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 2019 to March 2020
Report date:	31 March 2020
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 2020

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 was undertaken.

Methods

A replicated small plot trial was undertaken in a commercial plantation of cv. Ben Tirran to evaluate the efficacy of post-blossom sprays of 9 test products for control of blackcurrant gall mite, compared to an untreated control, a water only control and the industry standard of 2 early sulphur sprays. The sprays were applied on 15 March, 18 April and 10 May 2019. The numbers of sprays of each product applied was based on the company recommendations. 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 using miniature sticky traps in an infested commercial blackcurrant plantation (cv. Ben Tirran). Additional monitoring was done in an infested experimental planting of blackcurrant of cvs. Baldwin, Ben Gairn, Ben Hope, Ben Lomond and Ben Tirran at NIAB EMR for comparison.

Results

Gall mite monitoring

The emergence and subsequent migration of gall mite on the five varieties studied at NIAB EMR (Baldwin, Ben Gairn, Ben Hope, Ben Lomond and Ben Tirran) was highly variable between varieties and very different to the percentage emergence dates predicted by the model, which was based on the weather data from the NIAB EMR weather station. The only good agreement between the model and actual emergence was for the cv. Ben Gairn (Table 1). This poor agreement with the model was also shown for cv. Ben Tirran at Edward Vinson Ltd (based on the local weather data obtained by the AHDB from a weather station at Chilham 6km from the trial site).

Table 1. Predicted and actual gall mite emergence dates for all five NIAB EMR varieties and for cv Ben Tirran at Edward Vinson LTD

Location/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
Predicted Edward Vinson Ltd	**10 March**	**25 March**	**18 April**
Observed Ben Tirran	05 Mar	01 April	02 May

Spray Trial Efficacy

Of the 12 treatment programmes applied, three showed statistically significant effects on the rate of increase of the number of blackcurrant gall mite galls (Table 2).

These were:

- The industry standard of two applications of 10 Kg/ha Sulphur (Treatment 3)
- Sulphur at 10 Kg/ha applied at the predicted time of 50% point of the migration (18 April) (Treatment 6)
- and the experimental product, AHDB 9989 (Treatment 9)

A fourth treatment AHDB 9951 (Treatment 13) was almost statistically significant and may show promise as part of a control program or pesticide resistance control strategy (Table 2).

Table 2. 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. N.B. treatments 5 and 14 were withdrawn from the trial prior to treatment application – hence the empty slots.

Treatment	Treatment applications			Assessments		√
	15 Mar A	18 Apr B	10 May C	25 Feb Pre -bud break	7 Nov Post -leaf drop	Covariate
1 Untreated				2.6	63.6	7.08 a
2 Water only	●	●	●	4.2	63.0	6.91 ab
3 Sulphur 10 kg x2	●	●		3.8	35.8	5.01 b
4 Kumulus DF 1kg x3	●	●	●	3.2	58.0	5.97 ab
5						
6 Kumulus DF 10 kg x1		●		3.2	25.0	5.22 b
7 AHDB9945	●	●	●	4.8	75.5	7.59 a
8 Envidor		●		4.2	56.8	6.07 ab
9 AHDB 9989	●	●		4.2	33.8	5.27 b
10 AHDB 9931	●	●	●	6.6	74.0	6.78 ab
11 AHDB 9944		●		2.2	82.0	7.95 a
12 AHDB 9970	●	●	●	4.2	72.0	7.28 a
13 AHDB 9951		●		2.4	35.5	5.46 ab
14						
				F. prob (d.f. = 115)		0.005
				SED		0.837
				LSD		1.689

Conclusions

- The timing of specific key points in the emergence of gall mite and its subsequent migration may vary depending on location and cultivar
- Further work to monitor gall mite activity and varietal differences is needed to re-evaluate the gall mite emergence model in a changing climate
- The trials confirmed that sprays of Sulphur provide good control of gall mite on cv Ben Tirran
- AHDB 9989 has potential to control gall mite but requires further investigation to determine optimal timings of application
- AHDB 9951 has potential to control gall mite but requires further investigation to determine optimal timings of application
- Further work is needed to evaluate the products AHDB 9989 and 9951, plus full and reduced doses of Sulphur at the start and peak of migration, to create full IPM programmes that reduce the reliance on high dose applications sulphur and its associated phytotoxicity
- Further work is needed to evaluate the products AHDB 9989 and 9951as post flowering applications to control the end of the gall mite migration in early flowering varieties

Take home message

Sulphur is still the most effective method of gall mite control currently available, but there are products on the horizon that will reduce the industry's reliance on this single product. The Behaviour of the blackcurrant gall mite has changed and is no longer accurately predicted by the emergency model, work is required urgently to provide the data to realign the model with what is actually happening in the real world.

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	Edward Vinson Ltd. Graveney Road, Faversham ME138UP (51.306820, 0.908678).
Crop	Blackcurrant
Cultivar	Ben Tirran
Soil or substrate type	Soilscape 6 Freely draining slightly acid loamy 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)	1.5 m x 3 m
Plot size: (m^2)	4.5 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	/	/	/	/	/	/	/
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	/	/	/	/	/	/	/

Note: Treatments 05 and 14 were removed from the trial by the SCEPTREplus committee after the trial had been marked out and initial assessment of gall numbers conducted. Hence the empty slots.

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	/	/	A B C
03	Kumulus DF BASF	80%	10 kg	A B
04	Kumulus DF BASF	80%	1 kg	A B C
05	/	/	/	/
06	Kumulus DF BASF	80%	10 kg	B
07	AHDB 9945	/	1l/ha	A B C
08	Envidor	240g/l	0.4 l/ha	B
09	AHDB 9989	100g/l	0.5 l/ha	A B
10	AHDB 9931	/	8 l/ha	A B C
11	AHDB 9944	164g/l	1 l	B
12	AHDB 9970	47.9% w/v	8 l	A B C
13	AHDB 9951	200g/l	0.3 l	B
14	/	/	/	/

A = 15 March 2019
B = 18 April 2019
C = 10 May 2019

Application details

	Application A	Application B	Application C
Application date	15/03/19	18/04/19	10/05/19
Time of day	09:31	09:27	9:45
Crop growth stage (Max, min average BBCH)	00	09	55
Crop height (cm)	1 m	1 m	1 m
Crop coverage (%)	N/A	N/A	N/A
Application Method	Mist blower	Mist blower	Mist blower
Application Placement	Crop	Crop	Crop
Application equipment	Birchmeier B245	Birchmeier B245	Birchmeier B245
Nozzle pressure	N/A	N/A	N/A
Nozzle type	N/A	N/A	N/A
Nozzle size	N/A	N/A	N/A
Application water volume l/ha	500	500	500
Temperature of air-shade (°C)	12	18	12
Relative humidity (%)	100	40	65
Wind speed range (m/s)	2.3-2.7	0	0-0.78
Dew presence (Y/N)	Y	N	N
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	1.33	1.33	38.83

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 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.

To investigate the migration further several additional varieties were monitored at NIAB EMR, these were; Ben Lomond, Ben Hope, Ben Gairn and Baldwin. Each variety had 10 miniature sticky cap traps, which were checked weekly

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

The temperature and humidity of the trial site was monitored hourly using 2 Lascar EL-USB 2 temperature and humidity loggers (Appendix C) for the duration of the trial

Crop development was recorded throughout the trial whenever mite traps were checked.

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**
25/02/19	0	N/A	0	Efficacy	Gall counts
21/03/19	6 days	N/A	09	Phytotoxicity	Visual
25/04/19	7 days	N/A	61	Phytotoxicity	Visual
16/05/19	6 days	N/A	71	Phytotoxicity	Visual
07/11/19	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

Cv Ben Tirran

Mites were monitored using 20 miniature sticky traps per site at NIAB EMR and at Edward Vinson Ltd. Monitoring started at NIAB EMR on 19 February 2019 and on 5 March 2019 at Edward Vinson Ltd. At NIAB EMR the traps were checked twice weekly to ensure an accurate estimate of the start of the gall mite migration (Figure 1). The traps at Edward Vinson Ltd. were changed weekly. The gall mite migration started on 4 March at NIAB EMR and the final mite was caught on 13 June. The gall mite emergence model run by the AHDB forecast the start of the emergence (1st emergence) as 13 March, 5% emergence as 28 March and 50% emergence as 18 April. The model uses the data form a weather station located at NIAB EMR (Appendix b) next to the blackcurrant planting.

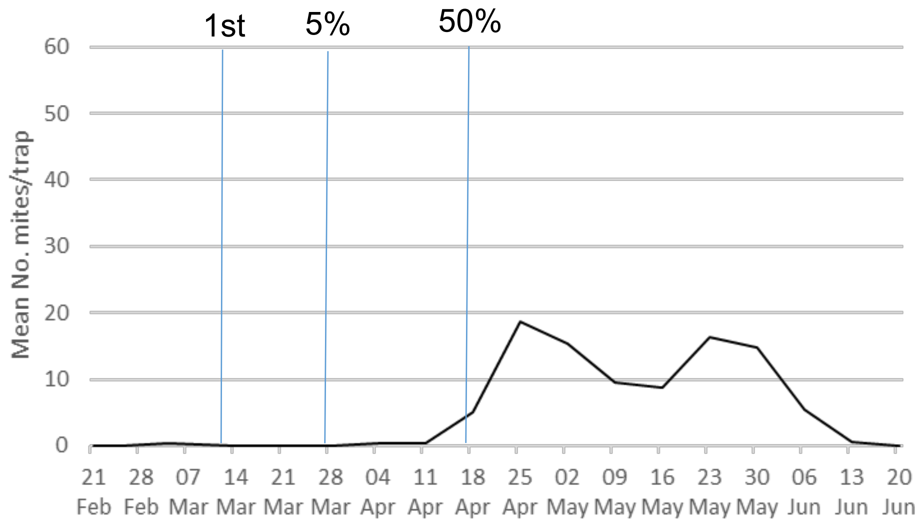

Figure 1. Mean number of gall mites per trap on cv Ben Tirran at NIAB EMR in 2019.

When we look at the mite population as a percentage of its final total (Figure 2), we find 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 theses dates as 13 March, 28 March and 18 April respectively, when in reality the first emergence occurred much earlier, on 4 March, while the 5% and 50% points occurred much later than predicted, on 18 April and 9 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.

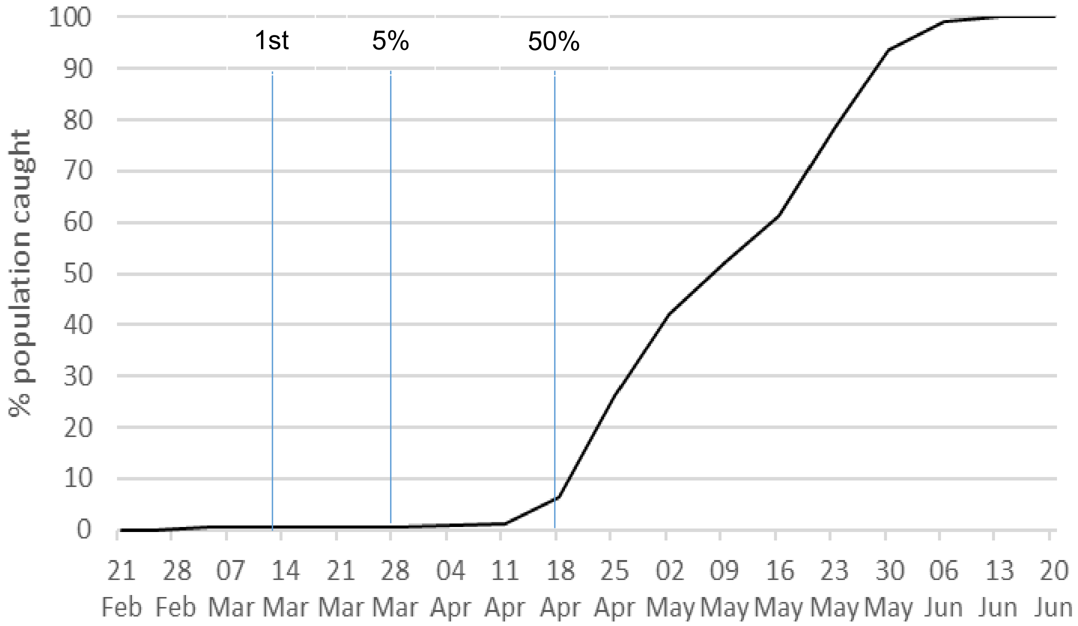

Figure 2. Percentage mites caught per week as a percentage of the final total catch on cv Ben Tirran at NIAB EMR in 2019.

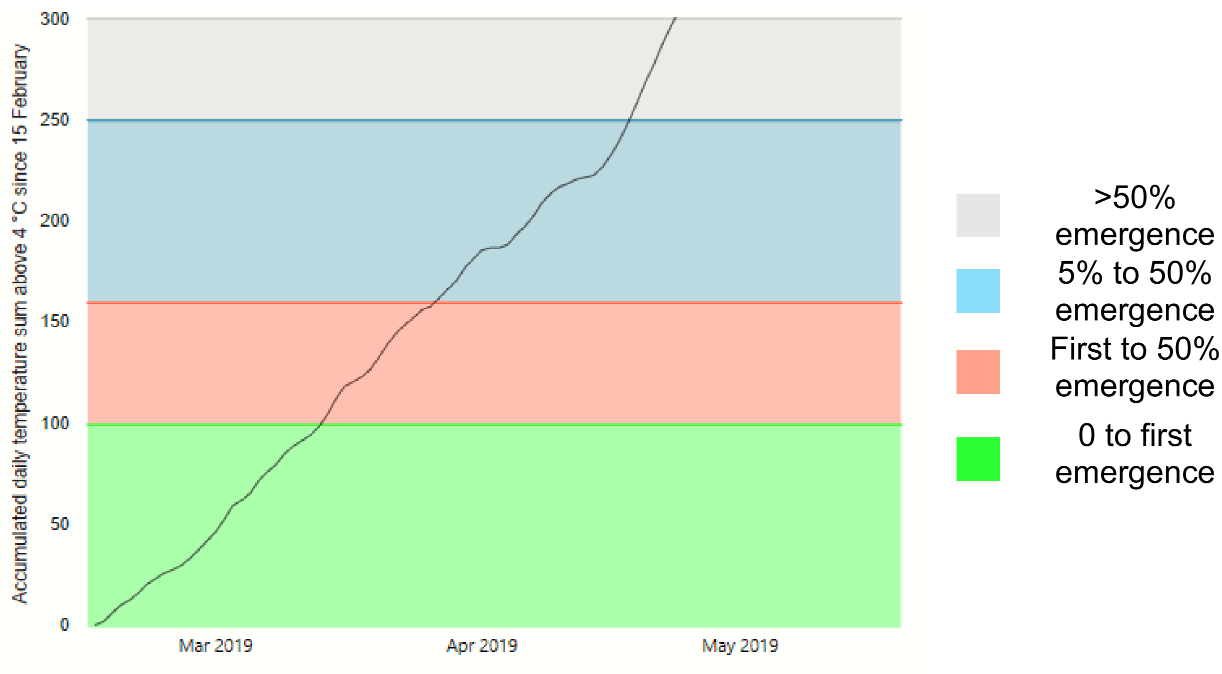

Figure 3. Gall mite emergence model, predictions based on weather data from the NIAB EMR weather station

The gall mite monitoring was also conducted at the trial site at Edward Vinson Ltd. on the same variety, Ben Tirran. The data collected was again compared to the emergence model provided by the AHDB and the model took its weather data from a station in Chilham 6 km from the site. Migration started on 5 March with the final mite being caught on 6 June.

The emergence model predicted the first emergence of mites at Edward Vinson Ltd to be on 10 March, the 5% emergence to be 25 March and the 50% emergence to be 18 April (Figure 4).

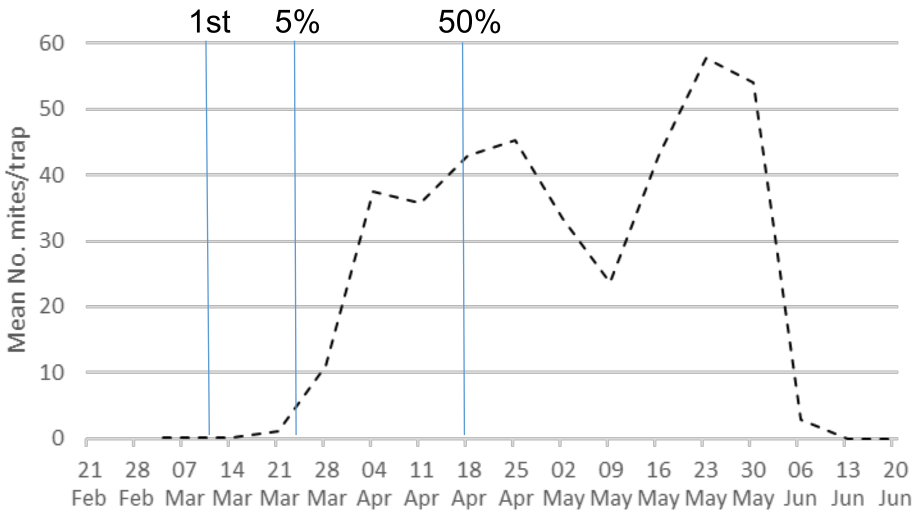

Figure 4. Mean number of gall mites per trap on cv Ben Tirran at Edward Vinson Ltd.

Plotting the actual emergence data as a percentage of the final population (Figure 5) allows us to see that the actual date of the gall mite emergence was earlier than predicted (Figure 6) on 5 March, while 5% emergence occurred later than predicted on 1 April and 50% emergence was even later, on 30 April.

Compared to the NIAB EMR predictions, those for Edward Vinson Ltd were much closer by approximately +/- 5 days. This coupled with the unstable UK climate, and the weather conditions required for applications of plant protection products means that sprays for gall mite control are applied at broadly the correct time and some degree of control should be possible. This fits with the original predictions from the gall mite model (Cross and Ridout, 2001).

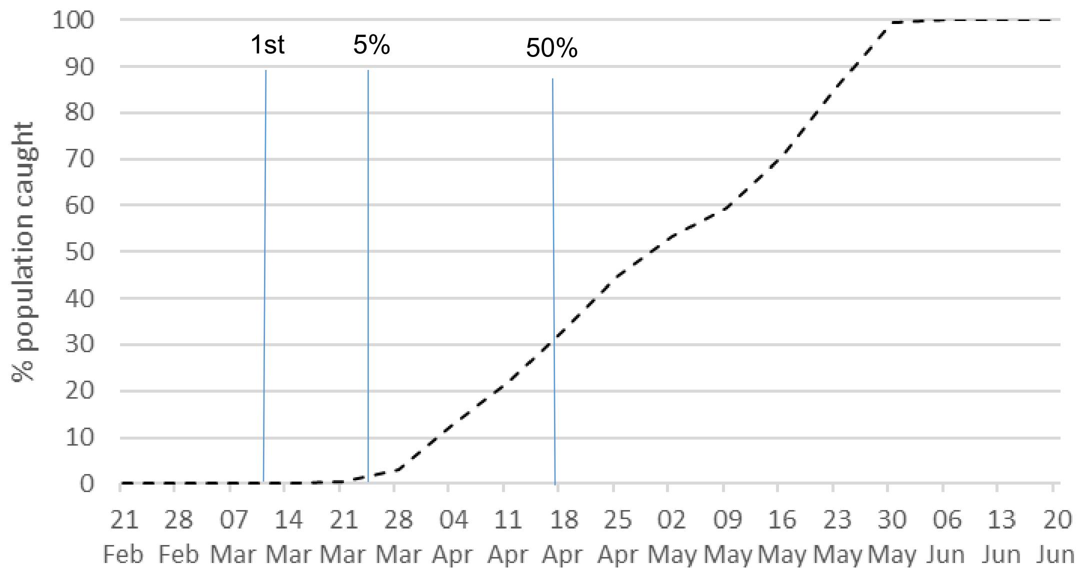

Figure 5 Percentage mites caught per week as a percentage of the final total catch on cv Ben Tirran at Edward Vinson Ltd. Showing the predicted 1st, 5% and 50% migration.

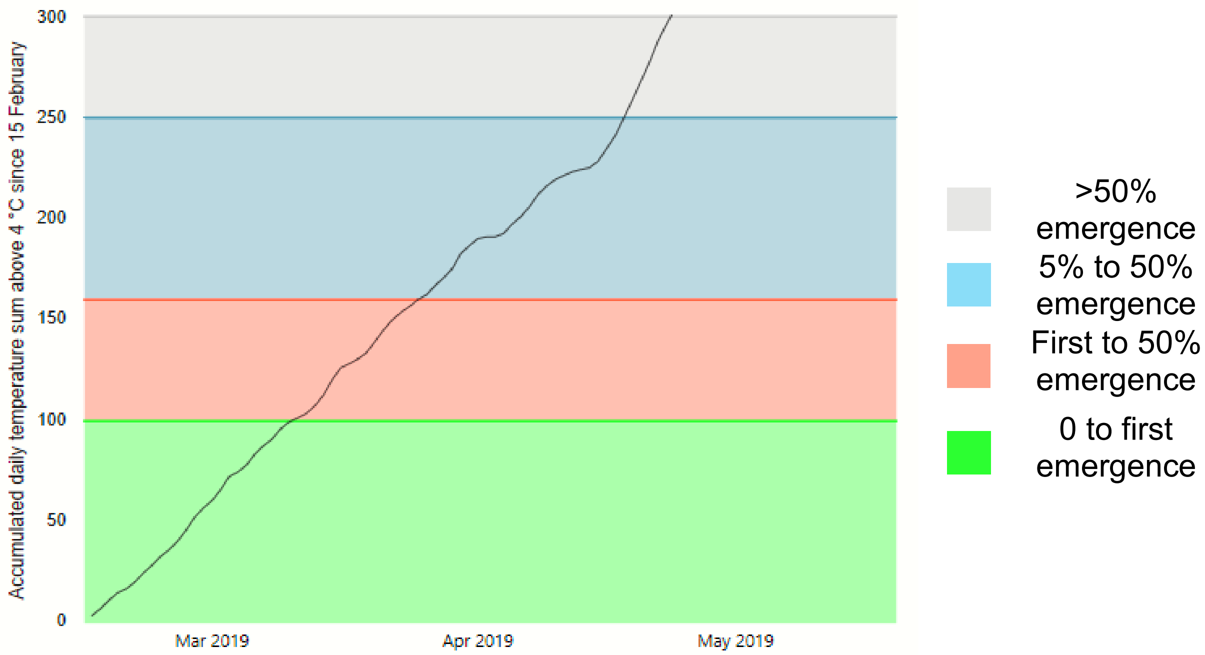

Figure 6. Gall mite emergence model, predictions based on weather data from the Chilham weather station 6 km from the site at Edward Vinson Ltd.

Other varieties

At NIAB EMR four other varieties were also monitored for gall mite emergence, these were, Ben Gairn, Baldwin, Ben Lomond and Ben Hope alongside the Ben Tirran (Figure 7). 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 (Table 1).

Table 1. Predicted and actual gall mite emergence dates for all 5 NIAB EMR varieties and for Ben Tirran at Edward Vinson Ltd.

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
Predicted Edward Vinson Ltd	**10 March**	**25 March**	**18 April**
Observed en Tirran	05 Mar	01 April	02 May

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

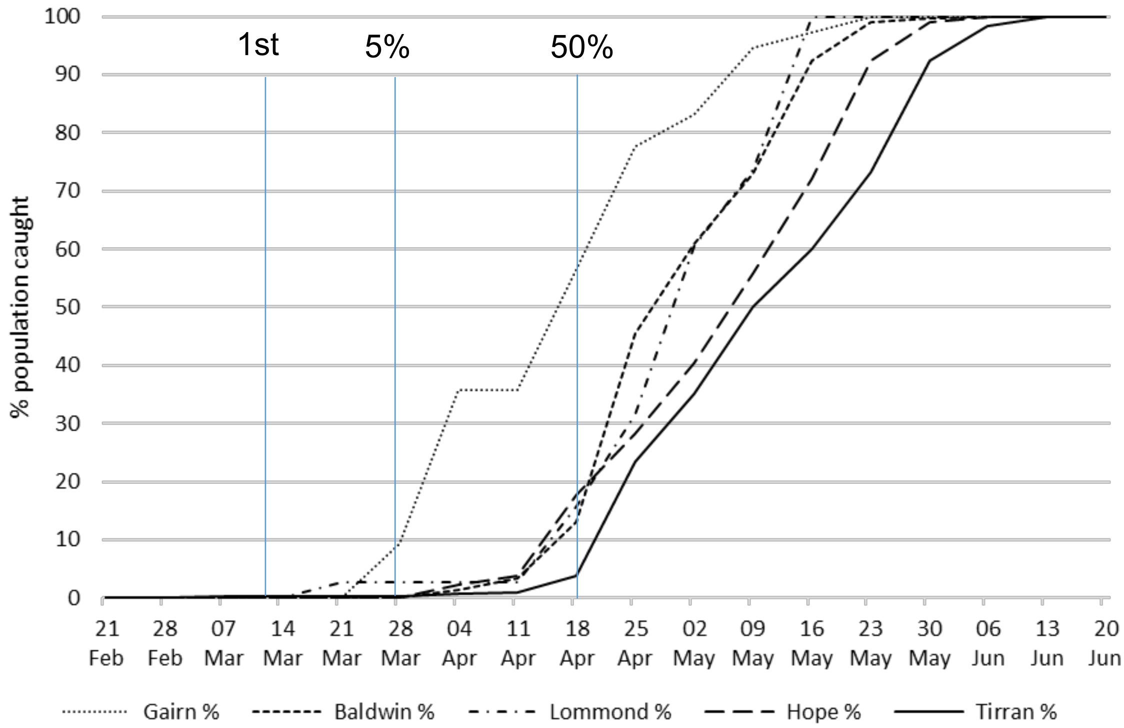

Figure 7. The percentage gall mite migration for each of the five varieties monitored at NIAB EMR and the predicted dates of 1st, 5% and 50% emergence

Phytotoxicity

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

Spray Trial Efficacy

Spray application A was aimed for the start of the mite migration and was applied as close to the actual start as weather permitted (Appendix B). Application B was timed to have the maximum impact on mite populations and to show the greatest effects for those products where only a single application was allowed and was timed to coincide with 50% mite emergence. Spray application C was to be applied post flowering, however, based on data from 2018, where the end of the mite migration occurred before the end of flowering, it was judged necessary to apply the final round of spraying pre-flowering at BBCH growth stage 55 (EPPO growth stage E, first grape visible). The final mites were caught on 30 May 2019, which coincides with the end of flowering of Ben Tirran at Edward Vinson Ltd.

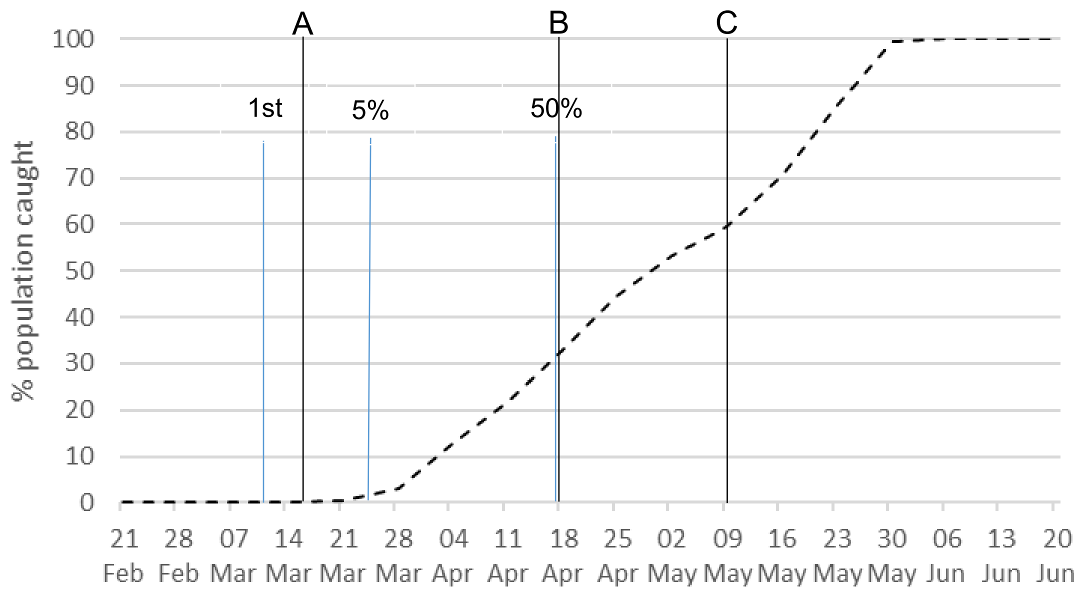

Figure 8. Percentage mites caught per week as a percentage of the final total catch on cv Ben Tirran at Edward Vinson Ltd, showing the predicted 1st, 5% and 50% migration and the timing of spray applications (A, B and C).

The number of galls per bush were recorded pre–bud break (25 February 2019) and post-leaf drop (7 November 2019) for the middle three bushes of the five-bush plots. The pre-bud break numbers of galls were low (2.6 galls per bush on the untreated control), while the end of season counts were extremely high (63.6 galls per bush). 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 12 treatment programmes applied, three showed statistically significant effects on the rate of increase of the number of blackcurrant gall mite galls (Table 2).
These were:

- The industry standard of two applications of 10 Kg/ha Sulphur (Treatment 3)
- Sulphur at 10 Kg/ha applied at 50% point of the migration (18 April) (Treatment 3)
- and the experimental product, AHDB 9989 (Treatment 9)

A fourth treatment AHDB 9951 (Treatment 13) was almost statistically significant and may show promise as part of a control programme or pesticide resistance control strategy (Table 2 and Figure 9).

Table 2. 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. N.B. treatments 5 and 14 were withdrawn from the trial prior to treatment application – hence the empty slots.

Treatment	Treatment applications			Assessments		Number of galls Post-leaf drop Pre-bud burst	√ Covariate
	15 Mar A BBCH 0	18 Apr B BBCH 9	10 May C BBCH 55	25 Feb Pre -bud break	7 Nov Post -leaf drop		
1 Untreated				2.6	63.6	24.17	7.08 a
2 Water only	●	●	●	4.2	63.0	25.84	6.91 ab
3 Headland Sulphur 10 kg x2	●	●		3.8	35.8	17.52	5.01 b
4 Kumulus DF 1kg x3	●	●	●	3.2	58.0	20.75	5.97 ab
5							
6 Kumulus DF 10 kg x1		●		3.2	25.0	9.82	5.22 b
7 AHDB9945	●	●	●	4.8	75.5	17.18	7.59 a
8 Envidor		●		4.2	56.8	17.79	6.07 ab
9 AHDB 9989	●	●		4.2	33.8	11.18	5.27 b
10 AHDB 9931	●	●	●	6.6	74.0	13.16	6.78 ab
11 AHDB 9944		●		2.2	82.0	34.33	7.95 a
12 AHDB 9970	●	●	●	4.2	72.0	18.34	7.28 a
13 AHDB 9951		●		2.4	35.5	17.03	5.46 ab
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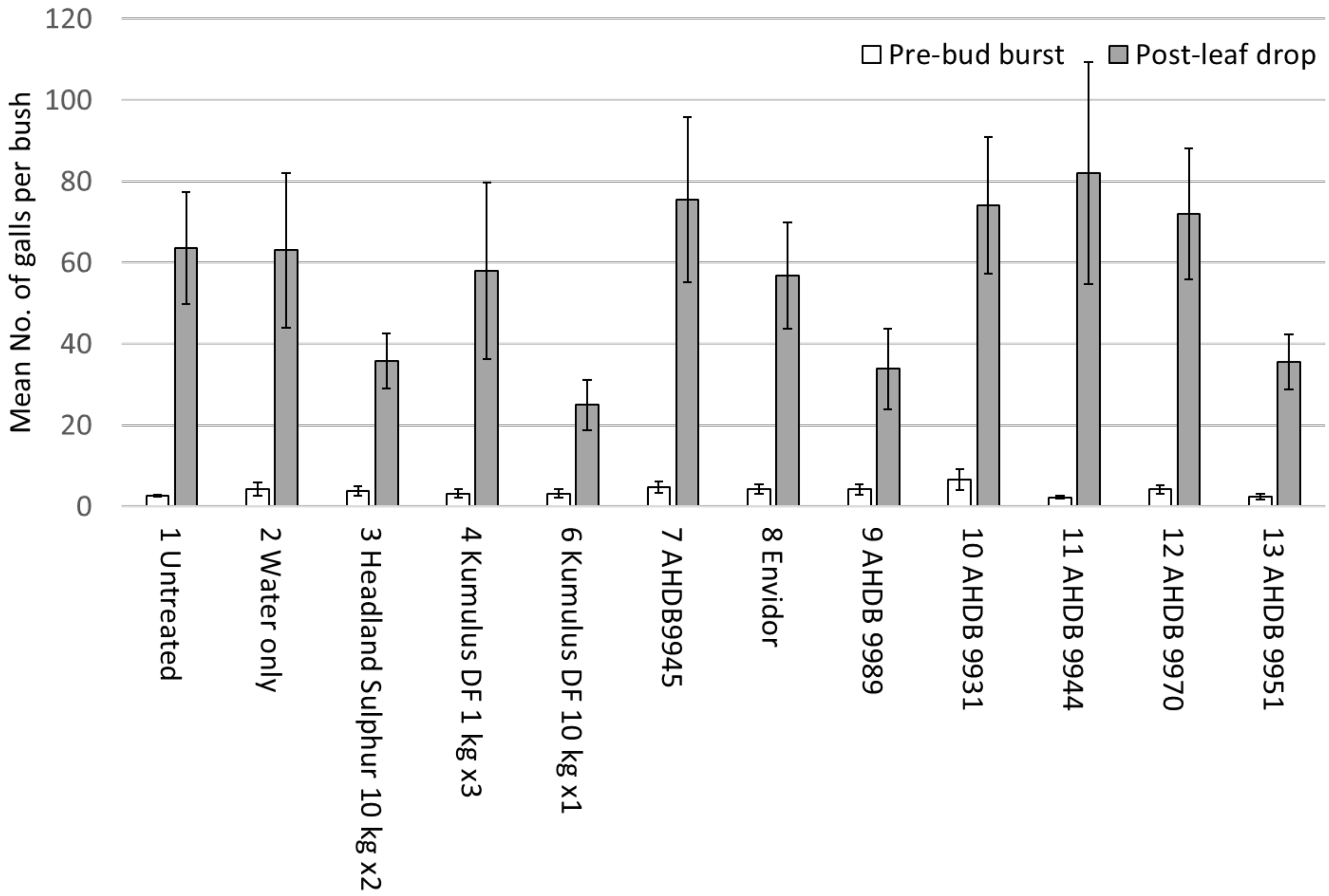


Figure 9. Numbers of galls pre-bud burst and post-leaf drop per bush per plot with standard error

Discussion

The blackcurrant gall mite emergence model is currently not giving good predictions of mite emergence for most blackcurrant varieties in south east England with only the predictions for Ben Gairn being accurate enough to time applications of crop protection products. Why the model is no longer accurate is unclear and this needs further investigation. 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 development patterns towards mites that migrate later in the season.

It is proposed, with the support of LR Suntory, to generate new gall mite migration data from across the country from multiple sites and varieties, and to use this data to validate/update the model on a national scale

The chemical control programmes evaluated in this trial have shown that sulphur still gives control of gall mite but that its corrected application timing is critical. Of the novel products, applied two products may have some potential for gall mite control. it is proposed to create spray programs using these test products together, with sulphur and with a new sulphur product “ Thiapron” which is now available on the market with a 5kg/ha rate, to try and find new programs for gall mite control that avoid using sulphur later in the season when it can prove phytotoxic (Cross and Harris, 2005)

Conclusions

- The timing of specific key points in the emergence of gall mite and its subsequent migration may vary depending on location and cultivar
- Further work to monitor gall mite activity and varietal differences is needed to re-evaluate the gall mite emergence model in a changing climate
- The trials confirmed that sprays of Sulphur provide good control of gall mite on cv Ben Tirran
- AHDB 9989 has potential to control gall mite but requires further investigation to determine optimal timings of application
- AHDB 9951 has potential to control gall mite but requires further investigation to determine optimal timings of application
- Further work is needed to evaluate the products AHDB 9989 and 9951, plus full and reduced doses of Sulphur at the start and peak of migration, to create full IPM programmes that reduce the reliance on high dose applications sulphur and its associated phytotoxicity
- Further work is needed to evaluate the products AHDB 9989 and 9951as post flowering applications to control the end of the gall mite migration in early flowering varieties

Take home message

Sulphur is still the most effective method of gall mite control currently available, but there are products on the horizon that will reduce the industry's reliance on this single product. The Behaviour of the blackcurrant gall mite has changed and is no longer accurately predicted by the emergency model, work is required urgently to provide the data to realign the model with what is actually happening in the real world.

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 Edward Vinson Ltd for hosting the trial and LR Suntory for advice and support.

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

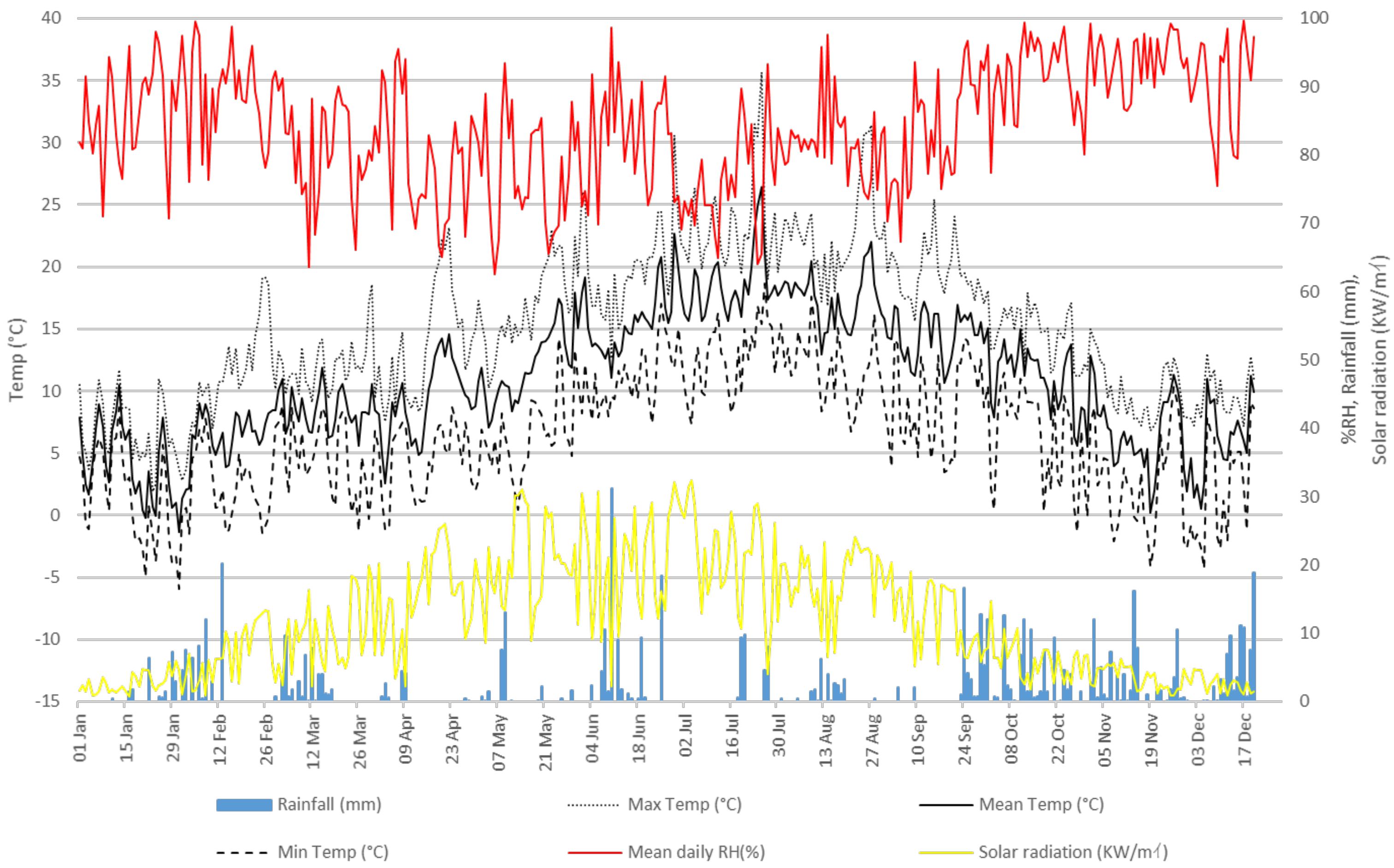
a. Crop diary – events related to growing crop are not applicable.

Date and name		Record of work done, observations made or reference to lab or field book entry (give book and page numbers – not applicable)
21/02/2019	IH	Preparing sticky traps
15/02/2019	IH	Putting out sticky traps on Ben Tirran at NIAB EMR
19/02/2019	IH	1st mite trap assessment on Ben Tirran at NIAB EMR
21/02/2019	IH	Traps changed on all varieties at NIAB EMR
25/02/2019	ALH IH	Traps changed on Ben Tirran at NIAB EMR Traps deployed at Edward Vinson Ltd Mark out plots Counts of pre spray gall numbers
28/02/2019	IH	Traps changed on all varieties at NIAB EMR
04/03/2019	IH	Traps changed on Ben Tirran at NIAB EMR
05/13/19	IH	Traps Changed at Edward Vinson Ltd
07/03/2019	IH ALH	Traps changed on all varieties at NIAB EMR
11/03/2019	IH	Traps changed on Ben Tirran at NIAB EMR
14/03/2019	IH ALH	Traps changed on all varieties at NIAB EMR
15/03/19	ALH T J	Traps Changed at Edward Vinson Ltd Spray round A conducted
18/03/2019	IH ALH	Traps changed on Ben Tirran at NIAB EMR
21/03/2019	ALH IH	Traps changed on all varieties at NIAB EMR Traps Changed at Edward Vinson Ltd and Phytotoxicity assessment
25/03/2019	IH	Traps changed on Ben Tirran at NIAB EMR
28/03/2019	IH	Traps changed on all varieties at NIAB EMR Traps Changed at Edward Vinson Ltd
01/04/2019	IH	Traps changed on Ben Tirran at NIAB EMR

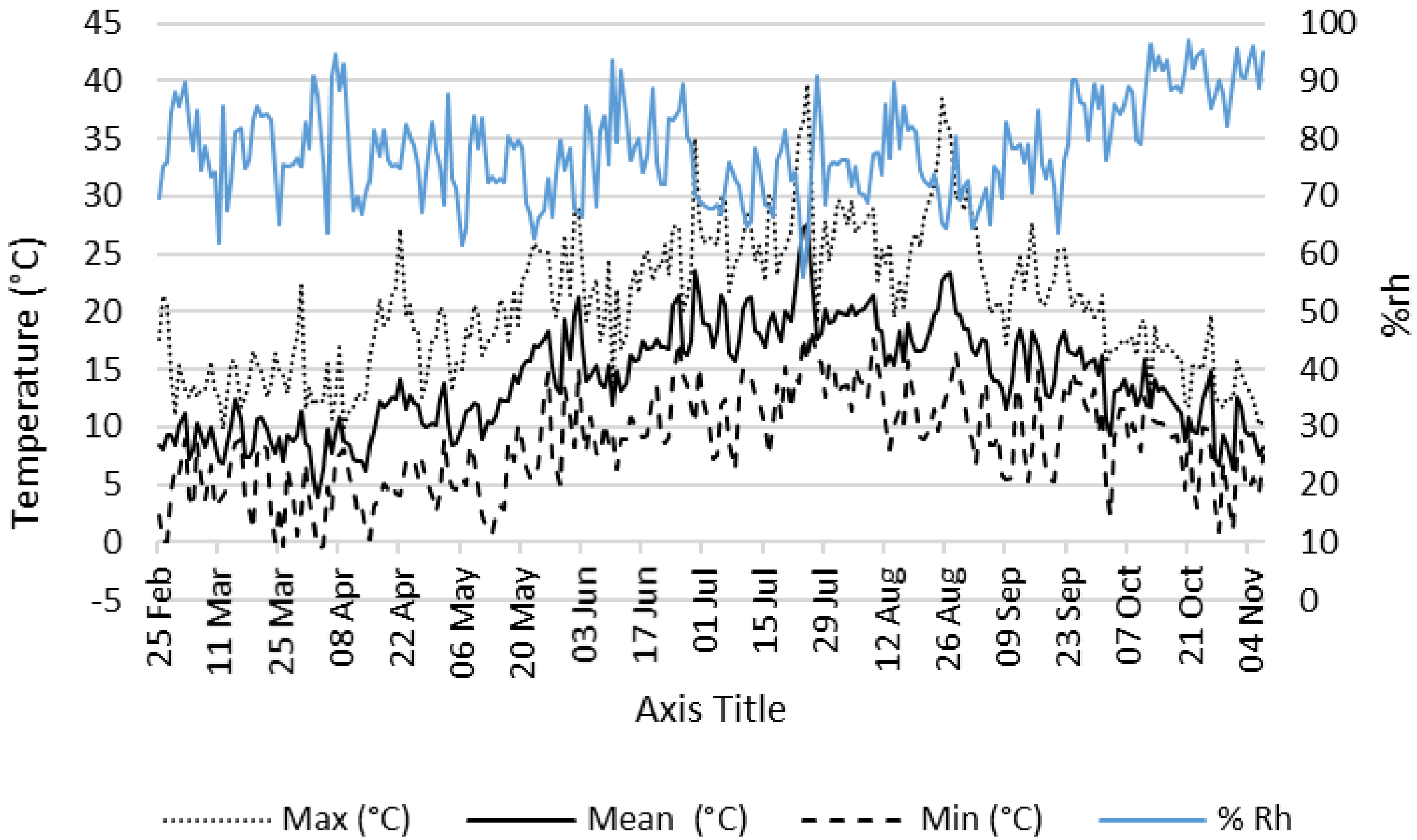
04/04/2019	IH LB	Traps changed on all varieties at NIAB EMR Traps Changed at Edward Vinson Ltd
08/04/2019	IH	Traps changed on Ben Tirran at NIAB EMR
11/04/2019	IH	Traps changed on all varieties at NIAB EMR Traps Changed at Edward Vinson Ltd
15/04/2019	IH	Traps changed on Ben Tirran at NIAB EMR
18/04/2019	IH ALH	Traps changed on all varieties at NIAB EMR Traps Changed at Edward Vinson Ltd and spray round B applied
22/04/2019	IH	Traps changed on Ben Tirran at NIAB EMR
25/04/2019	ALH IH	Traps changed on all varieties at NIAB EMR Traps Changed at Edward Vinson Ltd and Phytotoxicity assessment
28/04/2019	IH	Traps changed on Ben Tirran at NIAB EMR
02/05/2019	IH	Traps changed on all varieties at NIAB EMR Traps Changed at Edward Vinson Ltd
06/05/2019	IH	Traps changed on Ben Tirran at NIAB EMR
09/05/2019	IH	Traps changed on all varieties at NIAB EMR Traps Changed at Edward Vinson Ltd
10/05/19	ALH IH	Spray round C applied at Edward Vinson Ltd
13/05/2019	IH	Traps changed on Ben Tirran at NIAB EMR
16/05/2019	ALH IH	Traps changed on all varieties at NIAB EMR Traps Changed at Edward Vinson Ltd and phytotoxicity assessment
20/05/2019	IH	Traps changed on Ben Tirran at NIAB EMR
23/05/2019	IH	Traps changed on all varieties at NIAB EMR Traps Changed at Edward Vinson Ltd
27/05/2019	IH	Traps changed on Ben Tirran at NIAB EMR
30/05/2019	IH	Traps changed on all varieties at NIAB EMR Traps Changed at Edward Vinson Ltd

03/06/2019	IH	Traps changed on Ben Tirran at NIAB EMR
06/06/2019	IH	Traps changed on all varieties at NIAB EMR Traps Changed at Edward Vinson Ltd
10/06/2019	IH	Traps changed on Ben Tirran at NIAB EMR
13/06/2019	IH	Traps changed on all varieties at NIAB EMR Traps Changed at Edward Vinson Ltd
17/06/2019	IH	Traps changed on Ben Tirran at NIAB EMR
20/06/2019	IH	Traps changed on all varieties at NIAB EMR Traps Changed at Edward Vinson Ltd
24/10/2019	IH	Traps changed on Ben Tirran at NIAB EMR
07/11/19	ALH IH	Post leaf drop gall mite assessment

b. Climatological data from the NIAB EMR weather station.



c. Edward Vinson Ltd. weather data for the duration of the trial from 2 lascar EL-USB 2 data loggers



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

Block	plot	Treatment	Mean Pre-bud break gall no./ bush/plot	Mean post-leaf drop gall no./ bush/plot	Post/Pre
1	1	6	2.00	11.33	5.67
1	2	8	0.67	13.00	19.50
1	3	9	3.00	28.33	9.44
1	4	13	1.33	22.00	16.50
1	5	7	1.00	49.00	49.00
1	6	14	5.33	65.67	12.31
1	7	3	3.33	48.67	14.60
1	8	2	2.33	62.33	26.71
1	9	10	2.33	72.67	31.14
1	10	5	3.00	55.33	18.44
1	11	11	1.33	18.67	14.00
1	12	1	2.33	59.67	25.57
1	13	12	2.33	59.67	25.57
1	14	4	1.00	39.67	39.67
2	1	1	1.00	54.00	54.00
2	2	4	2.67	41.00	15.38
2	3	2	1.67	23.33	14.00
2	4	5	2.67	19.33	7.25
2	5	7	1.67	*	*
2	6	8	3.33	77.67	23.30
2	7	3	2.00	20.67	10.33
2	8	9	3.00	14.33	4.78
2	9	10	2.00	39.67	19.83
2	10	13	2.33	27.00	11.57
2	11	14	2.67	46.00	17.25
2	12	12	2.67	56.00	21.00
2	13	6	1.67	39.33	23.60
2	14	11	0.67	76.33	114.50
3	1	2	3.00	88.67	29.56
3	2	8	2.67	30.00	11.25
3	3	3	2.00	41.00	20.50
3	4	14	3.00	34.67	11.56
3	5	4	2.67	62.00	23.25
3	6	13	1.67	25.00	15.00
3	7	9	3.67	56.00	15.27
3	8	1	3.33	22.00	6.60
3	9	7	3.67	48.00	13.09
3	10	5	7.00	50.33	7.19
3	11	10	2.67	71.67	26.88
3	12	11	2.67	*	*

3	13	6	3.33	*	*
3	14	12	3.00	58.67	19.56
4	1	2	0.33	7.33	22.00
4	2	13	1.00	14.67	14.67
4	3	11	0.33	16.67	50.00
4	4	8	0.67	28.00	42.00
4	5	5	1.33	13.00	9.75
4	6	4	0.67	10.67	16.00
4	7	14	0.33	15.33	46.00
4	8	12	0.33	15.67	47.00
4	9	6	0.33	14.33	43.00
4	10	10	1.00	26.33	26.33
4	11	3	3.33	19.33	5.80
4	12	1	1.33	20.00	15.00
4	13	9	0.33	9.00	27.00
4	14	7	2.00	34.33	17.17
5	1	4	2.00	27.33	13.67
5	2	13	2.67	58.00	21.75
5	3	1	1.67	53.67	32.20
5	4	5	1.00	35.00	35.00
5	5	14	6.00	149.00	24.83
5	6	9	2.67	55.33	20.75
5	7	7	3.67	90.33	24.64
5	8	2	4.00	92.33	23.08
5	9	11	2.00	104.33	52.17
5	10	12	3.67	97.33	26.55
5	11	3	1.67	29.00	17.40
5	12	8	1.67	30.33	18.20
5	13	6	4.00	52.00	13.00
5	14	10	2.33	60.33	25.86
6	1	10	8.67	100.00	11.54
6	2	3	2.00	32.67	16.33
6	3	9	1.33	34.33	25.75
6	4	13	1.00	*	*
6	5	14	0.67	*	*
6	6	8	3.33	52.67	15.80
6	7	1	3.00	96.00	32.00
6	8	6	0.33	9.00	27.00
6	9	11	2.00	106.33	53.17
6	10	2	2.33	110.67	47.43
6	11	4	3.67	95.33	26.00
6	12	7	4.67	108.33	23.21
6	13	12	1.67	79.67	47.80
6	14	5	2.00	78.67	39.33

e ORETO certificate should be pasted in at end.

Certificate of

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

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

Authorised signatory

Certification Number
ORETO 411

HSE
Chemicals Regulation Division

Department of
Agriculture and Rural Development