcurrants 2005. Confidential report to GlaxoSmithKline/HDC growers fund issued 28 Nov 2005, 13 pp.

Appendix

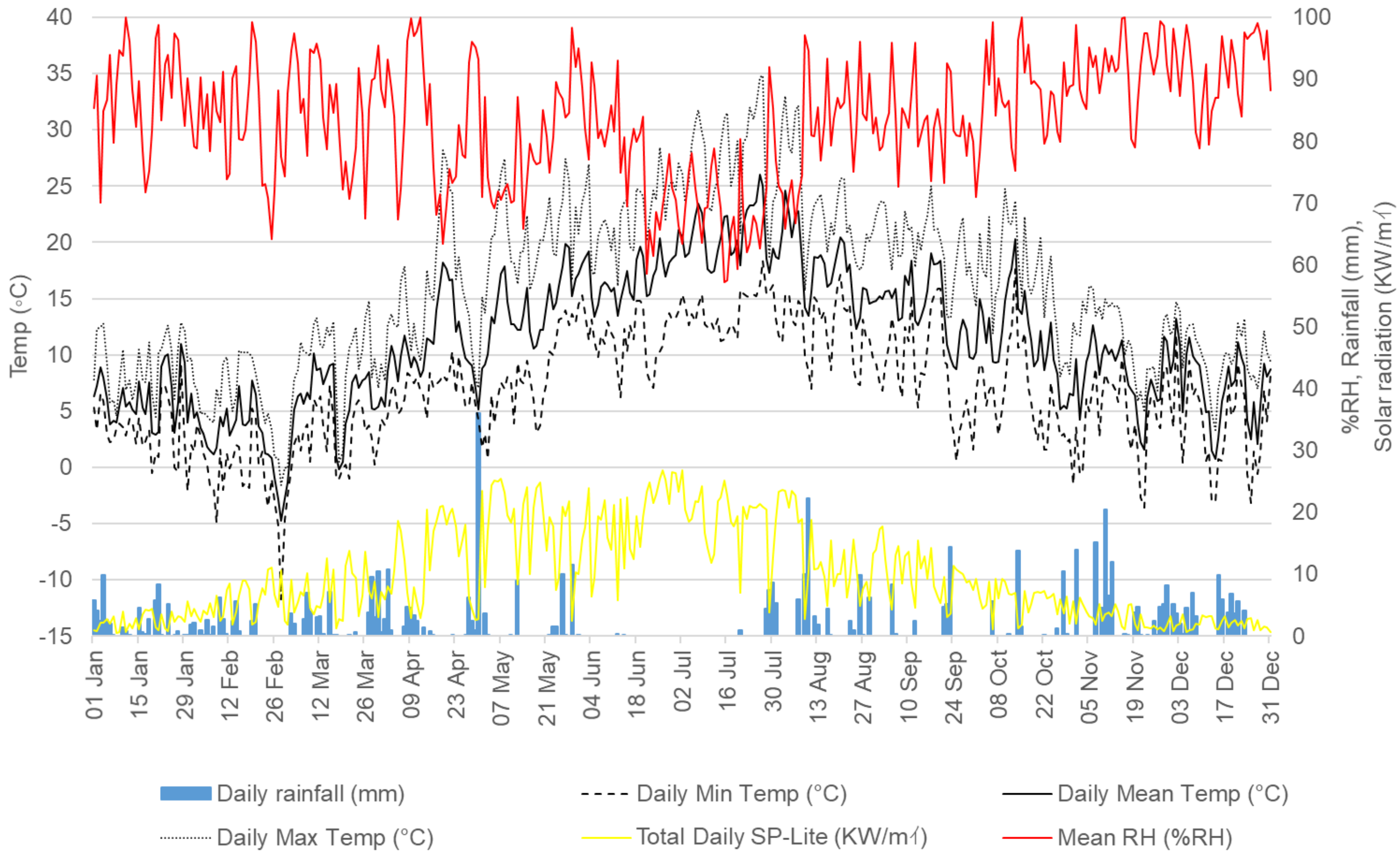
a. Crop diary – events related to growing crop are not applicable.

b. Trial diary

Date and name		Record of work done, observations made or reference to lab or field book entry (give book and page numbers – not applicable)
21/02/2018	MP	Preparing sticky traps
22/02/2018	MP	Putting out sticky traps at NIAB EMR
26/02/2018	MP	1st mite trap assessment at NIAB EMR
27/02/2018	ALH	Assessments stopped due to snowy weather
05/03/2018	MP	Monitoring restarted, 2nd mite trap assessment at NIAB EMR
08/03/2018	MP ALH	Traps changed at NIAB EMR
09/03/2018	MP	3rd mite trap assessment finished(the double sided sticky tape currently being used in the sticky is reacting to the high humidity in the air and turning white in the field it's impossible to make counts of mites try a different type of tape.)
12/03/2018	MP	Traps changed, 4th mite trap assessment
13/03/2018	MP ALH	Numbers of galls per bush recorded and plots marked out at Harpers Farm.
15/03/2018	MP ALH	Traps changed, 5th mite trap assessment. New tape sourced
19/03/2018	MP	Traps changed, 6th mite trap assessment, snow hits the site again
22/03/2018	MP	Traps changed, 7th mite trap assessment
26/03/2018	MP	Traps changed both at EMR and Harpers farm.
27/03/2018	MP	8th mite trap assessment, 1st mite trap assessment of Harper`s farm samples
29/03/2018	MP ALH	Traps changed at EMR (the new tape being used is drying out in the field and losing its stickiness, so it is not capturing mites, source an alternative double-sided tape).
03/04/2018	MP	Mite trap assessment
05/04/2018	MP LB	Traps changed at both sites, first spray of sulphur (Kumulus) applied at Harpers farm Treatment A
06/04/2018	MP	Mite trap assessment of EMR traps, Mite trap assessment of Harpers farm traps
09/04/2018	MP	Mite trap assessments of EMR traps, New tape arrived and will be used from now on
11/04/2018	MP	Traps changed at Harpers farm
12/04/2018	MP	Traps changed at EMR, first use of 3M tape collection using new tape, mites are present
16/04/2018	MP	Traps changed at EMR

18/04/2018	MP LB	Traps changed at Harpers farm, second application of sulphur Treatment B
19/04/2018	MP	Traps changed at EMR
23/04/2018	MP	Traps changed at EMR
26/04/2018	MP	Traps changed at EMR and Harpers farm
30/04/2018	MP	Traps changed at EMR
02/05/2018	MP	Traps changed at Harpers farm
03/05/2018	MP	Traps changed at EMR
08/05/2018	MP	Traps changed at EMR
10/05/2018	MP	Traps changed at EMR and Harpers farm
14/05/2018	MP	Traps changed at EMR
17/05/2018	MP LB	Treatment C applied, traps changed at Harpers
18/05/2018	MP	Traps changed at EMR
21/05/2018	MP	Traps changed at EMR
23/05/2018	MP LB	Treatment D applied, traps changed at Harpers
24/05/2018	MP	Traps changed at EMR
29/05/2018	MP	Traps changed at EMR
01/06/2018	MP	Traps changed at EMR
02/06/2018	MP LB	Treatment E applied, traps changed at Harpers
05/06/2018	MP	Traps changed at EMR and Harpers farm
08/06/2018	MP	Traps changed at EMR
12/06/2018	MP	Traps changed at EMR
13/06/2018	MP	Monitoring stopped at Harpers farm, last mite trap assessment
30/10/2018	MP	Final gall mite assessment at Harpers farm (counts of galls per plot), bringing back flags and data loggers

c. Climatological data from the NIAB EMR weather station.



d. Raw data from assessments

Block	Plot	Treatment	Mean Pre-bud break gall No:/ bush/plot	Mean Post-leaf drop gall No:/ bush/ plot	Post/Pre
2	4	1	4.67	20.33	4.36
6	3	1	0.33	1.33	4.00
1	5	1	42.00	59.33	1.41
3	8	1	2.33	14.33	6.14
4	2	1	1.67	12.33	7.40
5	7	1	0.67	5.00	7.50
1	12	2	10.00	29.67	2.97
2	12	2	3.00	60.33	20.11
3	13	2	1.67	11.67	7.00
6	6	2	0.33	1.33	4.00
5	8	2	0.67	3.33	5.00
4	9	2	1.33	9.67	7.25
1	14	3	7.67	4.00	0.52
2	2	3	6.67	15.67	2.35
4	4	3	1.33	1.67	1.25
3	6	3	2.33	0.33	0.14
6	5	3	0.33	0.00	0.00
5	13	3	0.67	0.00	0.00
6	2	4	0.33	0.33	1.00
2	14	4	3.00	20.33	6.78
5	5	4	0.67	12.00	18.00
1	10	4	19.67	32.33	1.64
4	1	4	1.67	6.67	4.00
3	12	4	2.00	16.00	8.00
1	6	5	38.33	37.67	0.98
6	1	5	0.33	6.00	18.00
2	5	5	4.67	11.67	2.50
4	6	5	1.33	14.00	10.50
3	5	5	2.67	31.33	11.75
5	14	5	0.67	1.33	2.00
1	4	6	48.00	23.33	0.49
4	13	6	1.00	19.33	19.33
5	11	6	0.67	9.33	14.00
6	11	6	0.33	9.33	28.00
2	1	6	7.33	37.67	5.14
3	1	6	3.00	4.00	1.33
1	7	7	37.67	25.33	0.67
2	10	7	3.33	4.67	1.40
4	5	7	1.33	1.33	1.00
3	7	7	2.33	18.00	7.71
5	10	7	0.67	1.67	2.50

6	9	7	0.33	3.33	10.00
1	9	8	34.33	34.67	1.01
4	11	8	1.00	12.00	12.00
5	2	8	0.67	66.67	100.00
2	3	8	6.33	17.00	2.68
3	4	8	2.67	90.33	33.88
6	8	8	0.33	4.00	12.00
5	1	9	0.67	1.33	2.00
1	1	9	67.00	51.33	0.77
3	9	9	2.33	23.33	10.00
4	3	9	1.67	0.67	0.40
2	9	9	4.00	6.33	1.58
6	13	9	0.33	1.67	5.00
2	13	10	3.00	13.33	4.44
3	3	10	2.67	25.33	9.50
5	4	10	0.67	2.67	4.00
1	8	10	36.33	62.67	1.72
4	8	10	1.33	9.67	7.25
6	14	10	0.33	0.33	1.00
1	13	11	8.33	3.00	0.36
6	4	11	0.33	0.33	1.00
3	2	11	2.67	3.00	1.13
2	6	11	4.33	8.67	2.00
4	7	11	1.33	21.00	15.75
5	12	11	0.67	5.33	8.00
2	11	12	3.00	13.00	4.33
1	2	12	65.33	71.33	1.09
3	14	12	1.67	13.67	8.20
6	7	12	0.33	0.33	1.00
5	9	12	0.67	2.00	3.00
4	14	12	1.00	4.67	4.67
2	8	13	4.00	14.33	3.58
4	10	13	1.00	8.33	8.33
1	3	13	50.67	83.00	1.64
5	6	13	0.67	2.00	3.00
3	11	13	2.00	23.67	11.83
6	10	13	0.33	9.67	29.00
1	11	14	10.33	44.33	4.29
4	12	14	1.00	1.33	1.33
3	10	14	2.00	17.67	8.83
2	7	14	4.33	2.33	0.54
5	3	14	0.67	7.67	11.50
6	12	14	0.33	9.00	27.00

e. Trial design

Plot plan showing location and treatment applied to each plot

Treatm	Block	Colour Code	Treatm	Block	Colour Code	Treatm	Block	Colour Code	Treatm	Block	Colour Code	Treatm	Block	Colour
						3	35	Y Y	2	61	B	6	84	Y
						3	34	Y Y	1	60	G	10	83	R Blk
						7	33	R R	1	59	G	12	82	B Y
						3	32	Y Y	1	58	G	5	81	R
						10	31	R Blk	5	57	R	9	80	R B
						5	30	R	8	56	R Y	14	79	Blk Blk
			11	17	B B	3	29	Y Y	10	55	R Blk	4	78	Blk Y
			1	16	G	4	28	Blk Y	9	54	R B	3	77	Y Y
			4	15	Blk Y	13	27	B Blk	8	53	R Y	11	76	B B
			8	14	R Y	3	26	Y Y	13	52	B Blk	6	75	Y
			13	13	B Blk	14	25	Blk Blk	4	51	Blk Y	9	74	R B
			6	12	Y	11	24	B B	7	50	R R	6	73	Y
			1	11	G	10	23	R Blk	13	49	B Blk	13	72	B Blk
14	5	Blk Blk	5	10	R	11	22	B B	11	48	B B	7	71	R R
2	4	B	7	9	R R	7	21	R R	4	47	Blk Y	2	70	B
5	3	R	8	8	R Y	14	20	Blk Blk	4	46	Blk Y	6	69	Y
2	2	B	11	7	B B	2	19	B	10	45	R Blk	9	68	R B
12	1	B Y	13	6	B Blk	14	18	Blk Blk	14	44	Blk Blk	8	67	R Y
									12	43	B Y	7	66	R R
									8	42	R Y	10	65	R Blk
									1	41	G	9	64	R B
									2	40	B	6	63	Y
									12	39	B Y	12	62	B Y
									5	38	R			
									12	37	B Y			
									9	36	R B			

f ORETO certificate should be pasted in at end.

Certificate of

Official Recognition of Efficacy Testing Facilities or Organisations in the United Kingdom

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This certifies that

NIAB EMR

complies with the minimum standards laid down in Regulation (EC) 1107/2009 for efficacy testing.

The above Facility/Organisation has been officially recognised as being competent to carry out efficacy trials/tests in the United Kingdom in the following categories:

Agriculture/Horticulture
Biological and Semiochemicals
Stored Crops

Date of issue: 12 July 2018
Effective date: 1 January 2018
Expiry date: 31 December 2022

Signature W. Mellor
Authorised signatory

Certification Number
ORETO 411

HSE
Chemicals Regulation Division

Department of
Agriculture and
Rural Development