

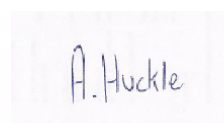
SCEPTREPLUS

Final Trial Report

Trial code:	SP 35. 2020 Trial 2 of 2
Title:	AHDB SCEPTREplus volunteer potato control in parsnips herbicide screen – 2020
Crop	Parsnips
Target	Volunteer potatoes
Lead researcher:	Angela Huckle
Organisation:	RSK ADAS Applications and assessments by Vegetable Consultancy Services
Period:	01/05/2020 – 31/01/2020
Report date:	14 th February 2022
Report author:	Guy Johnson Angela Huckle
ORETO Number: (certificate should be attached)	ORETO 409

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

14th February 2022...
Date



Authors signature

Trial Summary

Introduction

The trials carried out as part of the SceptrePlus program from 2017 to 2019 have identified new products for weed control in parsnips, but identifying effective products for control of volunteer potatoes is still an ongoing challenge. There haven't been any EAMU authorisations of herbicide products specifically targeting volunteer potatoes in parsnip crops since 2009. The herbicides most recently authorised, such as aclonifen, do not control volunteer potatoes. Therefore identifying products for post-emergence volunteer potato control remains a priority.

The objective of this trial was to evaluate a number of crop safe and effective post-emergence tank mixes for control of volunteer potatoes in parsnips.

Methods

The trial was sited in a commercial carrot field near Oxborough, Norfolk, with the crop drilled on 22nd May (variety 'Javelin'). The trial was laid out as a randomised block design, with three replicates of eight treatments giving twenty-four plots in total, with plots measuring 5 m x 1.83 m. Two types of potatoes were planted: determinate variety Annabelle, and indeterminate variety Markies. Six potatoes of each variety were planted in separate halves of the plot when the parsnips emerged on 2nd June. Treatments were applied at two timings, the first were applied on 1st July 2020 when the potatoes had reached a small rosette, with the second application 13 days later on the 12th July 2020. All treatments were applied with an Oxford precision sprayer with a two metre boom at 400L/ha water volume. Plots were assessed on four occasions; 13th July, 28th July, 11th August and the 9th September, focusing on plant population, crop safety (phytotoxicity), and phytotoxic effects on the volunteer potatoes, and potato height was measured at every assessment date. Phytotoxicity of the treatments to both crop and potatoes was scored on a scale starting at 0 (no damage) to 10 (plant death). Fanging and other root effects were assessed at harvest on the 14th October.

Results

All treatments significantly increased the phytotoxic effects on the parsnip crop for up to two weeks after the final application with the exception of Validate + **Hurricane SC** where effects on the parsnips were at an acceptable level by the application of Timing 2 (**Table 1**). At the final harvest assessment there was no significant effects observed in crop phytotoxicity, excessive root hairs or fanged parsnips in this trial (**Table 2**). All treatments scored below the acceptable crop damage threshold (2.00). However, it should be noted that in other studies **Starane Hi-Load** has caused unacceptable root distortion with excessive root hairs being produced. In this study the sprays were applied in cool temperatures, and therefore in more extreme application conditions of heat and/or humidity, these effects may be produced. Therefore, it would be advisable to test these treatments again before considering commercial use.

Table 1. Mean crop phytotoxicity at two four and six weeks after the second treatment application. 0 = no damage 10 = crop death < 2 = acceptable damage not likely to affect yield or quality. Scores > 2 highlighted in red.

Treat No	Treatment	Mean parsnip phytotoxicity scores (0-10)			
		13 th July Just before Timing 2	28 th July 2 weeks after Timing 2	11 th August 4 weeks after Timing 2	9 th Sept 8 weeks after Timing 2
1	Untreated	0.00	0.00	0.00	0.00
2	Validate 0.5 L/ha AHDB9822	3.33	2.33	0.67	0.00
3	Validate 0.5 L/ha Hurricane SC 0.1 L/ha	2.67	1.67	1.00	0.00
4	Validate 0.5 L/ha Hurricane SC 0.1 L/ha AHDB9822	6.00	2.33	0.67	0.00

Treat No	Treatment	Mean parsnip phytotoxicity scores (0-10)			
		13 th July Just before Timing 2	28 th July 2 weeks after Timing 2	11 th August 4 weeks after Timing 2	9 th Sept 8 weeks after Timing 2
5	Validate 0.5 L/ha Hurricane SC 0.1 L/ha AHDB9981	3.67	4.33	1.67	0.00
6	Validate 0.5 L/ha Hurricane SC 0.1 L/ha Starane Hi-Load 0.1 L/ha	3.00	2.33	1.00	0.00
7	Validate 0.5 L/ha Starane Hi-Load 0.1 L/ha AHDB9822	4.00	2.67	1.33	0.00
8	Validate 0.5 L/ha Starane Hi-Load 0.1 L/ha AHDB9981	3.67	2.67	1.00	0.00
F.Pr		<.001	<.001	0.628	N/A
D.F		14	14	14	14
L.S.D		1.154	1.055	1.725	N/A
		Not significantly different from untreated control			
		Significantly different from untreated control			

Table 2. Mean percentage of fanged and split carrots at harvest on 14th October 2020.

Treat No	Treatment	Mean Fanging (%)	Mean Excessive root hairs (%)
1	Untreated	1.00	18.67
2	Validate 0.5 L/ha AHDB9822	0.00	7.33
3	Validate 0.5 L/ha Hurricane SC 0.1 L/ha	0.33	9.33
4	Validate 0.5 L/ha Hurricane SC 0.1 L/ha AHDB9822	0.67	14.00
5	Validate 0.5 L/ha Hurricane SC 0.1 L/ha AHDB9981	0.00	16.00
6	Validate 0.5 L/ha Hurricane SC 0.1 L/ha Starane Hi-Load 0.1 L/ha	0.00	18.67
7	Validate 0.5 L/ha Starane Hi-Load 0.1 L/ha AHDB9822	0.33	12.67
8	Validate 0.5 L/ha Starane Hi-Load 0.1 L/ha AHDB9981	1.33	16.67
F.Pr		0.179	0.743
D.F		14	14
L.S.D		1.154	16.31

All treatments significantly increased phytotoxicity on the Markies potatoes with the exception of Validate 0.5 L/ha + **Hurricane SC 0.1 L/ha** at two weeks after this final application on 28th July. Effects were chlorosis and necrosis of potato foliage ranging from slight to severe (**Table 3**).

By the last assessment, eight weeks after the final treatment was applied, only two treatments still significantly increased phytotoxicity on Markies potatoes. These treatments are Validate 0.5 L/ha + **Hurricane SC 0.1 L/ha + AHDB9822**, and Validate 0.5 L/ha + **Starane Hi-Load 0.1 L/ha + AHDB9822**. Potatoes sprayed with these treatments still had moderate symptoms of phytotoxicity at the final assessment which were severe chlorosis and necrosis of the foliage

Table 2. Mean indeterminate potato (Markies) phytotoxicity at the dates shown. First herbicide application- 1st July, Final application – 13th July. Scores: 0 = no damage shown, 10 = crop death.

Treat No	Treatment	Mean Markies phytotoxicity scores (0-10)			
		13 th July Just before Timing 2	28 th July 2 weeks after Timing 2	11 th August 4 weeks after Timing 2	9 th Sept 8 weeks after Timing 2
1	Untreated	0.00	0.00	0.00	1.00
2	Validate 0.5 L/ha AHDB9822	4.72	6.78	4.06	1.61
3	Validate 0.5 L/ha Hurricane SC 0.1 L/ha	1.56	0.94	0.78	0.56
4	Validate 0.5 L/ha Hurricane SC 0.1 L/ha AHDB9822	4.94	8.28	6.39	5.00
5	Validate 0.5 L/ha Hurricane SC 0.1 L/ha AHDB9981	2.44	3.00	1.28	0.00
6	Validate 0.5 L/ha Hurricane SC 0.1 L/ha Starane Hi-Load 0.1 L/ha	3.06	6.83	4.00	2.33
7	Validate 0.5 L/ha Starane Hi-Load 0.1 L/ha AHDB9822	4.72	6.83	5.50	5.11
8	Validate 0.5 L/ha Starane Hi-Load 0.1 L/ha AHDB9981	1.50	3.78	2.00	1.06
F.Pr		<.001	<.001	<.001	0.055
d.f.		14	14	14	14
L.S.D		2.022	1.853	1.744	3.632
		Not significantly different from untreated control			
		Significantly different from untreated control			

All treatments significantly reduced the mean height of the indeterminate Markies potato variety at the final assessment, recorded eight weeks after the final treatment application. The treatments which suppressed the potato height the greatest included either **Starane Hi-Load or AHDB 9822**. These reduced the height by between 53 and 68% compared to the untreated control when combined with Validate or other products. The best performing treatment was Validate 0.5 L/ha + **Hurricane SC 0.1 L/ha + AHDB9822**.

Table 3. Mean height (cm) of Markies indeterminate potatoes at each assessment date. Sprays applied on 1st July and 13th July.

Trt No	Treatment	Mean height (cm)				
		1 st July Just before Timing 1	13 th July Just before Timing 2	28 th July 2 weeks after Timing 2	11 th August 4 weeks after Timing 2	9 th Sept 8 weeks after Timing 2
1	Untreated	23.33	55.00	55.00	80.00	78.33
2	Validate 0.5 L/ha AHDB9822	25.00	36.67	17.67	31.67	31.67
3	Validate 0.5 L/ha Hurricane SC 0.1 L/ha	21.67	48.33	40.00	58.33	51.67
4	Validate 0.5 L/ha Hurricane SC 0.1 L/ha AHDB9822	20.00	30.00	11.67	21.67	25.00
5	Validate 0.5 L/ha Hurricane SC 0.1 L/ha AHDB9981	25.00	40.00	33.33	50.00	51.67
6	Validate 0.5 L/ha Hurricane SC 0.1 L/ha Starane Hi-Load 0.1 L/ha	23.33	33.33	20.33	33.33	33.33
7	Validate 0.5 L/ha Starane Hi-Load 0.1 L/ha AHDB9822	16.67	23.33	10.00	26.67	26.67
8	Validate 0.5 L/ha Starane Hi-Load 0.1 L/ha AHDB9981	20.00	30.00	19.00	38.33	36.67
F.Pr		0.817	0.01	<.001	<.001	<.001
d.f.		14	14	14	14	14
L.S.D		12.31	15.36	7.911	11.04	11.8
		Not significantly different from untreated control				
		Significantly different from untreated control				

All treatments significantly increased phytotoxicity of the Annabella potatoes at two weeks after the final application on 28th July. Effects were chlorosis and necrosis of foliage ranging from slight to severe.

Validate 0.5 L/ha + **Hurricane SC 0.1 L/ha + AHDB9822**, Validate 0.5 L/ha + **Hurricane SC 0.1 L/ha + Starane Hi-Load 0.1 L/ha** and Validate 0.5 L/ha + **Starane Hi-Load 0.1 L/ha + AHDB9822** significantly increased phytotoxic effects to a moderate to severe level at every assessment date, and resulted in the death of the volunteer potatoes at the final assessment.

The increase in the score in the untreated control on 9th September was due to natural senescence of the potatoes and blight, but it could be observed that the effective treatments still significantly increased the phytotoxic effect on the potatoes.

Table 4. Mean phytotoxicity score of Annabella determinate potatoes at each assessment date 0 = no damage 10 = crop death. Sprays applied on 1st and 13th July Scores: 0 = no damage shown, 10 = crop death.

Treat No	Treatment	Mean Phytotoxicity (Score 0-10)			
		13 th July Just before Timing 2	28 th July 2 weeks after Timing 2	11 th August 4 weeks after Timing 2	9 th Sept 8 weeks after Timing 2
1	Untreated	0.00	0.00	0.00	4.72
2	Validate 0.5 L/ha AHDB9822	5.67	7.89	6.78	8.89
3	Validate 0.5 L/ha Hurricane SC 0.1 L/ha	2.22	3.11	2.78	7.11
4	Validate 0.5 L/ha Hurricane SC 0.1 L/ha AHDB9822	7.61	8.56	9.28	10.00
5	Validate 0.5 L/ha Hurricane SC 0.1 L/ha AHDB9981	3.06	6.28	2.39	6.56
6	Validate 0.5 L/ha Hurricane SC 0.1 L/ha Starane Hi-Load 0.1 L/ha	5.50	7.22	8.11	10.00
7	Validate 0.5 L/ha Starane Hi-Load 0.1 L/ha AHDB9822	7.94	9.33	7.72	10.00
8	Validate 0.5 L/ha Starane Hi-Load 0.1 L/ha AHDB9981	4.39	5.22	2.67	6.67
F.Pr		<.001	<.001	<.001	0.104
D.F		14	14	14	14
L.S.D		2.393	1.672	1.549	4.138
		Not significantly different from untreated control			
		Significantly different from untreated control			

All treatments significantly reduced determinate potato height from two weeks after the first application until the final assessment on 9th September. Four treatments reduced potato height to zero at the final assessment. These were Validate 0.5 L/ha + **AHDB 9822**, Validate 0.5 L/ha + **Hurricane SC 0.1 L/ha + AHDB9822**, Validate 0.5 L/ha + **Hurricane SC 0.1 L/ha + Starane Hi-Load 0.1 L/ha** and Validate 0.5 L/ha + **Starane Hi-Load 0.1 L/ha + AHDB9822**.

Table 5. Mean height (cm) of Annabella determinate potatoes at each assessment date 0 = no damage 10 = crop death. Sprays applied on 1st and 13th July.

Treat No	Treatment	Mean height (cm)				
		1 st July Just before Timing 1	13 th July Just before Timing 2	28 th July 2 weeks after Timing 2	11 th August 4 weeks after Timing 2	9 th Sept 8 weeks after Timing 2
1	Untreated	16.67	46.67	43.33	45.00	41.67
2	Validate 0.5 L/ha AHDB9822	15.67	18.33	9.00	18.33	0.00
3	Validate 0.5 L/ha Hurricane SC 0.1 L/ha	16.67	31.67	26.67	35.00	8.33
4	Validate 0.5 L/ha Hurricane SC 0.1 L/ha AHDB9822	17.67	21.67	5.00	5.00	0.00

Treat No	Treatment	Mean height (cm)				
		1 st July Just before Timing 1	13 th July Just before Timing 2	28 th July 2 weeks after Timing 2	11 th August 4 weeks after Timing 2	9 th Sept 8 weeks after Timing 2
5	Validate 0.5 L/ha Hurricane SC 0.1 L/ha AHDB9981	18.33	26.67	18.33	33.33	11.67
6	Validate 0.5 L/ha Hurricane SC 0.1 L/ha Starane Hi-Load 0.1 L/ha	17.33	21.67	15.00	30.00	0.00
7	Validate 0.5 L/ha Starane Hi-Load 0.1 L/ha AHDB9822	18.33	16.67	6.67	18.33	0.00
8	Validate 0.5 L/ha Starane Hi-Load 0.1 L/ha AHDB9981	18.33	30.00	20.67	30.00	16.67
F.Pr		0.899	<.001	<.001	<.001	<.001
D.F		14	14	14	14	14
L.S.D		4.832	6.755	5.362	7.673	15.71
		Not significantly different from untreated control				
		Significantly different from untreated control				

As aforementioned, there were differences between the control of the determinate (Anabella) and indeterminate (Markies) potatoes, with the determinate potatoes being easier to control with the experimental treatments tested. No indeterminate potatoes were completely killed.

Conclusions

- All treatments significantly reduced the height of determinate and indeterminate volunteer potato.
- Determinate potatoes were more susceptible to the treatments tested than indeterminate potatoes.
- **Starane Hi-Load, Hurricane SC and AHDB 9982** are promising products for post-emergence volunteer potato control, which provided suppression of indeterminate potatoes, and in some cases death of determinate potatoes when used in tank-mixes.
 - The treatments which suppressed the indeterminate potato height the greatest included either **Starane Hi-Load or AHDB 9822**
- All treatments did not significantly increase the effect on crop fanging or splitting in the carrot roots in this trial, but it should be noted that **Starane Hi-Load** has been observed to increase the occurrence of root hairs to a level detrimental to crop quality in other trials.
- All treatments increased phytotoxic effects on the carrot foliage above an acceptable level at two weeks after application, but the effects were transient.
 - **Starane Hi-Load** caused foliar distortion and curling.
 - **Hurricane SC** caused interveinal chlorosis.
 - **AHDB 9982** caused a slight stunting.

Take home message: All treatments were crop safe in this trial and significantly increased potato phytotoxicity and decreased potato height. **AHDB9822** performed well and should be considered for authorisation. **Hurricane SC** caused moderate to severe suppression of determinate potatoes. **Starane Hi- Load** was effective for potato control, but severe quality effects (root hair proliferation) have been observed on parsnips in other trials, and the product should be tested again in more adverse application conditions.

Objectives

To trial a number of post-emergence tank mixes for selectivity (crop safety) and efficacy of control of volunteer potatoes in parsnips.

Trial conduct

This study will be conducted in compliance with the requirements of the UK Official Recognition of Efficacy Testing scheme. Protocol conforms to EPPO1/99(3) for Weeds in root vegetables.

Relevant EPPO guideline(s)		Variation from EPPO
EPPO PP1/135(4)	Phytotoxicity assessment.	None
EPPO PP1/152(4)	Guideline on design and analysis of efficacy evaluation trials.	None
EPPO PP1/225(2)	Minimum effective dose.	None
EPPO PP1/181(4)	Conduct and reporting of efficacy evaluation trials including good experimental practice.	None
EPPO PP 1/214(3)	Principles of acceptable efficacy.	None
EPPO PP 1/224(2)	Principles of efficacy evaluation for minor uses.	None
EPPO1/99(3)	Weeds in root vegetables	Yes

There were no deviations from EPPO guidance.

EPPO1/99(3) Section 1.4, Design and lay-out of trial.

“Replicates: at least 4”

Current study to have only 3 replicates – number of treatments provides acceptable number of residual degrees of freedom, and client has requested only three replicates.

Test site

Item	Details
Location address	Field: Lbts: Swaffham Road Swaffham Road, Oxborough, Breckland, Norfolk PE33 9DD
Crop	Parsnip
Cultivar	Javelin
Soil or substrate type	Sandy Silt Loam
Agronomic practice	Parsnips drilled 22/05/2020
Prior history of site	2019 – Winter wheat

Trial design

Item	Details
Trial design:	Randomised block
Number of replicates:	3
Row spacing:	1 m
Plot size: (w x l)	1.88 m X 5 m
Plot size: (m ²)	9.40
Number of plants per plot:	385
Leaf Wall Area calculations	N/A

Treatment details

AHDB Code	Active substance	Product name/ manufacturers code	Formulation batch number	Content of active substance in product	Formulation type	Adjuvant
Untreated	N/A	N/A	N/A	N/A	N/A	No
AHDB 9822	N/D	N/D	10238668	N/D	N/D	No
N/A	diflufenican	Hurricane SC	19008335	500 g/L	Suspension concentrate	No
AHDB 9981	N/D	N/D	04287B1823	N/D	N/D	No
N/A	fluroxypyr	Starane Hi-Load	F006J3K202	480 g/L (20.7% w/w)	Emulsifiable concentrate	No
N/A	lecithin, esterified vegetable oil, alcohol ethoxylate	Validate	PCS NO. 92262	(50% w/w) (25% w/w) (25% w/w)		Yes

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 code
1	Untreated	N/A	N/A	N/A
2	Validate	(50% w/w) (25% w/w) (25% w/w)	0.5	A,B
	AHDB9822		0.5	
3	Validate	(50% w/w) (25% w/w) (25% w/w)	0.5	A,B
	Hurricane SC	50	0.1	
4	Validate	(50% w/w) (25% w/w) (25% w/w)	0.5	A,B
	Hurricane SC	50	0.1	
	AHDB9822		0.5	
5	Validate	(50% w/w) (25% w/w) (25% w/w)	0.5	A,B
	Hurricane SC	50	0.1	
	AHDB9981	(45% w/w)	(kg/ha) 0.5	
6	Validate	(50% w/w) (25% w/w) (25% w/w)	0.5	A,B
	Hurricane SC	50	0.1	
	Starane Hi-Load	48	0.1	
7	Validate	(50% w/w) (25% w/w) (25% w/w)	0.5	A,B
	Starane Hi-Load	48	0.1	
	AHDB9822		0.5	

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 code
8	Validate	(50% w/w) (25% w/w) (25% w/w)	0.5	A,B
	Starane Hi-Load	48	0.1	
	AHDB9981		0.5	

Application details

	Application A	Application B
Application date	01/07/2020	13/07/2020
Time of day	11:00	10:30
Crop growth stage (Max, min average BBCH)	12	14
Crop height (cm)	3	5
Crop coverage (%)	25	35
Application Method	Spray	Spray
Application Placement	Soil/Foliar	Soil/Foliar
Application equipment	Oxford precision sprayer	Oxford precision sprayer
Nozzle pressure	3.0	3.0
Nozzle type	Flat fan	Flat fan
Nozzle size	02F110	02F110
Application water volume/ha	400 L/ha	400 L/ha
Temperature of air - shade (°C)	17.05	14.8
Relative humidity (%)	81.5	63.5
Wind speed range (m/s)	0.5	0.8
Dew presence (Y/N)	N	N
Temperature of soil - 2-5 cm (°C)	N/A	N/A
Wetness of soil - 2-5 cm	Dry	Dry
Cloud cover (%)	100	80

N/A = not available

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
Volunteer potatoes	<i>Solanum tuberosum</i>	SOLTU	6 plants	6 plants	6 plants

Assessment details

The carrots were drilled 22nd May and developed to 102 BBCH before preliminary assessments and treatment applications were made. Two potato varieties Markies - (indeterminate) and Annabelle (determinate) were planted 2nd of June when the parsnips emerged. Plant population assessments were carried out before the first treatment application and two weeks after the final application. Four additional assessments were made at two, four, and eight weeks after application B and at harvest, recording treatment effects on the crop and the potatoes. Plants were scored on a 0 to 10 phytotoxicity scale, where 0 is no effect on the plant, 2 is an acceptable

level of damage that should have no adverse effect on the plant and 10 is complete plant death (**Table 1**). Counts of fanged roots were made of 100 roots just prior to harvest with any other defects noted.

Table 1. Scale used for the assessment of the extent of phytotoxic damage in treated plots.

Crop tolerance score	Equivalent to crop damage (% phytotoxicity)
0	<i>(no damage)</i> 0%
1	10%
*2	<i>(acceptable damage)</i> 20%
3	30%
4	40%
5	50%
6	60%
7	70%
8	80%
9	90%
10	<i>(complete crop kill)</i> 100%

Evaluation date	Evaluation timing (DA)*	Crop Growth Stage (BBCH)	Evaluation type (efficacy, phytotox)	Assessment
01/07/2020	N/A	102	Baseline	Plant population count
13/07/2020	12	104	Efficacy, phytotoxicity	Phytotoxicity (scale 0-10; 10 = dead), weed height (cm).
28/07/2020	27	105	Efficacy, phytotoxicity	Phytotoxicity (scale 0-10; 10 = dead), weed height (cm).
29/07/2020	27	105	Phytotoxicity	Plant population count
11/08/2020	42	105	Efficacy, phytotoxicity	Phytotoxicity (scale 0-10; 10 = dead), weed height (cm).
09/09/2020	71	106	Efficacy, phytotoxicity	Phytotoxicity (scale 0-10; 10 = dead), weed height (cm).
14/10/2020	106	N/A	Phytotoxicity	Crop fanging and excessive root hairs

* DA – days after application

Statistical analysis

The trial design was a fully randomised block design, with three replicates of eight treatments including an untreated control.

All data was analysed by ANOVA using Genstat (18th edition) by Chris Dyer at RSK ADAS UK Ltd.

Results

Phytotoxicity

There was no significant effect ($p < 0.05$) on plant population per m^2 at any assessment date.

All treatments had a significant effect on the crop, with all phytotoxicity scores greater than the acceptable score of 2 when compared to the untreated control at two weeks after the first application (14th July). The effects were exhibited as interveinal chlorosis and whitening where plots had been treated with **Hurricane SC**, and distortion of the foliage where plots have been treated with **Starane Hi-Load**. Treatments where **AHDB 9822** had been included exhibited the most severe phytotoxic effects gaining moderate scores from 3.3 to 6 at two weeks after the first application (14th July). The symptoms were necrosis of the treated leaves in addition to either chlorosis or distortion where the spray had been applied with either **Hurricane SC** or **Starane Hi-Load** respectively (**Table 2**). However, the foliage had recovered from the application at four weeks after Timing 2 with new growth unaffected by the treatment.

All treatments except Validate + **Hurricane SC** increased crop phytotoxicity greater than the commercially acceptable score (> 2) on the 28th July at two weeks after the final application. But by four weeks after the final application, no significant differences in crop phytotoxicity were observed on the 11th August or 9th September. All scores also fell below the commercially acceptable score of 2, indicating that the foliar effects were transient and the crop had recovered at four weeks after the second and final application timing. Any foliar effects had completely disappeared by eight weeks after the final treatment application.

Table 2. Mean crop phytotoxicity at two four and six weeks after the second treatment application. 0 = no damage 10 = crop death < 2 = acceptable damage not likely to affect yield or quality. Scores > 2 highlighted in red.

Treat No	Treatment	Mean parsnip phytotoxicity scores (0-10)			
		13 th July Just before Timing 2	28 th July 2 weeks after Timing 2	11 th August 4 weeks after Timing 2	9 th Sept 8 weeks after Timing 2
1	Untreated	0.00	0.00	0.00	0.00
2	Validate 0.5 L/ha AHDB9822	3.33	2.33	0.67	0.00
3	Validate 0.5 L/ha Hurricane SC 0.1 L/ha	2.67	1.67	1.00	0.00
4	Validate 0.5 L/ha Hurricane SC 0.1 L/ha AHDB9822	6.00	2.33	0.67	0.00
5	Validate 0.5 L/ha Hurricane SC 0.1 L/ha AHDB9981	3.67	4.33	1.67	0.00
6	Validate 0.5 L/ha Hurricane SC 0.1 L/ha Starane Hi-Load 0.1 L/ha	3.00	2.33	1.00	0.00
7	Validate 0.5 L/ha Starane Hi-Load 0.1 L/ha AHDB9822	4.00	2.67	1.33	0.00
8	Validate 0.5 L/ha Starane Hi-Load 0.1 L/ha AHDB9981	3.67	2.67	1.00	0.00
F.Pr		<.001	<.001	0.628	N/A
D.F		14	14	14	14
L.S.D		1.154	1.055	1.725	N/A
		Not significantly different from untreated control			
		Significantly different from untreated control			

There were no significant differences between the treatments and the untreated control with respect to percentage incidence of fanging or split carrots when harvested in this trial. (**Table 3**)

Table 3. Mean percentage of fanged and split carrots at harvest on 14th October 2020.

Treat No	Treatment	Mean Fanging (%)	Mean Excessive root hairs (%)
1	Untreated	1.00	18.67
2	Validate 0.5 L/ha AHDB9822	0.00	7.33
3	Validate 0.5 L/ha Hurricane SC 0.1 L/ha	0.33	9.33
4	Validate 0.5 L/ha Hurricane SC 0.1 L/ha AHDB9822	0.67	14.00
5	Validate 0.5 L/ha Hurricane SC 0.1 L/ha AHDB9981	0.00	16.00
6	Validate 0.5 L/ha Hurricane SC 0.1 L/ha Starane Hi-Load 0.1 L/ha	0.00	18.67
7	Validate 0.5 L/ha Starane Hi-Load 0.1 L/ha AHDB9822	0.33	12.67
8	Validate 0.5 L/ha Starane Hi-Load 0.1 L/ha AHDB9981	1.33	16.67
F.Pr		0.179	0.743
D.F		14	14
L.S.D		1.154	16.31

Efficacy – effect on potatoes

Indeterminate variety – Markies

The results for mean phytotoxicity and height of the Markies potatoes are presented in **Table 4 and 5**~~Error! Reference source not found.~~

All treatments significantly increased phytotoxicity on the Markies potatoes with the exception of Validate 0.5 L/ha + **Hurricane SC 0.1 L/ha** at two weeks after this final application on 28th July. Effects were chlorosis and necrosis of potato foliage ranging from slight to severe.

By the last assessment, eight weeks after the final treatment was applied, only two treatments still significantly increased phytotoxicity on Markies potatoes. These treatments are Validate 0.5 L/ha + **Hurricane SC 0.1 L/ha + AHDB9822**, and Validate 0.5 L/ha + **Starane Hi-Load 0.1 L/ha + AHDB9822**. Potatoes sprayed with these treatments still had moderate symptoms of phytotoxicity at the final assessment which were severe chlorosis and necrosis of the foliage.

No treatments killed the indeterminate Markies potatoes.

Table 4. Mean indeterminate potato (Markies) phytotoxicity at the dates shown. First herbicide application- 1st July, Final application – 13th July. Scores: 0 = no damage shown, 10 = crop death.

Treat No	Treatment	Mean Markies phytotoxicity scores (0-10)			
		13 th July Just before Timing 2	28 th July 2 weeks after Timing 2	11 th August 4 weeks after Timing 2	9 th Sept 8 weeks after Timing 2
1	Untreated	0.00	0.00	0.00	1.00
2	Validate 0.5 L/ha AHDB9822	4.72	6.78	4.06	1.61
3	Validate 0.5 L/ha Hurricane SC 0.1 L/ha	1.56	0.94	0.78	0.56
4	Validate 0.5 L/ha Hurricane SC 0.1 L/ha AHDB9822	4.94	8.28	6.39	5.00
5	Validate 0.5 L/ha Hurricane SC 0.1 L/ha AHDB9981	2.44	3.00	1.28	0.00
6	Validate 0.5 L/ha Hurricane SC 0.1 L/ha Starane Hi-Load 0.1 L/ha	3.06	6.83	4.00	2.33
7	Validate 0.5 L/ha Starane Hi-Load 0.1 L/ha AHDB9822	4.72	6.83	5.50	5.11
8	Validate 0.5 L/ha Starane Hi-Load 0.1 L/ha AHDB9981	1.50	3.78	2.00	1.06
F.Pr		<.001	<.001	<.001	0.055
d.f.		14	14	14	14
L.S.D		2.022	1.853	1.744	3.632
		Not significantly different from untreated control			
		Significantly different from untreated control			

All treatments significantly reduced the mean height of the indeterminate Markies potato variety at the final assessment, recorded eight weeks after the final treatment application. The treatments which suppressed the potato height the greatest included either **Starane Hi-Load or AHDB 9822**. These reduced the height by between 53 and 68% compared to the untreated control when combined with Validate or other products. The best performing treatment was **Validate 0.5 L/ha + Hurricane SC 0.1 L/ha + AHDB9822**.

Table 5. Mean height (cm) of Markies indeterminate potatoes at each assessment date. Sprays applied on 1st July and 13th July.

Trt No	Treatment	Mean height (cm)				
		1 st July Just before Timing 1	13 th July Just before Timing 2	28 th July 2 weeks after Timing 2	11 th August 4 weeks after Timing 2	9 th Sept 8 weeks after Timing 2
1	Untreated	23.33	55.00	55.00	80.00	78.33
2	Validate 0.5 L/ha AHDB9822	25.00	36.67	17.67	31.67	31.67
3	Validate 0.5 L/ha Hurricane SC 0.1 L/ha	21.67	48.33	40.00	58.33	51.67
4	Validate 0.5 L/ha Hurricane SC 0.1 L/ha AHDB9822	20.00	30.00	11.67	21.67	25.00

Trt No	Treatment	Mean height (cm)				
		1 st July Just before Timing 1	13 th July Just before Timing 2	28 th July 2 weeks after Timing 2	11 th August 4 weeks after Timing 2	9 th Sept 8 weeks after Timing 2
5	Validate 0.5 L/ha Hurricane SC 0.1 L/ha AHDB9981	25.00	40.00	33.33	50.00	51.67
6	Validate 0.5 L/ha Hurricane SC 0.1 L/ha Starane Hi-Load 0.1 L/ha	23.33	33.33	20.33	33.33	33.33
7	Validate 0.5 L/ha Starane Hi-Load 0.1 L/ha AHDB9822	16.67	23.33	10.00	26.67	26.67
8	Validate 0.5 L/ha Starane Hi-Load 0.1 L/ha AHDB9981	20.00	30.00	19.00	38.33	36.67
F.Pr		0.817	0.01	<.001	<.001	<.001
d.f.		14	14	14	14	14
L.S.D		12.31	15.36	7.911	11.04	11.8
		Not significantly different from untreated control				
		Significantly different from untreated control				

Determinate variety – Annabella

The results for mean phytotoxicity and height of the Annabella potatoes are presented in **Table 6 and 7** **Error! Reference source not found.**

All treatments significantly increased phytotoxicity of the Annabella potatoes at two weeks after the final application on 28th July. Effects were chlorosis and necrosis of foliage ranging from slight to severe.

Validate 0.5 L/ha + **Hurricane SC 0.1 L/ha + AHDB9822**, Validate 0.5 L/ha + **Hurricane SC 0.1 L/ha + Starane Hi-Load 0.1 L/ha** and Validate 0.5 L/ha + **Starane Hi-Load 0.1 L/ha + AHDB9822** significantly increased phytotoxic effects to a moderate to severe level at every assessment date, and resulted in the death of the volunteer potatoes at the final assessment.

The increase in the score in the untreated control on 9th September was due to natural senescence of the potatoes and blight, but it could be observed that the effective treatments still significantly increased the phytotoxic effect on the potatoes.

Table 6. Mean phytotoxicity score of Annabella determinate potatoes at each assessment date 0 = no damage 10 = crop death. Sprays applied on 1st and 13th July Scores: 0 = no damage shown, 10 = crop death.

Treat No	Treatment	Mean Phytotoxicity (Score 0-10)			
		13 th July Just before Timing 2	28 th July 2 weeks after Timing 2	11 th August 4 weeks after Timing 2	9 th Sept 8 weeks after Timing 2
1	Untreated	0.00	0.00	0.00	4.72
2	Validate 0.5 L/ha AHDB9822	5.67	7.89	6.78	8.89
3	Validate 0.5 L/ha Hurricane SC 0.1 L/ha	2.22	3.11	2.78	7.11
4	Validate 0.5 L/ha Hurricane SC 0.1 L/ha AHDB9822	7.61	8.56	9.28	10.00

Treat No	Treatment	Mean Phytotoxicity (Score 0-10)			
		13 th July Just before Timing 2	28 th July 2 weeks after Timing 2	11 th August 4 weeks after Timing 2	9 th Sept 8 weeks after Timing 2
5	Validate 0.5 L/ha Hurricane SC 0.1 L/ha AHDB9981	3.06	6.28	2.39	6.56
6	Validate 0.5 L/ha Hurricane SC 0.1 L/ha Starane Hi-Load 0.1 L/ha	5.50	7.22	8.11	10.00
7	Validate 0.5 L/ha Starane Hi-Load 0.1 L/ha AHDB9822	7.94	9.33	7.72	10.00
8	Validate 0.5 L/ha Starane Hi-Load 0.1 L/ha AHDB9981	4.39	5.22	2.67	6.67
F.Pr		<.001	<.001	<.001	0.104
D.F		14	14	14	14
L.S.D		2.393	1.672	1.549	4.138
		Not significantly different from untreated control			
		Significantly different from untreated control			

All treatments significantly reduced determinate potato height from two weeks after the first application until the final assessment on 9th September. Four treatments reduced potato height to zero at the final assessment. These were Validate 0.5 L/ha + **AHDB 9822**, Validate 0.5 L/ha + **Hurricane SC 0.1 L/ha + AHDB9822**, Validate 0.5 L/ha + **Hurricane SC 0.1 L/ha + Starane Hi-Load 0.1 L/ha** and Validate 0.5 L/ha + **Starane Hi-Load 0.1 L/ha + AHDB9822**.

Table 7. Mean height (cm) of Annabella determinate potatoes at each assessment date 0 = no damage 10 = crop death. Sprays applied on 1st and 13th July.

Treat No	Treatment	Mean height (cm)				
		1 st July Just before Timing 1	13 th July Just before Timing 2	28 th July 2 weeks after Timing 2	11 th August 4 weeks after Timing 2	9 th Sept 8 weeks after Timing 2
1	Untreated	16.67	46.67	43.33	45.00	41.67
2	Validate 0.5 L/ha AHDB9822	15.67	18.33	9.00	18.33	0.00
3	Validate 0.5 L/ha Hurricane SC 0.1 L/ha	16.67	31.67	26.67	35.00	8.33
4	Validate 0.5 L/ha Hurricane SC 0.1 L/ha AHDB9822	17.67	21.67	5.00	5.00	0.00
5	Validate 0.5 L/ha Hurricane SC 0.1 L/ha AHDB9981	18.33	26.67	18.33	33.33	11.67
6	Validate 0.5 L/ha Hurricane SC 0.1 L/ha Starane Hi-Load 0.1 L/ha	17.33	21.67	15.00	30.00	0.00
7	Validate 0.5 L/ha Starane Hi-Load 0.1 L/ha AHDB9822	18.33	16.67	6.67	18.33	0.00
8	Validate 0.5 L/ha Starane Hi-Load 0.1 L/ha AHDB9981	18.33	30.00	20.67	30.00	16.67
F.Pr		0.899	<.001	<.001	<.001	<.001

Treat No	Treatment	Mean height (cm)				
		1 st July Just before Timing 1	13 th July Just before Timing 2	28 th July 2 weeks after Timing 2	11 th August 4 weeks after Timing 2	9 th Sept 8 weeks after Timing 2
D.F		14	14	14	14	14
L.S.D		4.832	6.755	5.362	7.673	15.71
		Not significantly different from untreated control				
		Significantly different from untreated control				

Discussion

All treatments significantly increased the phytotoxic effects on the parsnip crop for up to two weeks after the final application with the exception of Validate + **Hurricane SC** where effects on the parsnips were at an acceptable level by the application of Timing 2. At the final harvest assessment there was no significant effects observed in crop phytotoxicity, excessive root hairs or fanged parsnips in this trial. All treatments scored below the acceptable crop damage threshold (2.00). However, it should be noted that in other studies **Starane Hi-Load** has caused unacceptable root distortion with excessive root hairs being produced. In this study the sprays were applied in cool temperatures, and therefore in more extreme application conditions of heat and/or humidity, these effects may be produced. Therefore, it would be advisable to test these treatments again before considering commercial use.

All treatments significantly increased phytotoxic damage to both potato species for up to two weeks after the final application, with the exception of Validate 0.5 L/ha + **Hurricane SC 0.1 L/ha**.

All treatments significantly increased phytotoxicity on the Markies potatoes with the exception of Validate 0.5 L/ha + **Hurricane SC 0.1 L/ha** at two weeks after this final application on 28th July. Effects were chlorosis and necrosis of potato foliage ranging from slight to severe.

By the last assessment, eight weeks after the final treatment was applied, only two treatments still significantly increased phytotoxicity on Markies potatoes. These treatments are Validate 0.5 L/ha + **Hurricane SC 0.1 L/ha + AHDB9822**, and Validate 0.5 L/ha + **Starane Hi-Load 0.1 L/ha + AHDB9822**. Potatoes sprayed with these treatments still had moderate symptoms of phytotoxicity at the final assessment which were severe chlorosis and necrosis of the foliage.

All treatments significantly reduced the mean height of the indeterminate Markies potato variety at the final assessment, recorded eight weeks after the final treatment application. The treatments which suppressed the potato height the greatest included either **Starane Hi-Load or AHDB 9822**. These reduced the height by between 53 and 68% compared to the untreated control when combined with Validate or other products. The best performing treatment was Validate 0.5 L/ha + **Hurricane SC 0.1 L/ha + AHDB9822**.

All treatments significantly increased phytotoxicity of the Annabella potatoes at two weeks after the final application on 28th July. Effects were chlorosis and necrosis of foliage ranging from slight to severe.

Validate 0.5 L/ha + **Hurricane SC 0.1 L/ha + AHDB9822**, Validate 0.5 L/ha + **Hurricane SC 0.1 L/ha + Starane Hi-Load 0.1 L/ha** and Validate 0.5 L/ha + **Starane Hi-Load 0.1 L/ha + AHDB9822** significantly increased phytotoxic effects to a moderate to severe level at every assessment date, and resulted in the death of the volunteer potatoes at the final assessment.

The increase in the score in the untreated control on 9th September was due to natural senescence of the potatoes and blight, but it could be observed that the effective treatments still significantly increased the phytotoxic effect on the potatoes.

All treatments significantly reduced determinate potato height from two weeks after the first application until the final assessment on 9th September. Four treatments reduced potato height

to zero at the final assessment. These were Validate 0.5 L/ha + **AHDB 9822**, Validate 0.5 L/ha + **Hurricane SC 0.1 L/ha + AHDB9822**, Validate 0.5 L/ha + **Hurricane SC 0.1 L/ha + Starane Hi-Load 0.1 L/ha** and Validate 0.5 L/ha + **Starane Hi-Load 0.1 L/ha + AHDB9822**.

As aforementioned, there were differences between the control of the determinate (Anabella) and indeterminate (Markies) potatoes, with the determinate potatoes being easier to control with the experimental treatments tested. No indeterminate potatoes were completely killed.

Conclusions

- All treatments significantly reduced the height of determinate and indeterminate volunteer potato.
- Determinate potatoes were more susceptible to the treatments tested than indeterminate potatoes.
- **Starane Hi-Load, Hurricane SC and AHDB 9822** are promising products for post-emergence volunteer potato control, which provided suppression of indeterminate potatoes, and in some cases death of determinate potatoes when used in tank-mixes.
 - The treatments which suppressed the indeterminate potato height the greatest included either **Starane Hi-Load or AHDB 9822**
- All treatments did not significantly increase the effect on crop fanging or splitting in the carrot roots in this trial, but it should be noted that **Starane Hi-Load** has been observed to increase the occurrence of root hairs to a level detrimental to crop quality in other trials.
- All treatments increased phytotoxic effects on the carrot foliage above an acceptable level at two weeks after application, but the effects were transient.
 - **Starane Hi-Load** caused foliar distortion and curling.
 - **Hurricane SC** caused interveinal chlorosis.
 - **AHDB 9822** caused a slight stunting.
-

Acknowledgements

AHDB for funding the work, and the crop protection companies for their financial contributions as well as providing samples for the trials. Vegetable Consultancy Services (UK) Ltd for trial delivery. Thanks also to O. W. Wortley & Sons who provided the site and crop for the trial.

Appendix

a. Crop diary – events related to growing crop

Crop	Cultivar	Drilling/planting date	Bed width
Parsnip	Javelin	22/05/2020	Bed width 1.88m, 4 rows per bed
Potatoes	Markies	05/06/2020	
Potatoes	Annabelle		

Date	Product	Rate	Unit
01/06/2020	Emerger	1.00	L/ha
	Goltix 70 SC	0.70	L/ha
	Stomp aqua	2.80	L/ha
01/07/2020	Minecto one	0.185	Kg/ha
	Bridgeway	1.50	L/ha
15/07/2020	Emerger	0.20	L/ha
	Defy	0.40	L/ha
20/07/2020	Movento	0.30	L/ha
	Hallmark with zeon technology	0.15	L/ha
	Bridgeway	2.00	L/ha
	Techmangam	3.00	Kg/ha
22/07/2020	Bittersalt epsotop	3.00	Kg/ha
	X change	0.25	L/ha
	Centurion Max	1.40	L/ha
03/08/2020	Hallmark with zeon technology	0.10	L/ha
	Amistar top	1.00	L/ha
	Sulphur Gold	3.00	L/ha
17/08/2020	Reflect	1.00	L/ha
	Hallmark with zeon technology	0.10	L/ha
	Headland boron 15%	3.00	L/ha
	Techmangam	3.00	Kg/ha
	Bridgeway	2.00	L/ha
31/08/2020	Signum	1.00	Kg/ha
	Hallmark with zeon technology	0.10	L/ha
	Bittersalt epsotop	3.00	Kg/ha
	Headland copper 435	0.50	L/ha
14/09/2020	Reflect	1.00	L/ha
	Headland Sulphur	3.00	L/ha
	Techmangam	3.00	Kg/ha
	Calmax ultra	1.00	L/ha
07/10/2020	Amistar	1.00	L/ha

	Headland Copper	0.50	L/ha
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b. Trial diary

Date	Event
01/07/2020	Timing A application Trial assessment, plant population count
13/07/2020	Timing B application Trial assessment, crop phyto, potato phyto, potato height
28/07/2020	Trial assessment, crop phyto, potato phyto, potato height
29/07/2020	Plant population count
11/08/2020	Trial assessment, crop phyto, potato phyto, potato height
09/09/2020	Trial assessment, crop phyto, potato phyto, potato height
14/10/2020	Harvest, crop fanging, excessive root hairs

c. Photographs



Figure 1 Overview of trial site



Figure 2. Untreated control



Figure 3. AHDB 9822 + Validate 0.5 L/ha



Figure 4. Hurricane 0.1 L/ha + Validate 0.5 L/ha

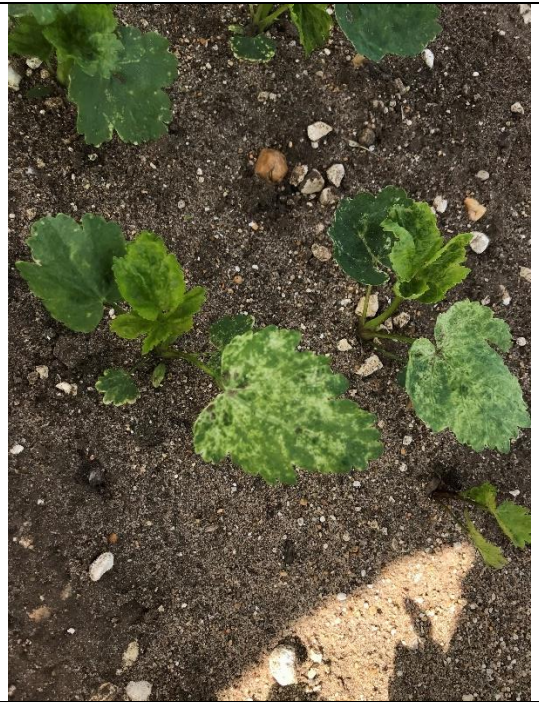


Figure 5. Hurricane 0.1 L/ha + Validate 0.5 L/ha effect on crop



Figure 6. Starane 0.1 L/ha + Hurricane 0.1 L/ha + Validate 0.5 L/ha



Figure 7. Starane 0.1 L/ha + Hurricane 0.1 L/ha + Validate 0.5 L/ha effect on crop

d. Climatological data during study period

Date	Min Temp (°C)	Max temp (°C)	Av. Relative humidity (%)
1-07-20	15.00	20.60	81.75
2-07-20	12.10	20.00	82.59
3-07-20	11.50	21.00	79.35
4-07-20	15.30	20.50	86.33
5-07-20	14.10	22.50	61.60
6-07-20	11.40	19.90	67.50
7-07-20	8.00	20.10	86.94
8-07-20	12.40	16.70	96.24
9-07-20	13.50	18.40	97.48
10-07-20	11.00	18.50	85.55
11-07-20	8.40	18.60	78.66
12-07-20	7.20	25.60	69.80
13-07-20	9.40	23.40	77.20
14-07-20	11.00	20.60	78.89
15-07-20	8.80	18.30	87.23
16-07-20	14.40	21.60	83.49
17-07-20	14.80	27.50	69.04
18-07-20	14.90	24.50	75.74
19-07-20	12.20	21.60	77.71
20-07-20	9.70	19.40	73.96
21-07-20	6.70	21.10	71.38
22-07-20	11.90	24.80	64.48
23-07-20	13.10	25.90	65.53
24-07-20	14.60	23.90	74.03
25-07-20	13.20	24.30	86.85
26-07-20	11.50	23.20	76.56
27-07-20	12.40	21.20	88.68
28-07-20	10.90	21.40	71.60
29-07-20	10.20	23.70	70.32
30-07-20	11.90	29.40	63.12
31-07-20	15.10	34.30	50.85
1-08-20	17.30	26.90	65.50
2-08-20	12.00	25.30	64.47
3-08-20	9.60	22.20	78.48
4-08-20	6.80	22.60	68.26
5-08-20	16.30	28.70	62.23
6-08-20	17.30	26.40	81.05
7-08-20	13.30	34.90	64.52
8-08-20	16.80	26.20	79.75
9-08-20	16.40	31.40	78.27
10-08-20	16.20	34.40	69.02
11-08-20	16.90	34.40	72.74
12-08-20	16.70	36.30	67.13
13-08-20	16.60	20.70	94.37
14-08-20	16.10	22.10	96.71
15-08-20	16.80	19.60	99.42
16-08-20	16.80	23.00	96.92
17-08-20	14.70	24.60	93.83

Date	Min Temp (°C)	Max temp (°C)	Av. Relative humidity (%)
18-08-20	14.60	25.50	84.78
19-08-20	15.10	21.80	96.75
20-08-20	15.20	27.10	73.08
21-08-20	16.10	26.00	72.38
22-08-20	13.80	25.10	74.68
23-08-20	12.80	23.50	85.20
24-08-20	11.00	28.90	84.18
25-08-20	14.10	22.30	92.75
26-08-20	12.70	19.40	89.85
27-08-20	10.10	19.80	95.81
28-08-20	11.80	20.10	100.00
29-08-20	12.30	14.50	99.89
30-08-20	11.20	17.60	92.70
31-08-20	6.90	20.50	92.57
1-09-20	5.00	22.60	91.32
2-09-20	5.80	21.20	88.71
3-09-20	14.00	20.60	98.80
4-09-20	11.10	19.90	91.21
5-09-20	8.40	19.10	89.25
6-09-20	8.60	22.10	89.90
7-09-20	8.50	18.20	96.14
8-09-20	13.60	24.20	93.42
9-09-20	7.80	23.50	86.99
10-09-20	4.40	17.40	86.69
11-09-20	6.60	17.60	85.53
12-09-20	10.60	22.00	81.00
13-09-20	11.30	25.70	83.17
14-09-20	8.00	30.90	80.26
15-09-20	8.40	32.70	82.45
16-09-20	13.20	22.50	92.01
17-09-20	6.80	23.40	83.03
18-09-20	6.70	21.90	82.01
19-09-20	11.20	23.70	83.95
20-09-20	9.70	22.40	88.08
21-09-20	7.80	26.20	86.51
22-09-20	7.90	26.50	81.18
23-09-20	10.50	17.90	96.90
24-09-20	7.20	17.40	90.75
25-09-20	8.00	10.30	96.51
26-09-20	5.90	12.10	94.33
27-09-20	10.10	12.40	99.39
28-09-20	6.80	17.40	91.11
29-09-20	6.80	14.30	99.83
30-09-20	8.70	17.70	95.31
1-10-20	6.60	15.70	95.92
2-10-20	7.30	15.70	94.61
3-10-20	10.90	15.40	100.00
4-10-20	8.40	10.80	100.00
5-10-20	9.40	14.90	98.56

Date	Min Temp (°C)	Max temp (°C)	Av. Relative humidity (%)
6-10-20	8.50	16.80	97.41
7-10-20	8.60	16.30	90.61
8-10-20	4.30	15.80	98.94
9-10-20	3.30	13.30	96.50
10-10-20	4.10	14.00	98.85
11-10-20	4.20	14.30	96.05
12-10-20	4.50	13.30	96.84

e. Trial design

	104 7	108 2	204 6	208 1	304 3	308 7	
	103 4	107 8	203 4	207 5	303 6	307 2	
	102 5	106 1	202 7	206 3	302 4	306 8	
	101 3	105 6	201 2	205 8	301 5	305 1	

f. ORETO certificate



Certificate of

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

This certifies that

RSK ADAS Ltd

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
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Biologicals and Semiochemicals**

Date of issue: 1 June 2018
Effective date: 18 March 2018
Expiry date: 17 March 2023

Signature 
Authorised signatory

Certification Number

ORETO 409



Chemicals Regulation Division



Department of
Agriculture and
Rural Development