Final Trial Report

Trial code:	SP 20
Title:	Initial screening of the 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 2021 to March 2021
Report date:	20 May 2020
Report author:	Adrian Harris
ORETO Number: (certificate should be attached)	20/002 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 2021

Date

Authors signature

Introduction

The aim of this 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 of blackcurrant 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 blackcurrant. Therefore, a trial was undertaken to evaluate novel acaricides for control of gall mite.

Methods

A replicated small plot trial was undertaken at NIAB EMR in an experimental plantation of cv. Ben Tirran to evaluate the efficacy of spray programmes containing three test products compared to an untreated control (and a water only control). The spray applications were timed to mimic industry standard practice. The sprays were applied on 07 April (aimed for the start of the mite migration), 01 May (timed to have maximum impact on mite populations by aiming to coincide with 50% mite emergence) and 20 May 2020 (applied during flowering, to investigate the possibility of the use of products during this sensitive and vulnerable growth stage, where currently no products are approved).

To assess the efficacy of the treatments, the number of galls per shoot compared to the total number of buds per shoot was assessed. The seasonal migration of the gall mites from galls was monitored twice weekly over two years (2019, 2020) using miniature sticky traps in the experimental planting (cv. Ben Tirran). Additional monitoring was performed for comparison in an infested experimental planting of blackcurrant of cvs. Baldwin, Ben Gairn, Ben Hope and Ben Lomond at NIAB EMR.

Results

Gall mite monitoring

The emergence and subsequent migration of gall mite for the five varieties studied at NIAB EMR (Baldwin, Ben Gairn, Ben Hope, Ben Lomond and Ben Tirran) was highly different between the 2 years studied. In the previous study in 2019 the dates of gall mite emergence and migration were variable between the 5 varieties, with only the 1st emergence and 5% emergence dates being accurately predicted by the emergence model for the early variety Ben Gairn. However, in 2020 emergence and migration were synchronised between all 5 varieties, and showed good corroboration with the prediction model with the dates of 1st and 5% gall mite emergence being within 8 days of that predicted by the model (Table 1). The accuracy of the prediction of 50% emergence was highly variable between varieties, with 50% emergence being predicted accurately only for the early variety Ben Gairn.

Table 1. Predicted and actual gall mite emergence dates for all 5 NIAB EMR varieties in 2020.

Variety	1st Emergence	5% Emergence	50% Emergence
Predicted NIAB EMR	**15 March**	**04 April**	**14 April**
Observed			
Ben Gairn	23 March	12 April	23 April
Baldwin	23 March	12 April	01 May
Ben Lomond	23 March	12 April	06 May
Ben Hope	23 March	12 April	06 May
Ben Tirran	23 March	12 April	16 May

Spray Trial Efficacy

Of the twelve treatment programmes applied, five significantly reduced the percentage infestation of buds by gall mite compared to the untreated control (Table 2):

- Treatment 4, 3 sprays of Thiopron.
- Treatment 6, 2 applications of AHDB 9989 (01 May and 20 May).
- Treatment 7, 1 application of AHDB 9786 (07 April) + 2 x AHDB 9989 (01 May and 20 May).
- Treatment 8, 2 applications of AHDB 9786 (07 April and 01 May) and AHDB 9989 (20 May).
- Treatment 10, 2 applications of Thiopron (07 April and 01 May) and AHDB 9989 late (20 May).

Due to the age of the plot and the stress of the warm wet winter of 2019-20, the plot suffered extensive die back. As a result of this Treatments 3, 5 and 9 did not have enough replicated data, therefore the data sets from these treatments could not be analysed.

Table 2. Mixed model binomial regression of the numbers of infested and uninfested buds post-leaf drop. The Dunnett test for significant difference was used to investigate the probability that buds on treated plots had a lower level of infestation than the untreated control. * Denotes plots that were statistically significantly different from the untreated control.

Treatment		Treatment applications			Assessments				F. Prob
		07 Apr A BBCH 0	01 May B BBCH 65	20 May C BBCH 71	Sampled shoots	Galled buds	Total buds	Mean % infested buds	
1	Untreated				13	119	237	50.98	
2	Water	●	●	●	4	43	127	30.63	0.3590
3	AHDB 9786	●	●		1	0	7	NA	NA
4	Thiopron Full	●	●	●	17	59	401	12.28	<0.001*
5	2 x AHDB 9989	●	●		1	0	5	NA	NA
6	2 x AHDB 9989		●	●	2	1	26	4.55	0.0320*
7	AHDB 9786 + 2 x AHDB 9989	●	●	●	9	22	230	4.58	<0.001*
8	2 x AHDB 9786 + AHDB 9989	●	●	●	10	7	240	3.13	<0.001*
9	Thiopron + AHDB 9989	●	●	●	2	0	10	NA	NA
10	2 x Thiopron + AHDB 9989	●	●	●	5	3	101	2.01	<0.001*
11	Thiopron			●	4	29	51	50.87	0.9509
12	2 x Thiopron	●	●		5	16	76	18.89	0.1998

N.B. Due to the age of the plot and the stress of the warm wet winter of 2019-20, the plot suffered extensive die back. As a result of this treatments 3, 5 and 9 did not have enough replicated data, therefore the data sets from these plots could not be analysed (NA).

Conclusions

- Based on the findings from 2019 and 2020, the timing of specific key points in the emergence of gall mite and its subsequent migration may vary depending on location, cultivar, and year.
- Further work to monitor gall mite activity and varietal differences is needed to re-evaluate the gall mite emergence model in a changing climate.
- AHDB 9989 has potential to control gall mite.
- AHDB 9989 integrates well with AHDB 9786 or Thiopron to give good gall mite control.
- Thiopron is a useful late season spray for gall mite control (further testing is required to ensure its crop safety on all commercial blackcurrant varieties).

Take home message

More data is required to fully understand the inconsistencies in the prediction model for gall mite emergence, and how this relates to yearly variation in climate and variety. AHDB 9989 can be a useful gall mite control product, when used either in conjunction with the current industry standard or with Thiopron.

Science Section

Objectives

The overall objective was to evaluate the efficacy of programmes of foliar sprays of test products applied 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	NIAB EMR, New Road, East Malling, Kent, ME19 6BJ
Crop	Blackcurrant
Cultivar	Ben Tirran
Soil or substrate type	Soilscape 7 Freely draining slightly acid but base rich soils
Agronomic practice	LR Suntory advised
Prior history of site	Cereals

Trial design

Item	Details
Trial design:	Randomised complete block design
Number of replicates:	5
Row spacing:	3m
Plot size: (w x l)	1.5m x 3m
Plot size: (m^2)	4.5m^2
Number of plants per plot:	3
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	AHDB 9786	N/D	N/D	N/D	N/D	N/D	None
04	Authorised	Sulphur	Thiopron	0119257202	825g/l	SC	None
05	AHDB 9989	N/D	N/D	N/D	N/D	N/D	None
06	AHDB 9989	N/D	N/D	N/D	N/D	N/D	None
07	AHDB 9786 AHDB 9989	N/D	N/D	N/D	N/D	N/D	None
08	AHDB 9786 AHDB 9989	N/D	N/D	N/D	N/D	N/D	None
09	AHDB 9989	N/D	N/D	N/D	N/D	N/D	None
10	AHDB 9989	N/D	N/D	N/D	N/D	N/D	None
11	Authorised	Sulphur	Thiopron	0119257202	825g/l	SC	None
12	Authorised	Sulphur	Thiopron	0119257202	825g/l	SC	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	NA			/ / /
02	NA			A B C
03	N/D	N/D	10kg	A B C
04	Thiopron	825g/l	5l	A B C
05	N/D	N/D	0.5l	A B
06	N/D	N/D	0.5l	B C
07	N/D	N/D	10kg 0.5l	A B C
08	N/D	N/D	10kg 0.5l	A B C
09	N/D	N/D	5l 0.5	A B C
10	N/D	N/D	5l 0.5	A B C
11	Thiopron	825g/l	5l	C
12	Thiopron	825g/l	5l	A B

A = 07 April 2020
B = 01 May 2020
C = 20 May 2020

Application details

	Application A	Application B	Application C
Application date	07/04/20	01/05/20	20/05/20
Time of day	08:15	09:30	08:00
Crop growth stage (Max, min average BBCH)	A-B1	F2	F3/I1
Crop height (cm)	90	100	100
Crop coverage (%)	N/A	N/A	N/A
Application method	Mist Blower	Mist Blower	Mist Blower
Application placement	Crop	Crop	Crop
Application equipment	EURO-PULVE + Electric Blower Birchmeier	EURO-PULVE + Electric Blower Birchmeier	EURO-PULVE + Electric Blower Birchmeier
Nozzle pressure	3 Bar	3 Bar	3 Bar
Nozzle type	Brown Albuz	Brown Albuz	Brown Albuz
Nozzle size	atr 80	atr 80	atr 80
Application water volume l/ha	500	500	500
Temperature of air-shade (°C)	8.5	11	17
Relative humidity (%)	70	90	87.5
Wind speed range (m/s)	0.7	3.6	2
Dew presence (Y/N)	N/A	N/A	N/A
Temperature of soil-2-5 cm (°C)	N/A	N/A	N/A
Wetness of soil-2-5 cm	N/A	N/A	N/A
Cloud cover (%)	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	66.7	66.7	

Methods and Assessment details

Due to COVID-19 limiting our ability to travel to growers' sites and to conduct the experiments off site, it was decided to host the trial in an old blackcurrant planting of the highly gall mite susceptible cultivar Ben Tirran at NIAB EMR.

Initially this work was a single trial investigating the spray efficacy of different programmes of acaricides for the control of blackcurrant gall mite. However, the AHDB requested we also investigate how gall mite emergence/migration varies across cultivars and whether artificial manipulation of growth stages of blackcurrants by the application of dormancy breaking products can also affect gall mite emergence/migration.

Common Set-up Across all Trials

Across all experiments, mite monitoring was conducted using miniature sticky cap traps. In each experiment fifteen traps per treatment were set 5cm above galls on each target cultivar to monitor mite migration.

Ben Tirran was used in all experiments (cultivar, growth stage and acaricide efficacy trial) as a reference cultivar to link all aspects of this work. Two adjacent blackcurrant plantings at NIAB EMR were used. One planting was alternating blocks of the cultivars Ben Hope and Ben Tirran, where the Ben Tirran was used for the acaricide efficacy trial. The second planting consisted of alternating blocks of five cultivars: Ben Tirran, Ben Lomond, Ben Hope, Ben Gairn and Baldwin, where all five cultivars were used for the monitoring of gall mite emergence across different cultivars, and the Ben Tirran alone was used for the dormancy breaking experiment.

The traps deployed in the cultivar Ben Tirran were monitored every 3 days to allow us to target spray applications to the key points in the gall mite migration. The temperature and humidity of the trial sites was monitored hourly using 2 Lascar EL-USB 2 temperature and humidity loggers (Appendix C) for the duration of all three trials. Crop development was recorded throughout the trials whenever mite traps were checked.

Varietal Variation in Gall Mite Migration 2019 and 2020

To investigate the varietal variation in gall mite migration, several cultivars were monitored at NIAB EMR, these were: Ben Lomond, Ben Hope, Ben Gairn and Baldwin. Each cultivar had 15 miniature sticky cap traps, which were checked weekly. This was repeated in both 2019 and 2020.

Effects of Dormancy Breaking Products on Gall Mite Emergence 2020

In consultation with the AHDB (Rachel McGauley) it was decided to add assessments of gall mite migration to an existing trial investigating the effects of dormancy breaking products on Blackcurrant. This allowed us to investigate potential links between the growth stage of the host blackcurrant bush and gall mite emergence. Four dormancy breaking product treatments were monitored weekly for gall mite emergence using miniature sticky traps.

Acaricide Spray Efficacy Trial 2020

The initial plan in the spray efficacy trial was to record the numbers of galls per bush pre-spray, then record the numbers of galls per bush in the autumn post leaf drop. However, the highly gall mite susceptible cultivar Ben Tirran requires prolonged winter chilling where the temperatures are consistently below 7°C for 2328 hours. Unfortunately, the winters of 2018-19 and 2019-20 were warm and wet, increasing the stress on the bushes. Due to the age of the planting, and the repeated stress of consecutive warm wet winters, a high number of bushes died during the 2019-20 growing season. We therefore used an alternative method to obtain the maximum amount of data from the remaining bushes. Each growing shoot was assessed independently with the number of infested and un-infested buds per shoot being recorded.

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

	Evaluation Timing (DA)*		**Crop growth stage (BBCH)**	**Evaluation type (efficacy, phytotox)**	**Assessment**
Evaluation date	**After conventional insecticides**	**After Bio-insecticides**			
21/02/20	0 days	N/A	0	Efficacy	Gall counts
14/04/20	6 days	N/A	09	Phytotoxicity	Visual
06/05/20	7 days	N/A	61	Phytotoxicity	Visual
25/05/20	6 days	N/A	71	Phytotoxicity	Visual
19/03/21	N/A	N/A	0	Efficacy	Gall counts

* DA – days after application

N/A – not applicable

Statistical analysis

A mixed model binomial regression was used to investigate the ratio of infected to total buds. A Dunnett test for significant difference between treatments was used to investigate if there was a significant difference in the probability of buds being infested with mites between the treatments and the untreated control. Results were averaged over the levels of block.

Results

Gall mite monitoring

Cv. Ben Tirran 2020

Mites were monitored using 15 miniature sticky traps per variety at NIAB EMR. Monitoring started at NIAB EMR on 02 March 2020. The traps were checked twice weekly to ensure an accurate estimate of the start of the gall mite migration (Figure 1). The gall mite migration started on 23 March at NIAB EMR and the final mite was caught on 22 June. The gall mite emergence model run by the AHDB forecasted the start of the emergence (1st emergence) as 15 March, 5% emergence as 04 April and 50% emergence as 14 April. The model uses the data from a weather station located at NIAB EMR (Appendix b) next to the blackcurrant planting.

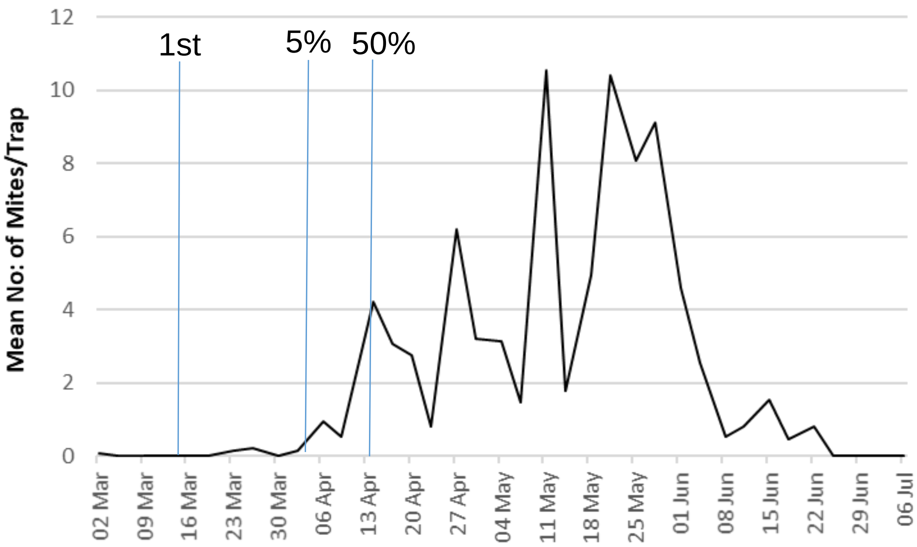

Figure 1. Mean number of gall mites per trap on cv. Ben Tirran at NIAB EMR in 2020 and predictions of 1st, 5% and 50% emergence form the gall mite emergence model as above.

Looking at the mite population as a percentage of its final total (Figure 2), shows very poor agreement between the model and the recorded mite emergence for NIAB EMR (Figure 3). The key timings for applications of control measures are 1st emergence, 5% emergence and 50% emergence. The emergence model predicted these dates as 15 March, 04 April and 14 April respectively, when in reality the first emergence occurred later, on 23 March, while the 5% and 50% points occurred much later than predicted, on 12 April and 16 May respectively. This means that any grower in this region would have had difficulty gaining control of gall mite on the variety Ben Tirran using this model and its predictions.

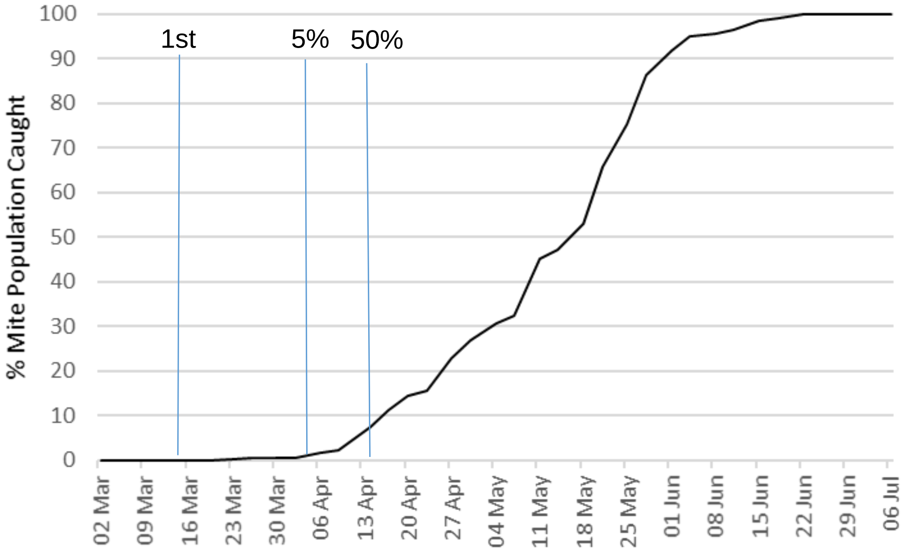

Figure 2. Cumulative percentage mites caught per week as a percentage of the final total catch on cv. Ben Tirran at NIAB EMR in 2020 and the predicted dates of 1st, 5% and 50% emergence.

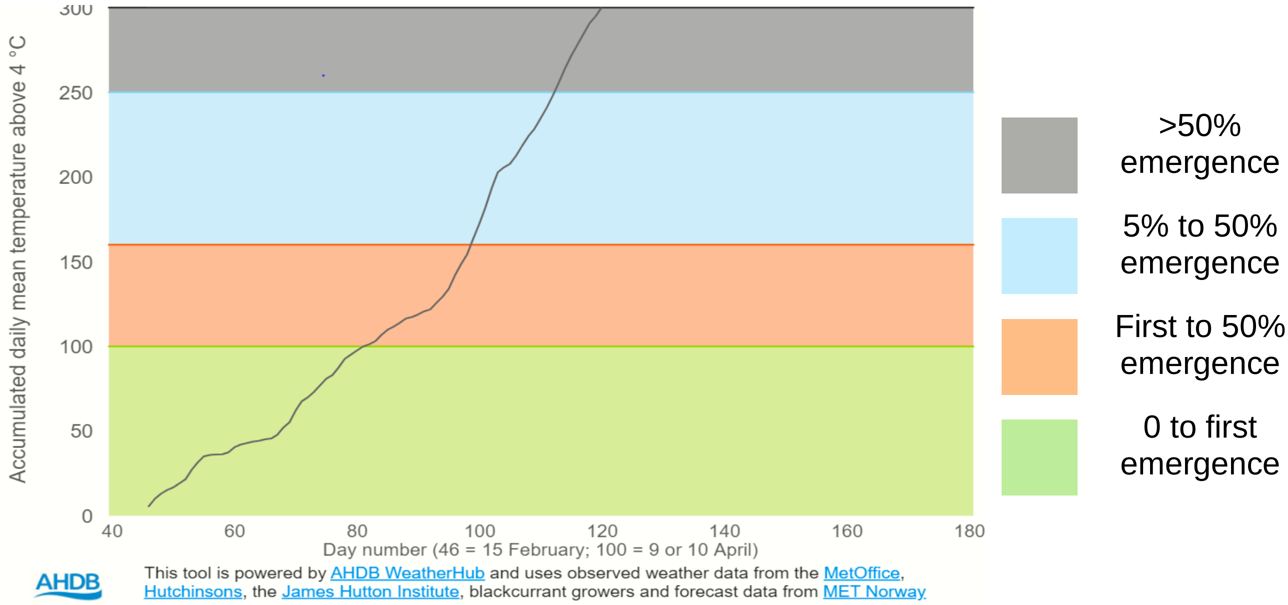

Figure 3. Gall mite emergence model output, predictions based on weather data from the NIAB EMR weather station.

Varietal Variation in Gall Mite Migration, 2019 and 2020

The migration of gall mite was recorded on a total of five varieties at NIAB EMR over the growing seasons of 2019 and 2020 (both years are reported here due to the highly different results between the two seasons), to provide preliminary results on any differences in the timing of gall mite migration between varieties. In the initial work of Cross and Ridout (2001) the timing of gall mite emergence and migration was found to be independent of variety.

At NIAB EMR in 2019 the gall mite migration was monitored in five varieties, these were: Ben Gairn, Baldwin, Ben Lomond and Ben Hope and Ben Tirran (Figure 4). The emergence model based on the weather data from the NIAB EMR weather station gave a good prediction of the real emergence on cv. Ben Gairn, the predicted 1st emergence was 10 days early, but the 5% and 50% emergence were within 2 days of the predicted dates (Table 1).

Table 1. Predicted and actual gall mite emergence dates for all five NIAB EMR varieties in 2019.

Variety	1st Emergence	5% Emergence	50% Emergence
Predicted NIAB EMR	**13 March**	**28 March**	**18 April**
Observed			
Ben Gairn	23 March	29 March	16 April
Baldwin	28 March	13 April	26 April
Ben Lomond	21 March	13 April	30 April
Ben Hope	28 March	13 April	07 May
Ben Tirran	04 March	18 April	09 May

The other four varieties were much later to reach the key growth stages than Ben Gairn. This suggests that ‘variety’ does play a part in the timing of the gall mite migration.

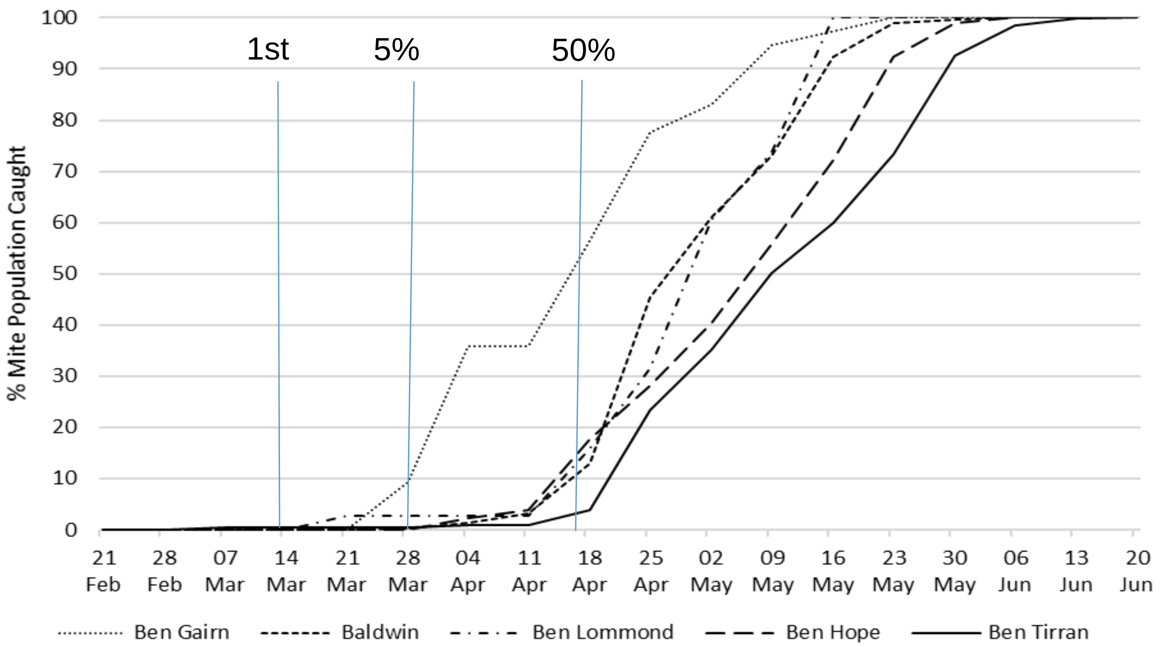

Figure 4. The percentage gall mite migration for each of the five varieties monitored at NIAB EMR in 2019, and the predicted dates of 1st, 5% and 50% emergence.

At NIAB EMR in 2020 we continued to monitor the gall mite emergence on the five varieties we monitored in 2019, these were: Ben Gairn, Baldwin, Ben Lomond and Ben Hope and Ben Tirran (Figure 5). The 1st and 5% gall mite emergence dates were synchronised for all five varieties with 1st emergence being recorded on 23 March and 5% emergence on 12 April, both of which were 8 days later than predicted by the model (but close enough to accurately time sulphur applications). The only difference between the varieties were the dates when they reached 50% emergence, ranging from the earliest on 23 April (Ben Gairn) to the latest on 16 May (Ben Tirran) (Table 2).

Table 2. Predicted and actual gall mite emergence dates for all 5 NIAB EMR varieties in 2020.

Variety	1st Emergence	5% Emergence	50% Emergence
Predicted NIAB EMR	**15 March**	**04 April**	**14 April**
Observed			
Ben Gairn	23 March	12 April	23 April
Baldwin	23 March	12 April	01 May
Ben Lomond	23 March	12 April	06 May
Ben Hope	23 March	12 April	06 May
Ben Tirran	23 March	12 April	16 May

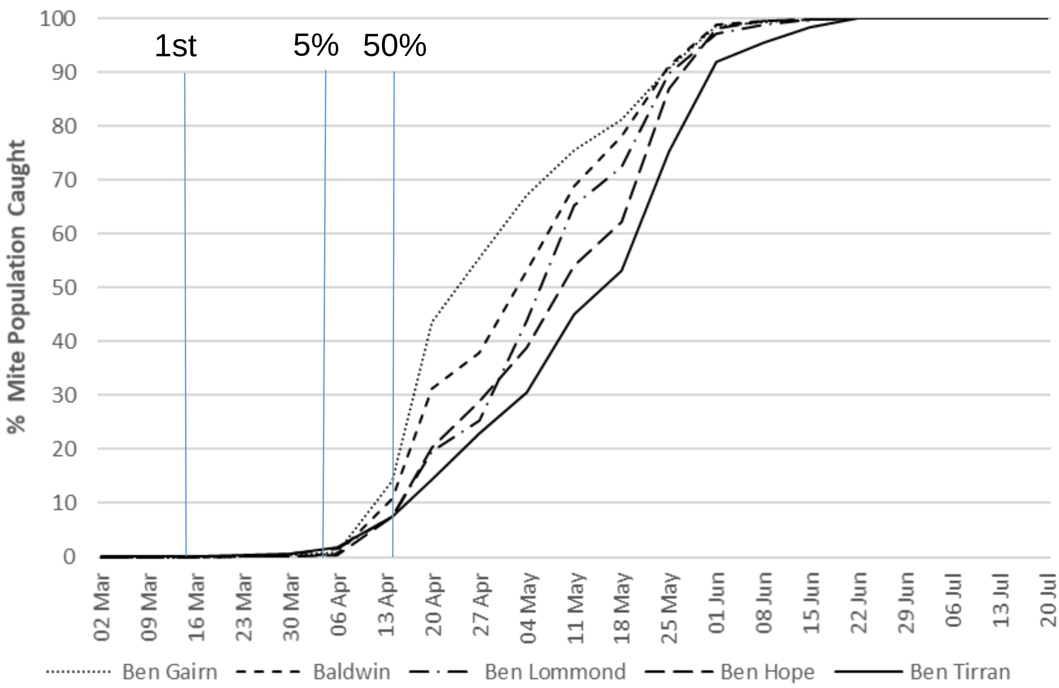

Figure 5. The percentage gall mite migration for each of the five varieties monitored at NIAB EMR in 2020 and the predicted dates of 1st, 5% and 50% emergence.

Comparing the 1st emergence of gall mite and its subsequent migration between 2019 and 2020, we can see there are differences between when the migration starts and how quickly it progresses on each variety (which also changes between years), suggesting that further investigation is required to maintain the accuracy and usefulness of the gall mite prediction model.

Effects of Dormancy Breaking Products on Gall Mite Emergence 2020
An additional AHDB trial was conducted in an adjacent plantation to investigate the efficacy of spray applications of products for dormancy breaking in blackcurrant. It was decided by the AHDB that we should investigate any relationship between dormancy breaking and gall mite emergence and migration, e.g. does application of dormancy breaking products lead to more synchronised bud burst, which in turn leads to a more synchronised mite migration.

Four treatments of the eight applied for dormancy breaking were selected for monitoring (Table 3).

Table 4. Dormancy breaking treatments (also monitored for mite emergence).

Treatment		Wetter	Citric acid	Glucose
1	Untreated	-	-	-
2	Erger (20l/ha)	Active Erger (30l/ha)	-	-
3	"Basal A" Calcium nitrate 40kg/ha	Wetcit (0.25%)	8kg/ha	8kg/ha
4	"Basal C" Ammonium nitrate 20kg/ha	Wetcit (0.25%)	8kg/ha	8kg/ha

All treatments were applied on 09 April 2020 with a Euro-Pulve Knapsack sprayer with a Birchmeier Blower.

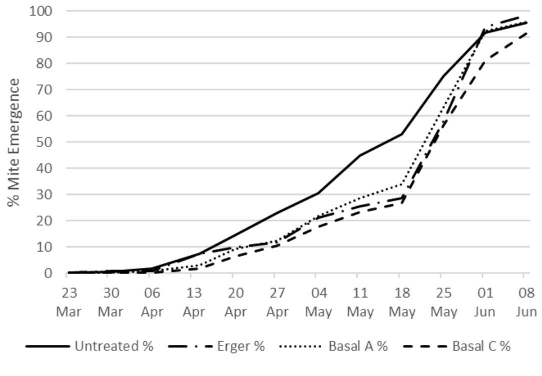

Figure 6a. Percentage mite emergence in the four dormancy breaking treatments.

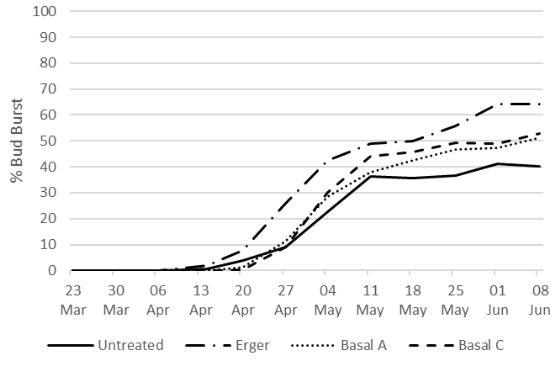

Figure 6b. Percentage bud burst in the four dormancy breaking treatments.

In all four treatments the mites started to emerge at the same time (23 March) with mites being detected until 22 June (Figure 6a). In the untreated control the mite emergence and migration preceded quicker than in the three dormancy breaking treatments. When we look at the corresponding level of dormancy breaking (Figure 6b), the untreated control broke bud slower than the other three dormancy breaking treatments. This disagrees with our hypothesis and suggests that the triggers for mites to emerge from their galls and migrate up the plant are not directly related to the bushes' dormancy or how quickly they break bud. Further investigation of the interaction between mite emergence and dormancy are required.

Acaricide Spray Trial Efficacy 2020

Spray application A was aimed for the start of the mite migration (Figure 7) and was applied as close to the actual start as weather permitted (Appendix B). Application B was timed to have maximum impact on mite populations by aiming to coincide with 50% mite emergence to show the greatest effects for those products where only a single application was allowed. Spray application C was to be applied during flowering, to investigate the possibility of the use of products during this sensitive and vulnerable growth stage. The final mites were caught on 22 June 2020, which coincides with early fruit set of cv. Ben Tirran at NIAB EMR.

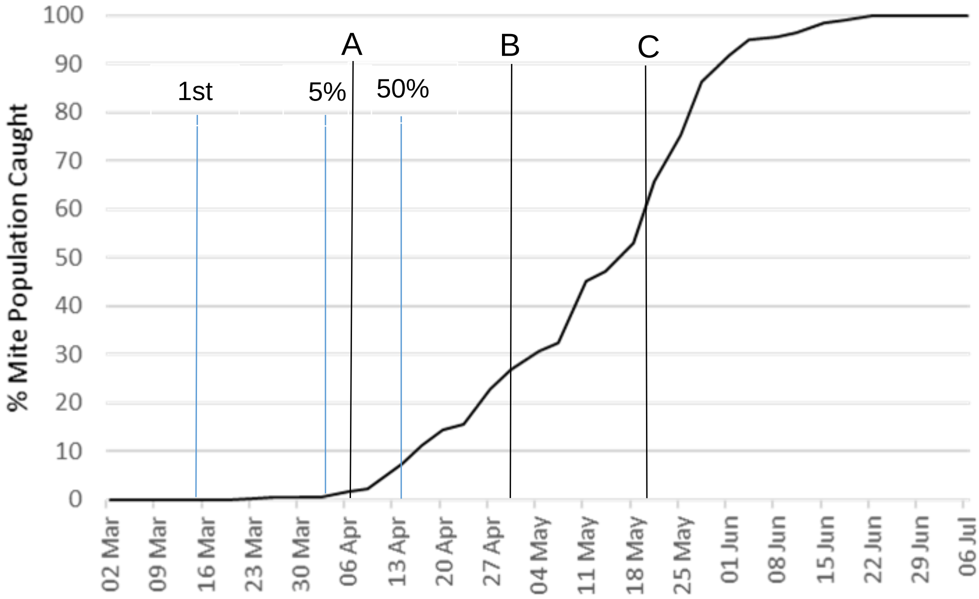

Figure 7. Percentage mites caught per week as a percentage of the final total catch on cv. Ben Tirran at NIAB EMR, showing the predicted 1st, 5% and 50% migration and the timing of spray applications 2020 (A, B and C).

Due to the developing COVID-19 pandemic in March 2020, it was decided to host the trial at NIAB EMR to ensure that the trial could be conducted whilst restrictions to control the pandemic were imposed. The number of galls per bush were recorded pre–bud break (21 February 2020) and post-leaf drop (19 March 2021) for the middle bush of the three bush plots. The pre-bud break numbers of galls were high (66.7 galls per bush on average). The plot was monitored weekly from December 2020 waiting for the infested buds to be sufficiently evident to conduct the final assessment. As the weeks passed in spring 2021 it became clear that only 47% of the bushes had survived the winter, effectively leaving several treatments with no data. After a consultation with our statistician, it was decided every living shoot would be recorded as an individual data point and the total number of buds per shoot would be recorded, along with the number of infested buds per shoot.

Of the twelve treatment programmes applied, three treatments had too little data to be analysable (treatments 3, 5 and 9) (Table 3, Figure 8).

Five of the spray programmes used significantly reduced the percentage infestation of buds by gall mite compared to the untreated control:

- Treatment 4, 3 sprays of Thiopron.
- Treatment 6, 2 applications of AHDB 9989 (01 May and 20 May).
- Treatment 7, 1 application of AHDB 9786 (07 April) + 2 x AHDB 9989 (01 May and 20 May).
- Treatment 8, 2 applications of x AHDB 9786 (07 April and 01 May) and AHDB 9989 late (20 May).
- Treatment 10, 2 applications of Thiopron (07 April and 01 May) and AHDB 9989 (20 May).

This indicates the use of Thiopron, AHDB 9786 and AHDB 9989 in spray programmes can give significant control of gall mite without relying on a single active ingredient.

The single late application of Thiopron (Treatment 11) on 20 May was applied during flowering specifically to investigate any possible phytotoxic effects of this new sulphur formulation when applied during the sensitive flowering stage. It gave no significant control of gall mite when compared to the untreated control, but it was never anticipated to control gall mite as a lone application, but as there was no detectable phytotoxicity from this late sulphur application it may be safe to apply later during the mite migration, into the flowering period.

The 2 early applications of Thiopron (Treatment 12) did result in a decrease in the percentage of buds infested but not significantly so, indicating that Thiopron needs to be used as part of a 3 spray programme (Treatment 4), or as part of programme using more than one mode of action (Treatment 10).

Phytotoxicity

No symptoms of phytotoxicity were evident 7 days after any of the applications used in the spray efficacy trial.

Table 3. Mixed model binomial regression of the numbers of infested and uninfected buds post-leaf drop. Dunnett test for significant difference was used to investigate if the probability of buds being infested with mites between the treatments and the untreated control was significantly different. * Denotes significantly different to the untreated control.

Treatment		Treatment applications			Assessments				
		07 Apr A BBCH 0	01 May B BBCH 65	20 May C BBCH 71	Sampled shoots	Galled buds	Total buds	Mean % infested buds	F. Prob
1	Untreated				13	119	237	50.98	
2	Water	●	●	●	4	43	127	30.63	0.3590
3	AHDB 9786	●	●		1	0	7	NA	NA
4	Thiopron Full	●	●	●	17	59	401	12.28	<0.001*
5	2 x AHDB 9989	●	●		1	0	5	NA	NA
6	2 x AHDB 9989		●	●	2	1	26	4.55	0.0320*
7	AHDB 9786 + 2 x AHDB 9989	●	●	●	9	22	230	4.58	<0.001*
8	2 x AHDB 9786 + AHDB 9989	●	●	●	10	7	240	3.13	<0.001*
9	Thiopron + AHDB 9989	●	●	●	2	0	10	NA	NA
10	2 x Thiopron + AHDB 9989	●	●	●	5	3	101	2.01	<0.001*
11	Thiopron			●	4	29	51	50.87	0.9509
12	2 x Thiopron	●	●		5	16	76	18.89	0.1998

N.B. Due to the age of the plot and the stress of the warm wet winter of 2019-20, the plot suffered extensive die back. As a result of this Treatments 3, 5 and 9 did not have enough replicated data, therefore the data sets from these plots could not be analysed (NA)

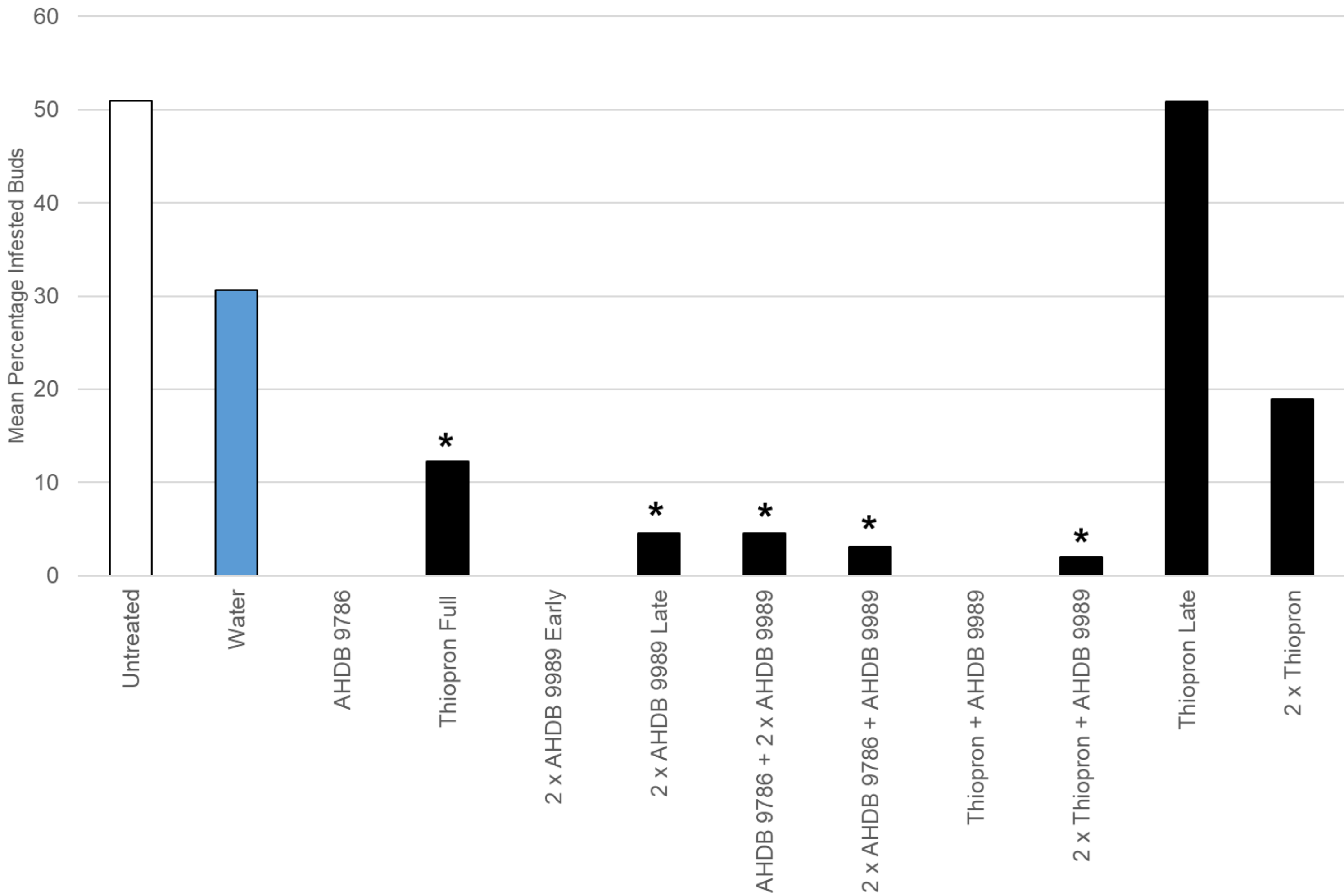

Figure 8. Mean percentage of infested buds post leaf drop. * denotes significantly different to the untreated control.

Discussion

The blackcurrant gall mite emergence model is currently giving varying levels of accuracy when predicting emergence and migration of gall mite in South East England, this variation seems to depend on year and variety with further data being needed to explain these discrepancies. Since the model was developed by Cross and Ridout in 2001, the UK climate has undergone considerable change, with many blackcurrant varieties now failing to achieve the required chilling over winter to trigger synchronized growth in the spring. Cross and Ridout found no link between growth stage and mite migration in their data from pre-2001, however this may not be the case now. For 20 years there has been a need to place heavy reliance on the use of sulphur for gall mite control. This may not have induced metabolic resistance in the gall mite, but may have selected for a change in behavioural patterns towards mites that migrate later in the season.

The chemical control programmes evaluated in this trial have shown that IPM strategies of spray programmes combining different modes of action can result in significant levels of control of blackcurrant gall mite.

The new sulphur formulation "Thiopron" which is now available on the market with a 5kg/ha rate, integrates well with other coded products tested here, and can be applied later into the season (during flowering) when conventional sulphur formulations may cause phytotoxicity (Cross and Harris, 2005), further testing is required to ensure its crop safety on all commercial blackcurrant varieties.

Conclusions

- The timing of specific key points in the emergence of gall mite and its subsequent migration may vary depending on location, cultivar and year.
- Further work to monitor gall mite activity and varietal differences is needed to re-evaluate the gall mite emergence model in a changing climate.
- AHDB 9989 integrates well with AHDB 9786 or Thiopron to give good gall mite control.
- Thiopron is a useful late season spray for gall mite control (further testing is required to ensure its crop safety on all commercial blackcurrant varieties).

Take home message

More data is required to fully understand the inconsistencies in the prediction model for gall mite emergence, and how this relates to yearly variation in climate and variety. AHDB 9989 would be a useful gall mite control product, when used either in conjunction with the current industry standard or Thiopron.

Acknowledgements

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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, and UPL.

References

Cross, J, V & Ridout, M. S. 2001. Emergence of blackcurrant gall mite (*Cecidophyopsis ribis*) from galls in spring. Journal of Horticultural Science and Biotechnology 76(3):311-319.

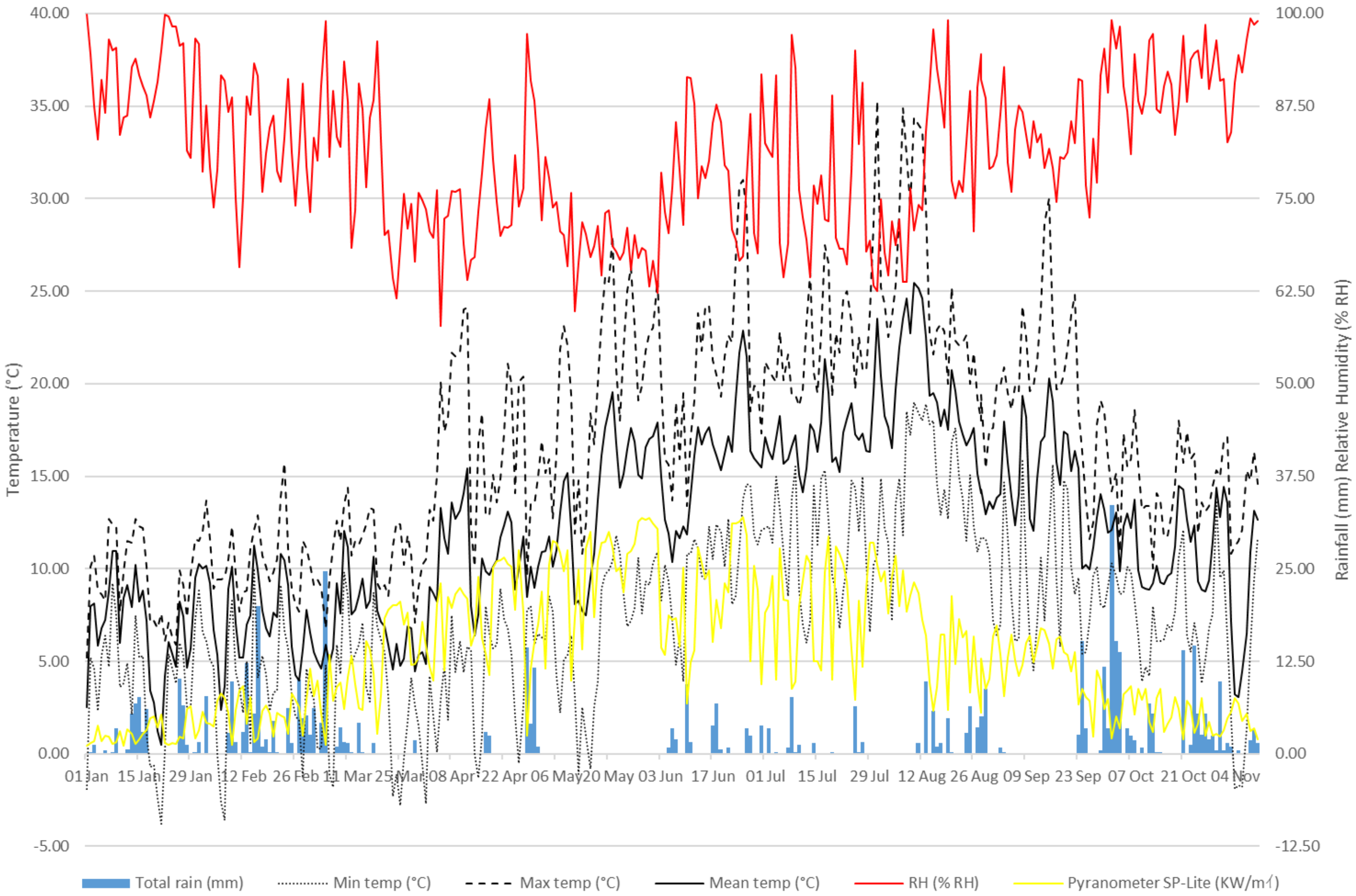
Cross, J. V. & Harris, A. L. 2005. Tests of the phytotoxicity of sulphur to blackcurrants 2005. Confidential report to GlaxoSmithKline/HDC growers fund issued 28 Nov 2005, 13 pp.

Appendix

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

Date and name		**Record of work done, observations made or reference to lab or field book entry (give book and page numbers)**
21 Feb 2020	ALH IH	Mark out plot Assess levels of gall mite Begin assessing gall mite numbers
02 March 2020	IH	Gall mite trap count
09 March 2020	IH	Gall mite trap count
16 March 2020	IH	Gall mite trap count
23 March 2020	IH	Gall mite trap count
30 March 2020	IH	Gall mite trap count
06 April 2020	IH	Gall mite trap count
07 April 2020	IH LB	1st application
14 April 2020	ALH	Phytotoxicity assessment
14 April 2020	IH	Gall mite trap count
20 April 2020	IH	Gall mite trap count
27 April 2020	IH	Gall mite trap count
01 May 2020	IH LB	2nd application
04 May 2020	IH	Gall mite trap count
08 May 2020	ALH	Phytotoxicity assessment
11 May 2020	IH	Gall mite trap count
18 May 2020	IH	Gall mite trap count
20 May 2020	IH LB	3rd application
25 May 2020	IH	Gall mite trap count
27 May 2020	ALH	Phytotoxicity assessment
01 June 2020	IH	Gall mite trap count
08 June 2020	IH	Gall mite trap count
15 June 2020	IH	Gall mite trap count
22 June 2020	IH	Gall mite trap count
29 June 2020	IH	Gall mite trap count
06 July 2020	IH	Gall mite trap count
13 July 2020	IH	Gall mite trap count
20 July 2020	IH	Gall mite trap count
19 March 2021	ALH	Assessment of gall mites 2021

b. Climatological data from the NIAB EMR weather station 2020.



c. Raw data from assessments (* denotes missing value).

Block	Plot	Label	Colour code	Treatment	Shoot	Gall	Buds
1	9	109	G	1	1	14	32
1	9	109	G	1	2	15	25
1	9	109	G	1	3	18	32
2	3	203	G	1	1	1	3
3	12	312	G	1	1	14	31
3	12	312	G	1	2	2	2
3	12	312	G	1	3	14	16
3	12	312	G	1	4	3	10
4	8	408	G	1	1	3	14
5	7	507	G	1	1	3	17
5	7	507	G	1	2	17	23
5	7	507	G	1	3	4	16
5	7	507	G	1	4	11	16
4	11	411	B	2	1	10	27
5	12	512	B	2	1	15	40
5	12	512	B	2	2	2	10
5	12	512	B	2	3	7	20
5	12	512	B	2	4	9	30
2	10	210	Y Y	3	1	0	7
3	2	302	Y	4	1	0	5
3	2	302	Y	4	2	0	7
3	2	302	Y	4	3	4	43
4	10	410	Y	4	1	1	13
4	10	410	Y	4	2	1	9
4	10	410	Y	4	3	3	15
4	10	410	Y	4	4	4	27
4	10	410	Y	4	5	5	12
4	10	410	Y	4	6	6	27
4	10	410	Y	4	7	22	60
4	10	410	Y	4	8	0	22
5	10	510	Y	4	1	4	44
5	10	510	Y	4	2	1	27
5	10	510	Y	4	3	0	19
5	10	510	Y	4	4	1	12
5	10	510	Y	4	5	3	23
5	10	510	Y	4	6	4	36
3	6	306	R	5	1	0	5
1	8	108	R R	6	1	1	11
3	9	309	R R	6	1	0	15
1	1	101	Y R	7	1	0	12
1	1	101	Y R	7	2	0	9
1	1	101	Y R	7	3	0	5
3	7	307	Y R	7	1	0	23

3	7	307	Y R	7	2	0	14
4	12	412	Y R	7	1	17	65
5	9	509	Y R	7	1	0	13
5	9	509	Y R	7	2	4	79
5	9	509	Y R	7	3	1	10
1	3	103	Y Blk	8	1	2	29
1	3	103	Y Blk	8	2	0	26
1	3	103	Y Blk	8	3	1	16
1	3	103	Y Blk	8	4	1	19
1	3	103	Y Blk	8	5	0	27
3	5	305	Y Blk	8	1	0	7
3	5	305	Y Blk	8	2	0	37
5	8	508	Y Blk	8	1	0	18
5	8	508	Y Blk	8	2	2	19
5	8	508	Y Blk	8	3	1	42
3	3	303	Y Gry	9	1	0	4
3	3	303	Y Gry	9	2	0	6
1	5	105	Gry	10	1	1	17
3	4	304	Gry	10	1	0	7
3	4	304	Gry	10	2	0	9
3	4	304	Gry	10	3	2	48
4	3	403	Gry	10	1	0	20
3	10	310	R Gry	11	1	10	19
3	10	310	R Gry	11	2	2	6
3	10	310	R Gry	11	3	14	16
3	10	310	R Gry	11	4	3	10
1	11	111	R R Gry	12	1	5	28
1	11	111	R R Gry	12	2	7	25
2	4	204	R R Gry	12	1	0	6
2	4	204	R R Gry	12	2	2	7
2	4	204	R R Gry	12	3	2	10

d. Mean % mite emergence and % bud burst for each of the four dormancy breaking products.

Treatment		23 Mar	30 Mar	06 Apr	14 Apr	20 Apr	27 Apr	04 May	11 May	18 May	25 May	01 Jun	08 Jun
Untreated	% Mite emergence	0.24	0.48	1.77	7.47	14.51	22.95	30.58	45.05	53.14	75.41	91.96	95.66
Untreated	% Bud burst	0.00	0.00	0.00	0.56	3.86	9.09	22.55	36.36	35.80	36.79	41.23	40.21
Erger	% Mite emergence	0.18	0.90	0.90	7.40	9.93	11.91	21.30	25.63	28.70	58.12	93.86	98.38
Erger	% Bud burst	0.00	0.00	0.00	2.03	7.63	25.92	42.38	48.85	50.08	55.81	64.07	64.17
Basal A	% Mite emergence	0.29	0.29	0.78	2.94	9.30	12.44	21.74	28.80	34.08	63.37	92.56	95.89
Basal A	% Bud burst	0.00	0.00	0.00	0.00	1.15	11.39	28.59	38.06	42.52	46.70	47.38	51.21
Basal C	% Mite emergence	0.00	0.12	0.24	1.84	6.51	10.48	17.64	23.27	26.70	56.48	81.11	91.36
Basal C	% Bud burst	0.00	0.00	0.00	0.00	0.42	9.04	29.98	44.10	45.55	49.39	49.05	52.92

e ORETO certificate.

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
Biologicals and Semiochemicals
Stored Crops

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

Signature W. McCun

Authorised signatory

Certification Number
ORETO 411

HSE
Chemicals Regulation Division

Department of
Agriculture and Rural Development