

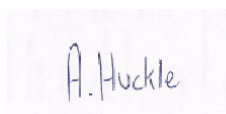
SCEPTREPLUS

Final Trial Report

Trial code:	SP 35.2020 Trial 1 of 2
Title:	AHDB SCEPTREplus volunteer potato control in carrots herbicide screen – 2020
Crop	Carrot
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:	12 th January 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

12th January 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 carrots, 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 carrot 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 carrots.

Methods

The trial was sited in a commercial carrot field near Larling, Norfolk, with the crop drilled on 19th May (variety 'Nairobi'). The trial was laid out as a randomised block design, with three replicates of twelve treatments giving thirty-six 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 carrots emerged on 2nd June. Treatments were applied at two timings, the first were applied on 2nd July 2020 when the potatoes had reached a small rosette, with the second application 13 days later on the 15th 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; 14th July, 28th July, 11th August and the 8th 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 13th October.

Results

All treatments significantly increased phytotoxic effects on the carrot crop for up to a month after application with the exception of Validate + **Hurricane SC**, where effects on the carrots were at an acceptable level at two weeks after application. (**Table 1**) At the final harvest assessment there were no significant effects observed in crop phytotoxicity, number of splits or fanged carrots. All treatments scored below the acceptable crop damage threshold of two. 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 still be produced. Therefore, it would be advisable to test these treatments again to ensure crop safety before considering commercial use.

Table 1. Mean carrot crop phytotoxicity scores. 0 = no damage 10 = crop death < 2 = acceptable damage not likely to affect yield or quality. Sprays applied on 2nd and 15th July.

		Mean crop phytotoxicity scores (0-10)		
		14 th July Just before Timing 2	28 th July 2 weeks after Timing 2	11 th August 4 weeks after Timing 2
1	Untreated	0.00	0.00	0.17
3	AHDB9822 Sencorex 0.3 then 0.5 L/ha	1.67	1.00	0.33
4	Validate 0.5 L/ha AHDB9822	3.00	1.33	0.00
5	Validate 0.5 L/ha Hurricane SC 0.1 L/ha	2.33	0.33	0.00
6	Validate 0.5 L/ha Hurricane SC 0.1 L/ha AHDB9822	5.67	3.00	0.33

		Mean crop phytotoxicity scores (0-10)		
		14 th July Just before Timing 2	28 th July 2 weeks after Timing 2	11 th August 4 weeks after Timing 2
7	Validate 0.5 L/ha Hurricane SC 0.1 L/ha Sencorex 0.3 then 0.5 L/ha	3.33	1.00	0.33
8	Validate 0.5 L/ha Hurricane SC 0.1 L/ha AHDB9981	2.33	1.00	0.33
9	Validate 0.5 L/ha Hurricane SC 0.1 L/ha Starane Hi-Load 0.1 L/ha	3.33	1.33	0.00
10	Validate 0.5 L/ha Starane Hi-Load 0.1 L/ha AHDB9822	2.67	0.67	0.00
11	Validate 0.5 L/ha Starane Hi-Load 0.1 L/ha Sencorex 0.3 then 0.5 L/ha	1.67	1.00	0.33
12	Validate 0.5 L/ha Starane Hi-Load 0.1 L/ha AHDB9981	1.33	0.67	0.00
F pr		<.001	<.001	0.886
D.F		23	23	23
L.S.D		1.192	0.523	0.610
		Not significantly different from untreated control (p>0.05)		
		Significantly different from untreated control (p<0.05)		

All treatments significantly increased damage to both potato species,

Three treatments resulted in significant phytotoxic damage to indeterminate potatoes throughout the trial, these were; Validate + **Hurricane SC** + **Starane Hi-Load**, Validate + **Starane Hi-Load** + **AHDB9822**, and Validate + **Starane Hi-Load** + Sencorex (**Table 2**). All treatments except Validate + **Hurricane SC**, Validate + **Hurricane SC** + Sencorex, and Validate + **Hurricane SC** + **AHDB9981** significantly reduced potato height throughout the trial (**Table 3**). The only treatment which nearly killed the potatoes is Validate + **Starane Hi-Load** + **AHDB9822**. All other treatments only offered moderate to severe suppression.

The increase in the phytotoxicity score in the untreated control on 8th 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 2. Mean phytotoxicity score of Markies indeterminate potatoes at each assessment date, 0 = no damage 10 = crop death. Sprays applied on 2nd and 15th July.

		Mean Phytotoxicity (Score 0-10)			
Treat No	Treatment	14/7/20	28/7/20	11/8/20	08/9/20
1	Untreated	0.00	0.00	0.86	3.44
3	AHDB9822 Sencorex 0.3 then 0.5 L/ha	5.61	7.06	7.22	6.22
4	Validate 0.5 L/ha AHDB9822	5.39	6.28	6.28	6.28
5	Validate 0.5 L/ha Hurricane SC 0.1 L/ha	2.50	1.94	2.22	3.56

Treat No	Treatment	Mean Phytotoxicity (Score 0-10)			
		14/7/20	28/7/20	11/8/20	08/9/20
6	Validate 0.5 L/ha Hurricane SC 0.1 L/ha AHDB9822	6.06	6.44	5.61	5.94
7	Validate 0.5 L/ha Hurricane SC 0.1 L/ha Sencorex 0.3 then 0.5 L/ha	3.44	4.28	4.06	5.56
8	Validate 0.5 L/ha Hurricane SC 0.1 L/ha AHDB9981	4.17	4.89	5.17	6.17
9	Validate 0.5 L/ha Hurricane SC 0.1 L/ha Starane Hi-Load 0.1 L/ha	5.56	7.11	6.44	7.67
10	Validate 0.5 L/ha Starane Hi-Load 0.1 L/ha AHDB9822	7.00	8.28	8.83	9.83
11	Validate 0.5 L/ha Starane Hi-Load 0.1 L/ha Sencorex 0.3 then 0.5 L/ha	3.50	5.17	5.89	7.72
12	Validate 0.5 L/ha Starane Hi-Load 0.1 L/ha AHDB9981	2.50	5.06	4.89	6.28
	F pr	<.001	<.001	<.001	0.068
	D.F	23	23	23	23
	L.S.D	1.556	1.514	2.365	3.492
		Not significantly different from untreated control (p>0.05)			
		Significantly different from untreated control (p<0.05)			

All treatments except Validate + **Hurricane SC** significantly reduced the height of the Markies indeterminate potatoes for up to four weeks after the final application when compared to the untreated control (14th, 28th July and 11th September). At the final assessment, all treatments reduced the height of the indeterminate potatoes by at least 50% with the exception of treatments; Validate + **Hurricane SC**, Validate + **Hurricane SC** + Sencorex and Validate + **Hurricane SC** + **AHDB9981** which had no significant effect on the height of the indeterminate potatoes (Table 3).

Table 3. Mean height (cm) of Markies indeterminate potatoes at each assessment date. Sprays applied on 2nd and 15th July.

Treat No	Treatment	Mean height of volunteer potatoes (cm)				
		02/07/20	14/07/20	28/07/20	11/08/20	09/09/20
1	Untreated	16.67	46.67	53.33	56.17	50.83
3	AHDB9822 Sencorex 0.3 then 0.5 L/ha	17.33	26.67	18.33	11.67	21.67
4	Validate 0.5 L/ha AHDB9822	18.33	31.67	26.67	25.00	26.67
5	Validate 0.5 L/ha Hurricane SC 0.1 L/ha	20.00	53.33	56.67	58.33	58.33

Treat No	Treatment	Mean height of volunteer potatoes (cm)				
		02/07/20	14/07/20	28/07/20	11/08/20	09/09/20
6	Validate 0.5 L/ha Hurricane SC 0.1 L/ha AHDB9822	19.33	33.33	23.33	16.67	18.33
7	Validate 0.5 L/ha Hurricane SC 0.1 L/ha Sencorex 0.3 then 0.5 L/ha	16.67	33.33	38.33	36.67	36.67
8	Validate 0.5 L/ha Hurricane SC 0.1 L/ha AHDB9981	13.33	28.33	31.67	36.67	35.00
9	Validate 0.5 L/ha Hurricane SC 0.1 L/ha Starane Hi-Load 0.1 L/ha	12.67	21.67	17.67	17.67	6.67
10	Validate 0.5 L/ha Starane Hi-Load 0.1 L/ha AHDB9822	19.00	25.00	16.67	10.00	6.67
11	Validate 0.5 L/ha Starane Hi-Load 0.1 L/ha Sencorex 0.3 then 0.5 L/ha	19.33	26.67	20.00	20.67	16.67
12	Validate 0.5 L/ha Starane Hi-Load 0.1 L/ha AHDB9981	15.67	24.00	20.00	16.00	15.00
	F pr	0.185	<.001	<.001	<.001	<.001
	D.F	23	23	23	23	23
	L.S.D	4.985	9.84	10.81	14.29	19.3
		Not significantly different from untreated control (p>0.05)				
		Significantly different from untreated control (p<0.05)				

All treatments significantly increased phytotoxic effects on determinate Annabelle potatoes at the 14th July, 28th July and 11th August assessments. **AHDB9822** + Sencorex, Validate + **AHDB9822**, Validate + **Hurricane SC** + **AHDB9822** and Validate + **Starane Hi-Load** + **AHDB9822** increased the phytotoxic effects above 7.00 at the first assessment compared to the untreated control (0.00). (**Table 4**). **AHDB9822** being the consistent product included across all the most effective tank-mixes.

Table 4. Mean phytotoxicity score of Annabelle determinate potatoes at each assessment date, 0 = no damage 10 = crop death. Sprays applied on 2nd and 15th July

Treat no	Treatment	Mean Phytotoxicity (Score 0-10)			
		14/7/20	28/7/20	11/8/20	08/9/20
1	Untreated	0.00	0.00	2.83	9.44
3	AHDB9822 Sencorex 0.3 then 0.5 L/ha	7.94	9.33	9.28	9.44
4	Validate 0.5 L/ha AHDB9822	7.28	8.28	9.17	9.44
5	Validate 0.5 L/ha Hurricane SC 0.1 L/ha	4.28	5.28	7.44	9.44
6	Validate 0.5 L/ha Hurricane SC 0.1 L/ha	8.33	9.28	9.72	10.00

Treat no	Treatment	Mean Phytotoxicity (Score 0-10)			
		14/7/20	28/7/20	11/8/20	08/9/20
	AHDB9822				
7	Validate 0.5 L/ha Hurricane SC 0.1 L/ha Sencorex 0.3 then 0.5 L/ha	5.94	6.94	9.00	10.00
8	Validate 0.5 L/ha Hurricane SC 0.1 L/ha AHDB9981	6.67	7.94	9.28	10.00
9	Validate 0.5 L/ha Hurricane SC 0.1 L/ha Starane Hi-Load 0.1 L/ha	5.83	7.89	8.89	9.44
10	Validate 0.5 L/ha Starane Hi-Load 0.1 L/ha AHDB9822	7.39	8.78	9.33	9.44
11	Validate 0.5 L/ha Starane Hi-Load 0.1 L/ha Sencorex 0.3 then 0.5 L/ha	4.50	6.11	6.72	8.89
12	Validate 0.5 L/ha Starane Hi-Load 0.1 L/ha AHDB9981	2.94	6.28	6.61	9.44
	F pr	<.001	<.001	<.001	0.751
	D.F	23	23	23	23
	L.S.D	1.353	1.189	2.391	1.051
		Not significantly different from untreated control (p>0.05)			
		Significantly different from untreated control (p<0.05)			

All treatments significantly reduced mean height of the determinate Annabelle potato variety compared to the untreated control on the 14th, 28th July and 11th August assessment dates. There were no significant differences in mean height on the 9th September assessment when compared to the untreated control due to the severe effect or death of the potatoes due to blight. But, where **AHDB 9822** was included in the tank-mix, then the reduction of the height of the potatoes was the greatest (**Table 5**)

Table 5. Mean height (cm) of Annabelle determinate potatoes at each assessment date 0 = no damage 10 = crop death. Sprays applied on 2nd and 15th July

Treat No	Treatment	Mean height cm				
		02/07/20	14/07/20	28/07/20	11/08/20	09/09/20
1	Untreated	13.83	42.50	41.67	31.67	3.33
3	AHDB9822 Sencorex 0.3 then 0.5 L/ha	12.33	21.67	10.67	0.00	0.00
4	Validate 0.5 L/ha AHDB9822	13.33	20.00	15.00	3.33	0.00
5	Validate 0.5 L/ha Hurricane SC 0.1 L/ha	15.00	26.67	31.00	20.00	0.00
6	Validate 0.5 L/ha Hurricane SC 0.1 L/ha AHDB9822	14.33	19.33	11.70	1.67	0.00
7	Validate 0.5 L/ha Hurricane SC 0.1 L/ha Sencorex 0.3 then 0.5 L/ha	13.33	21.67	22.67	10.00	0.00

Treat No	Treatment	Mean height cm				
		02/07/20	14/07/20	28/07/20	11/08/20	09/09/20
8	Validate 0.5 L/ha Hurricane SC 0.1 L/ha AHDB9981	11.67	24.00	17.67	3.33	0.00
9	Validate 0.5 L/ha Hurricane SC 0.1 L/ha Starane Hi-Load 0.1 L/ha	11.33	20.00	13.33	6.67	0.00
10	Validate 0.5 L/ha Starane Hi-Load 0.1 L/ha AHDB9822	13.33	17.00	12.33	0.00	0.00
11	Validate 0.5 L/ha Starane Hi-Load 0.1 L/ha Sencorex 0.3 then 0.5 L/ha	12.00	21.33	18.00	15.00	0.00
12	Validate 0.5 L/ha Starane Hi-Load 0.1 L/ha AHDB9981	14.00	23.00	20.33	17.67	0.00
	F pr	0.863	<.001	<.001	<.001	0.927
	D.F	23	23	23	23	23
	L.S.D	4.187	8.04	5.672	13.03	5.38
		Not significantly different from untreated control (p>0.05)				
		Significantly different from untreated control (p<0.05)				

Tank mixes containing **Starane Hi-Load** performed better in controlling indeterminate Markies potatoes at the final assessment. Tank mixes containing **AHDB9822** and **Hurricane SC** performed better in controlling determinate Annabelle potatoes.

Although the potatoes were affected by blight at the final assessment, it was still possible to make comparative assessments of the effects of the treatments, and the earlier assessments all showed significant trends.

Conclusions

- All treatments significantly increased phytotoxic or damaging effects on both potato species.
- All treatments except Validate + **Hurricane SC** significantly reduced the height of both potato species.
- 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. **Starane Hi- Load** was effective for potato control, but severe quality effects (root hair proliferation) have been observed on carrots 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 efficacy and selectivity (crop safety) 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 deviations from the following:

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	Roudham Road, Roudham and Larling, Bridgham, Breckland, Norfolk. NR16 2RN.
Crop	Carrots
Cultivar	Nairobi
Soil or substrate type	Sandy Silt Loam
Agronomic practice	Carrots Drilled – 19/05/2020
Prior history of site	2019 – Maize 2018 – Pigs 2017 - Potatoes

Trial design

Item	Details
Trial design:	Randomised block
Number of replicates:	3
Row spacing (m):	1
Plot size: (w x l)	5 X 1.83
Plot size: (m ²)	9.15
Number of plants per plot:	1253
<i>Leaf Wall Area calculations</i>	N/A

Treatment details

AHDB Code	Active substance	Product name/ manufacturer s 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
AHDB9822	N/D	N/D	N/D	N/D	N/D	No
N/A	diflufenican	Hurricane SC	19008335	500 g/L	Suspension concentrate	No
AHDB9981	N/D	N/D	N/D	N/D	N/D	No
N/A	metribuzin	Sencorex Flow	EV56005563	600 g/L	Suspension concentrate	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 + 2	N/A		N/A	A,B
3	AHDB9822	250	0.5	A,B
	Sencorex	180 300	(T1) 0.3 (T2) 0.5	A,B
4	Validate	(50% w/w) (25% w/w) (25% w/w)	0.5	A,B
	AHDB9822	N/D	0.5	A,B
5	Validate	(50% w/w) (25% w/w) (25% w/w)	0.5	A,B
	Hurricane SC	50	0.1	A,B
6	Validate	(50% w/w) (25% w/w) (25% w/w)	0.5	A,B
	Hurricane SC	50	0.1	A,B
	AHDB9822	N/D	0.5	A,B
7	Validate	(50% w/w) (25% w/w) (25% w/w)	0.5	A,B
	Hurricane SC	50	0.1	A,B
	Sencorex	180 300	(T1) 0.3 (T2) 0.5	A,B
8	Validate	(50% w/w) (25% w/w) (25% w/w)	0.5	A,B
	Hurricane SC	50	0.1	A,B
	AHDB9981	N/D	0.5	A,B
9	Validate	(50% w/w) (25% w/w)	0.5	A,B

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
		(25% w/w)		
	Hurricane SC	50	0.1	A,B
	Starane Hi-Load	48	0.1	A,B
10	Validate	(50% w/w) (25% w/w) (25% w/w)	0.5	A,B
	Starane Hi-Load	48	0.1	A,B
	AHDB9822	N/D	0.5	A,B
11	Validate	(50% w/w) (25% w/w) (25% w/w)	0.5	A,B
	Starane Hi-Load	48	0.1	A,B
	Sencorex	180 300	(T1) 0.3 (T2) 0.5	A,B
12	Validate	(50% w/w) (25% w/w) (25% w/w)	0.5	A,B
	Starane Hi-Load	48	0.1	A,B
	AHDB9981	N/D	0.5	A,B

Application details

	Application A	Application B
Application date	02/07/2020	15/07/2020
Time of day	07:00	10:30
Crop (carrot) growth stage (Max, min average BBCH)	15	17
Crop height (cm)	15	22
Crop coverage (%)	45	65
Application Method	Spray	Spray
Application Placement	Soil/foliar	Soil/foliar
Application equipment	Oxford precision sprayer	Oxford precision sprayer
Nozzle pressure (bar)	3.0	3.0
Nozzle type	Flat fan	Flat fan
Nozzle size	02F110	02F110
Application water volume/ha	400	400
Temperature of air - shade (°C)	11.8	15.2
Relative humidity (%)	78	64
Wind speed range (m/s)	2.65	1.8
Dew presence (Y/N)	N	N
Temperature of soil - 2-5 cm (°C)	16.5	17.5
Wetness of soil - 2-5 cm	Slightly wet	Dry
Cloud cover (%)	20	50

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 19th May and developed to 105 BBCH before preliminary assessments and treatment applications were made. Two potato varieties Markies - (indeterminate) and Annabelle (determinate) were planted 2nd of June when the carrots 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 4). Counts of fanged roots were made of 100 roots just prior to harvest with any other defects noted.

Table 2. Scale used for the assessment of the extent of phytotoxic damage in treated plots.

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

Evaluation date	Evaluation Timing (DA)*	Crop Growth Stage (BBCH)	Evaluation type (efficacy, phytotox)	Assessment
02/07/2020	0	105	preliminary	Plant population
14/07/2020	12	107	Efficacy Phytotoxicity	Crop phytotoxicity Weed phytotoxicity, height
28/07/2020	26	107	Efficacy Phytotoxicity	Crop phytotoxicity Weed phytotoxicity, height
29/07/2020	27	107	phytotoxicity	Plant population
11/08/2020	41	109	Efficacy Phytotoxicity	Crop phytotoxicity Weed phytotoxicity, height
08/09/2020	69	109	Efficacy Phytotoxicity	Crop phytotoxicity Weed phytotoxicity, height
13/10/2020	104	N/A	Phytotoxicity	Crop harvest

* DA – days after first application

Statistical analysis

The trial design was a fully randomised block design, with three replicates of twelve 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 nearly 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**. The exceptions being **AHDB 9822 + Sencorex**, **Validate + Starane Hi-Load + Sencorex** and **Validate + Starane Hi-Load + AHDB 9981**. **AHDB 9822** caused a slight stunt but no severe effects were observed, (Table 6).

All treatments except **Validate + Hurricane SC** significantly increased crop phytotoxicity on the 28th July at two weeks after the final application. But by four weeks after the final application, all treatments except **Validate + Hurricane SC + AHDB 9822** scored below the acceptable damage threshold of 2. No significant differences in crop phytotoxicity were observed on the 11th August, indicating that the foliar effects were transient and the crop had recovered at four weeks after the second and final application timing.

Table 6. 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.

Trt no		Mean carrot phytotoxicity scores (0-10)		
		14 th July Just before Timing 2	28 th July 2 weeks after Timing 2	11 th August 4 weeks after Timing 2
1+2	Untreated	0.00	0.00	0.17
3	AHDB9822 Sencorex 0.3 then 0.5 L/ha	1.67	1.00	0.33
4	Validate 0.5 L/ha AHDB9822	3.00	1.33	0.00
5	Validate 0.5 L/ha Hurricane SC 0.1 L/ha	2.33	0.33	0.00
6	Validate 0.5 L/ha Hurricane SC 0.1 L/ha AHDB9822	5.67	3.00	0.33
7	Validate 0.5 L/ha Hurricane SC 0.1 L/ha Sencorex 0.3 then 0.5 L/ha	3.33	1.00	0.33
8	Validate 0.5 L/ha Hurricane SC 0.1 L/ha AHDB9981	2.33	1.00	0.33
9	Validate 0.5 L/ha Hurricane SC 0.1 L/ha Starane Hi-Load 0.1 L/ha	3.33	1.33	0.00
10	Validate 0.5 L/ha Starane Hi-Load 0.1 L/ha AHDB9822	2.67	0.67	0.00
11	Validate 0.5 L/ha	1.67	1.00	0.33

Trt no		Mean carrot phytotoxicity scores (0-10)		
		14 th July Just before Timing 2	28 th July 2 weeks after Timing 2	11 th August 4 weeks after Timing 2
	Starane Hi-Load 0.1 L/ha Sencorex 0.3 then 0.5 L/ha			
12	Validate 0.5 L/ha Starane Hi-Load 0.1 L/ha AHDB9981	1.33	0.67	0.00
F pr		<.001	<.001	0.886
D.F		23	23	23
L.S.D		1.192	0.523	0.610
		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 7**).

Table 7. Mean percentage of fanged and split carrots at harvest on 13th October 2020.

Treat No	Treatment	Fanging (%)	Splits (%)
1 + 2	Untreated	4.5	1.3
3	AHDB9822 Sencorex 0.3 then 0.5 L/ha	2.3	2.0
4	Validate 0.5 L/ha AHDB9822	2.7	2.0
5	Validate 0.5 L/ha Hurricane SC 0.1 L/ha	1.7	3.0
6	Validate 0.5 L/ha Hurricane SC 0.1 L/ha AHDB9822	3.7	3.0
7	Validate 0.5 L/ha Hurricane SC 0.1 L/ha Sencorex 0.3 then 0.5 L/ha	3.0	1.0
8	Validate 0.5 L/ha Hurricane SC 0.1 L/ha AHDB9981	2.3	1.3
9	Validate 0.5 L/ha Hurricane SC 0.1 L/ha Starane Hi-Load 0.1 L/ha	1.7	0.7
10	Validate 0.5 L/ha Starane Hi-Load 0.1 L/ha AHDB9822	1.3	0.3
11	Validate 0.5 L/ha Starane Hi-Load 0.1 L/ha Sencorex 0.3 then 0.5 L/ha	2.3	0.3
12	Validate 0.5 L/ha Starane Hi-Load 0.1 L/ha AHDB9981	6.3	1.0
	F.pr	0.678	0.079
	D.F	23	23
	L.S.D	4.535	1.688

Efficacy – effect on potatoes

Indeterminate variety – Markies

The results for mean phytotoxicity and height of the Markies potatoes are presented in **Table 8 and 9**Table .

All treatments significantly increased the phytotoxic effect on the Markies potatoes on 14th and 28th July at two weeks after each of the applications. All treatments except Validate + **Hurricane SC** significantly increased Markies phytotoxicity scores at four weeks after the final application on 11th August. Validate + **Hurricane SC** + **Starane Hi-Load**, Validate + **Starane Hi-Load** + **AHDB9822** and Validate + **Starane Hi-Load** + Sencorex were the only treatments that significantly increased the phytotoxicity on 8th September at eleven weeks after the final treatment. The only treatment which nearly killed the potatoes is Validate + **Starane Hi-Load** + AHDB9822. All other treatments only offered moderate to severe suppression.

The increase in the score in the untreated control on 8th 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 8. Mean phytotoxicity score of Markies indeterminate potatoes at each assessment date, 0 = no damage 10 = crop death. Sprays applied on 2nd and 15th July

Treat No	Treatment	Mean Phytotoxicity (Score 0-10)			
		14/7/20	28/7/20	11/8/20	08/9/20
1	Untreated	0.00	0.00	0.86	3.44
3	AHDB9822 Sencorex 0.3 then 0.5 L/ha	5.61	7.06	7.22	6.22
4	Validate 0.5 L/ha AHDB9822	5.39	6.28	6.28	6.28
5	Validate 0.5 L/ha Hurricane SC 0.1 L/ha	2.50	1.94	2.22	3.56
6	Validate 0.5 L/ha Hurricane SC 0.1 L/ha AHDB9822	6.06	6.44	5.61	5.94
7	Validate 0.5 L/ha Hurricane SC 0.1 L/ha Sencorex 0.3 then 0.5 L/ha	3.44	4.28	4.06	5.56
8	Validate 0.5 L/ha Hurricane SC 0.1 L/ha AHDB9981	4.17	4.89	5.17	6.17
9	Validate 0.5 L/ha Hurricane SC 0.1 L/ha Starane Hi-Load 0.1 L/ha	5.56	7.11	6.44	7.67
10	Validate 0.5 L/ha Starane Hi-Load 0.1 L/ha AHDB9822	7.00	8.28	8.83	9.83
11	Validate 0.5 L/ha Starane Hi-Load 0.1 L/ha Sencorex 0.3 then 0.5 L/ha	3.50	5.17	5.89	7.72
12	Validate 0.5 L/ha Starane Hi-Load 0.1 L/ha AHDB9981	2.50	5.06	4.89	6.28
	F pr	<.001	<.001	<.001	0.068
	D.F	23	23	23	23

Treat No	Treatment	Mean Phytotoxicity (Score 0-10)			
		14/7/20	28/7/20	11/8/20	08/9/20
	L.S.D	1.556	1.514	2.365	3.492
		Not significantly different from untreated control ($p>0.05$)			
		Significantly different from untreated control ($p<0.05$)			

All treatments except Validate + **Hurricane SC** significantly reduced the height of the Markies indeterminate potatoes for up to four weeks after the final application when compared to the untreated control (14th, 28th July and 11th September). Validate + **Hurricane SC**, Validate + **Hurricane SC** + Sencorex and Validate + **Hurricane SC** + **AHDB9981** had no significant effect on the height of the indeterminate potatoes at the final assessment. All other treatments reduced the height of the indeterminate potatoes by at least 50% (**Table 9**)

Table 9. Mean height (cm) of Markies indeterminate potatoes at each assessment date.. Sprays applied on 2nd and 15th July

Treat No	Treatment	Mean height (cm)				
		02/07/20	14/07/20	28/07/20	11/08/20	09/09/20
1	Untreated	16.67	46.67	53.33	56.17	50.83
3	AHDB9822 Sencorex 0.3 then 0.5 L/ha	17.33	26.67	18.33	11.67	21.67
4	Validate 0.5 L/ha AHDB9822	18.33	31.67	26.67	25.00	26.67
5	Validate 0.5 L/ha Hurricane SC 0.1 L/ha	20.00	53.33	56.67	58.33	58.33
6	Validate 0.5 L/ha Hurricane SC 0.1 L/ha AHDB9822	19.33	33.33	23.33	16.67	18.33
7	Validate 0.5 L/ha Hurricane SC 0.1 L/ha Sencorex 0.3 then 0.5 L/ha	16.67	33.33	38.33	36.67	36.67
8	Validate 0.5 L/ha Hurricane SC 0.1 L/ha AHDB9981	13.33	28.33	31.67	36.67	35.00
9	Validate 0.5 L/ha Hurricane SC 0.1 L/ha Starane Hi-Load 0.1 L/ha	12.67	21.67	17.67	17.67	6.67
10	Validate 0.5 L/ha Starane Hi-Load 0.1 L/ha AHDB9822	19.00	25.00	16.67	10.00	6.67
11	Validate 0.5 L/ha Starane Hi-Load 0.1 L/ha Sencorex 0.3 then 0.5 L/ha	19.33	26.67	20.00	20.67	16.67
12	Validate 0.5 L/ha Starane Hi-Load 0.1 L/ha AHDB9981	15.67	24.00	20.00	16.00	15.00
	F pr	0.185	<.001	<.001	<.001	<.001
	D.F	23	23	23	23	23
	L.S.D	4.985	9.84	10.81	14.29	19.3

Treat No	Treatment	Mean height (cm)				
		02/07/20	14/07/20	28/07/20	11/08/20	09/09/20
		Not significantly different from untreated control (p>0.05)				
		Significantly different from untreated control (p<0.05)				

Determinate variety – Annabelle

The results for Annabelle mean phytotoxicity and mean height are presented in **Table 10** and **11**.

All treatments significantly increased the phytotoxicity of Annabelle potatoes at the first, second and third assessment when compared to the untreated control (**Table 10**). At the final phytotoxicity assessment there was no significant difference between any treatments when compared to the untreated control due to the crop being affected by potato blight which caused early death of the potatoes. However, useful data can be observed at the earlier assessments, and greater effects from all the treatments could be observed on the determinate variety when compared to the indeterminate variety.

At the final phytotoxicity assessment Validate + **Hurricane SC + AHDB9822**, Validate + **Hurricane SC + Sencorex** and Validate + **Hurricane SC + AHDB9981** all resulted in complete death of the potatoes, all other treatments scored at least 8.89 or above which was not significantly different when compared to the untreated control. However, this result is confounded by the occurrence of potato blight.

Table 10. Mean phytotoxicity score of Annabelle determinate potatoes at each assessment date 0 = no damage 10 = crop death. Sprays applied on 2nd and 15th July

Treat no	Treatment	Mean Phytotoxicity (Score 0-10)			
		14/7/20	28/7/20	11/8/20	08/9/20
1	Untreated	0.00	0.00	2.83	9.44
3	AHDB9822 Sencorex 0.3 then 0.5 L/ha	7.94	9.33	9.28	9.44
4	Validate 0.5 L/ha AHDB9822	7.28	8.28	9.17	9.44
5	Validate 0.5 L/ha Hurricane SC 0.1 L/ha	4.28	5.28	7.44	9.44
6	Validate 0.5 L/ha Hurricane SC 0.1 L/ha AHDB9822	8.33	9.28	9.72	10.00
7	Validate 0.5 L/ha Hurricane SC 0.1 L/ha Sencorex 0.3 then 0.5 L/ha	5.94	6.94	9.00	10.00
8	Validate 0.5 L/ha Hurricane SC 0.1 L/ha AHDB9981	6.67	7.94	9.28	10.00
9	Validate 0.5 L/ha Hurricane SC 0.1 L/ha Starane Hi-Load 0.1 L/ha	5.83	7.89	8.89	9.44
10	Validate 0.5 L/ha Starane Hi-Load 0.1 L/ha AHDB9822	7.39	8.78	9.33	9.44

Treat no	Treatment	Mean Phytotoxicity (Score 0-10)			
		14/7/20	28/7/20	11/8/20	08/9/20
11	Validate 0.5 L/ha Starane Hi-Load 0.1 L/ha Sencorex 0.3 then 0.5 L/ha	4.50	6.11	6.72	8.89
12	Validate 0.5 L/ha Starane Hi-Load 0.1 L/ha AHDB9981	2.94	6.28	6.61	9.44
	F pr	<.001	<.001	<.001	0.751
	D.F	23	23	23	23
	L.S.D	1.353	1.189	2.391	1.051
		Not significantly different from untreated control (p>0.05)			
		Significantly different from untreated control (p<0.05)			

All treatments significantly reduced mean height of the determinate Annabelle potato variety compared to the untreated control on the 14th, 28th July and 11th August assessment dates. There was no significant differences in mean height on the 9th September assessment when compared to the untreated control due to the severe effect or death of the potatoes due to blight.. Where **AHDB 9822** was included in the tank-mix, then the reduction of the height of the potatoes was the greatest.

Table 11. Mean height (cm) of Annabelle determinate potatoes at each assessment date.. Sprays applied on 2nd and 15th July

Treat No	Treatment	Mean height (cm)				
		02/07/20	14/07/20	28/07/20	11/08/20	09/09/20
1	Untreated	13.83	42.50	41.67	31.67	3.33
3	AHDB9822 Sencorex 0.3 then 0.5 L/ha	12.33	21.67	10.67	0.00	0.00
4	Validate 0.5 L/ha AHDB9822	13.33	20.00	15.00	3.33	0.00
5	Validate 0.5 L/ha Hurricane SC 0.1 L/ha	15.00	26.67	31.00	20.00	0.00
6	Validate 0.5 L/ha Hurricane SC 0.1 L/ha AHDB9822	14.33	19.33	11.70	1.67	0.00
7	Validate 0.5 L/ha Hurricane SC 0.1 L/ha Sencorex 0.3 then 0.5 L/ha	13.33	21.67	22.67	10.00	0.00
8	Validate 0.5 L/ha Hurricane SC 0.1 L/ha AHDB9981	11.67	24.00	17.67	3.33	0.00
9	Validate 0.5 L/ha Hurricane SC 0.1 L/ha Starane Hi-Load 0.1 L/ha	11.33	20.00	13.33	6.67	0.00
10	Validate 0.5 L/ha Starane Hi-Load 0.1 L/ha AHDB9822	13.33	17.00	12.33	0.00	0.00
11	Validate 0.5 L/ha Starane Hi-Load 0.1 L/ha Sencorex 0.3 then 0.5 L/ha	12.00	21.33	18.00	15.00	0.00

Treat No	Treatment	Mean height (cm)				
		02/07/20	14/07/20	28/07/20	11/08/20	09/09/20
12	Validate 0.5 L/ha Starane Hi-Load 0.1 L/ha AHDB9981	14.00	23.00	20.33	17.67	0.00
	F pr	0.863	<.001	<.001	<.001	0.927
	D.F	23	23	23	23	23
	L.S.D	4.187	8.04	5.672	13.03	5.38
		Not significantly different from untreated control (p>0.05)				
		Significantly different from untreated control (p<0.05)				

Discussion

All treatments significantly increased the phytotoxic effects on the crop for up to a month after application with the exception of Validate + **Hurricane SC** where effects on the carrots were at an acceptable level at two weeks after application. At the final harvest assessment there was no significant effects observed in crop phytotoxicity, number of splits or fanged carrots. 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,

Three treatments resulted in significant phytotoxic damage to indeterminate potatoes throughout the trial, these were; Validate + **Hurricane SC** + **Starane Hi-Load**, Validate + **Starane Hi-Load** + **AHDB9822**, and Validate + **Starane Hi-Load** + Sencorex. All treatments except Validate + **Hurricane SC**, Validate + **Hurricane SC** + Sencorex, and Validate + **Hurricane SC** + **AHDB9981** significantly reduced potato height throughout the trial. The only treatment which nearly killed the potatoes is Validate + **Starane Hi-Load** + **AHDB9822**. All other treatments only offered moderate to severe suppression.

The increase in the score in the untreated control on 8th 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 increased phytotoxic effects on determinate Annabelle potatoes on the 14th July, 28th July and 11th August assessments. **AHDB9822** + Sencorex, Validate + **AHDB9822**, Validate + **Hurricane SC** + **AHDB9822** and Validate + **Starane Hi-Load** + **AHDB9822** increased the phytotoxic effects above 7.00 at the first assessment compared to the untreated control (0.00).

All treatments significantly reduced mean height of the determinate Annabelle potato variety compared to the untreated control on the 14th, 28th July and 11th August assessment dates. There was no significant differences in mean height on the 9th September assessment when compared to the untreated control due to the severe effect or death of the potatoes due to blight. Where **AHDB 9822** was included in the tank-mix, then the reduction of the height of the potatoes was the greatest.

Tank mixes containing **Starane Hi-Load** performed better in controlling indeterminate Markies potatoes at the final assessment. Tank mixes containing **AHDB9822** and **Hurricane SC** performed better in controlling determinate Annabelle potatoes.

Although the potatoes were affected by blight at the final assessment, it was still possible to make comparative assessments of the effects of the treatments, and the earlier assessments all showed significant trends.

Conclusions

- All treatments significantly increased phytotoxic or damaging effects on both potato species.
- All treatments except Validate + **Hurricane SC** significantly reduced the height of both potato species.
- 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.

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Appendix

a. Crop diary – events related to growing crop

Crop	Cultivar	Drilling/planting date	Bed width
Carrots	Nairobi	19/05/2020	Bed width 1.83m, 4 rows per bed
Potatoes	Markies	02/06/2020	
Potatoes	Annabelle		

Pesticides and fertiliser applied

Date	Product	Rate	Unit
17/01/2020	Omex 0-0-21-5-0	1.176	t/ha
24/04/2020	Azural	4.00	L/ha
	X-Change	0.20	L/ha
14/05/2020	Azural	3.524	L/ha
	X-Change	1.50	L/ha
19/05/2020	Urea 46-00-00	86.967	Kg/ha
22/05/2020	Stomp Aqua	2.815	L/ha
	Gamit 36 CS	0.201	L/ha
	Emerger	0.807	L/ha
22/07/2020	X change	0.25	L/ha
	Centurion Max	1.40	L/ha
13/06/2020	Biscaya	0.397	L/ha
28/06/2020	Sencorex Flow	0.103	L/ha
	Movento	0.300	L/ha
	Cythrinx Max	0.048	L/ha
02/07/2020	Piamon N33 30SO3	105.608	Kg/ha
07/07/2020	Decis	0.068	L/ha
	Rudis	0.392	L/ha
	Headland Root 66	1.982	L/ha
	Decis Protech	0.383	L/ha
15/07/2020	Amistar Top	0.698	L/ha
	Hallmark with Zeon Technology	0.100	L/ha
	Omex 3X	3.041	L/ha
23/07/2020	Signum	1.000	Kg/ha
	Headland Root 66	2.658	L/ha
	Decis Protech	0.500	L/ha
03/08/2020	Reflect	0.581	L/ha
	Hallmark with Zeon Technology	0.097	L/ha
13/08/2020	Decis Protech	0.495	L/ha
	Headland Sulphur Flowable	4.995	L/ha

	Headland Root 66	1.966	L/ha
24/08/2020	Amistar Top	0.694	L/ha
	Hallmark with Zeon Technology	0.098	L/ha
04/09/2020	Nativo 75 WG	0.300	Kg/ha
	Hallmark with Zeon Technology	0.103	L/ha

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 plot.



Figure 3. AHDB9822 + Sencorex



Figure 4. Treatment effects of Validate + Hurricane SC + Starane Hi-Load.

d. Climatological data during study period

Date	Min Celsius (°C)	Max Celsius (°C)	Average Celsius (°C)	Average Humidity (%rh)
1-06-20	9.30	25.60	17.51	62.84
2-06-20	6.70	24.20	16.33	66.86
3-06-20	8.10	16.60	12.93	83.09
4-06-20	9.00	13.60	11.37	81.88
5-06-20	7.00	13.60	9.55	92.63
6-06-20	5.70	15.80	9.20	90.04
7-06-20	6.00	13.80	10.02	97.16
8-06-20	4.70	14.80	10.72	82.45
9-06-20	2.70	17.40	11.79	73.45
10-06-20	9.00	13.00	11.29	96.33
11-06-20	9.60	19.20	13.33	94.88
12-06-20	13.20	19.70	16.00	93.43
13-06-20	13.10	25.60	19.16	72.09
14-06-20	10.70	26.70	18.89	74.91
15-06-20	12.40	25.70	18.17	82.85
16-06-20	11.80	25.20	18.26	78.53
17-06-20	11.10	23.70	16.76	86.54
18-06-20	12.10	22.60	15.77	90.81
19-06-20	10.60	21.20	15.65	83.10
20-06-20	8.40	24.30	17.31	75.57
21-06-20	10.60	22.70	16.87	79.54
22-06-20	7.80	24.90	17.71	69.32
23-06-20	10.30	29.50	20.31	64.67
24-06-20	10.70	31.10	21.53	65.42
25-06-20	12.70	29.60	21.94	69.51
26-06-20	12.90	30.80	22.26	75.30
27-06-20	14.40	22.40	17.79	77.27
28-06-20	10.80	23.40	16.50	68.00
29-06-20	10.90	18.80	14.88	69.79
30-06-20	11.20	20.30	15.99	76.34
1-07-20	13.70	21.60	16.74	90.47
2-07-20	11.20	21.50	15.73	83.59
3-07-20	10.70	21.50	15.85	81.37
4-07-20	15.00	20.70	17.81	87.39
5-07-20	13.40	22.40	18.66	64.93
6-07-20	9.70	20.90	15.05	74.12
7-07-20	7.20	19.70	13.24	90.14
8-07-20	12.20	15.70	14.22	99.96
9-07-20	13.20	18.90	15.85	99.44
10-07-20	9.50	20.10	13.93	91.86
11-07-20	7.70	22.10	14.82	82.78
12-07-20	6.60	25.10	16.83	74.48
13-07-20	7.80	24.90	16.83	82.12
14-07-20	9.60	21.70	16.29	86.50
15-07-20	8.10	21.10	14.47	91.91
16-07-20	13.50	21.20	17.07	90.23
17-07-20	14.60	27.50	20.36	80.00

18-07-20	13.00	25.80	18.92	84.35
19-07-20	9.60	20.50	15.81	84.19
20-07-20	7.50	23.50	15.31	78.12
21-07-20	6.10	21.40	14.05	81.25
22-07-20	9.00	23.90	17.02	76.60
23-07-20	10.30	24.90	17.88	76.05
24-07-20	13.80	24.10	18.92	84.03
25-07-20	12.70	25.20	17.88	91.48
26-07-20	10.60	24.10	17.44	78.90
27-07-20	12.40	22.10	16.75	90.75
28-07-20	9.00	21.70	14.86	75.90
29-07-20	8.10	22.90	16.20	76.85
30-07-20	9.30	29.60	20.50	66.85
31-07-20	10.70	32.70	23.46	60.85
1-08-20	15.20	26.10	20.83	71.93
2-08-20	10.00	24.80	16.90	77.50
3-08-20	7.20	22.90	14.49	84.19
4-08-20	4.70	23.00	16.50	69.36
5-08-20	15.10	29.30	21.30	60.57
6-08-20	16.40	27.40	21.40	76.07
7-08-20	11.30	36.20	24.87	59.35
8-08-20	15.70	27.50	21.01	77.98
9-08-20	16.30	30.10	21.73	78.25
10-08-20	15.80	33.40	23.95	71.80
11-08-20	15.60	32.50	23.69	75.68
12-08-20	14.70	35.00	24.55	69.27
13-08-20	16.30	25.60	19.79	86.13
14-08-20	15.90	22.90	18.32	94.96
15-08-20	16.60	19.80	18.03	99.08
16-08-20	16.30	24.70	18.49	98.20
17-08-20	15.00	25.10	18.25	90.42
18-08-20	14.10	25.80	19.32	80.76
19-08-20	14.40	21.50	18.14	96.01
20-08-20	14.30	26.50	20.90	73.08
21-08-20	16.20	24.40	20.27	68.38
22-08-20	14.10	24.10	18.74	67.07
23-08-20	12.60	22.00	17.05	79.88
24-08-20	10.20	22.90	15.96	83.10
25-08-20	14.20	21.70	17.04	88.15
26-08-20	10.40	20.70	15.78	83.55
27-08-20	9.00	18.70	14.27	91.60
28-08-20	11.30	17.10	13.09	96.91
29-08-20	11.80	13.80	12.81	97.10
30-08-20	10.50	17.10	13.57	84.53
31-08-20	6.20	18.40	12.17	85.76
1-09-20	3.00	22.50	11.74	80.49
2-09-20	3.80	22.80	14.03	80.09
3-09-20	13.80	22.50	17.24	94.43
4-09-20	11.30	21.00	14.89	83.12
5-09-20	7.20	18.90	12.98	79.76
6-09-20	7.80	21.30	14.10	80.86
7-09-20	6.60	19.30	14.03	90.10

8-09-20	14.60	26.60	19.66	83.60
9-09-20	7.90	25.20	17.14	80.60
10-09-20	4.30	20.60	11.61	79.48
11-09-20	4.40	19.70	12.55	79.20
12-09-20	10.60	22.50	15.55	74.95
13-09-20	10.60	27.00	17.09	77.68
14-09-20	6.70	29.90	17.03	76.33
15-09-20	8.40	29.60	18.30	78.83
16-09-20	13.00	24.20	16.96	89.20
17-09-20	6.90	21.50	13.53	80.88
18-09-20	7.80	21.10	13.85	79.65
19-09-20	11.00	22.40	15.69	81.43
20-09-20	9.50	21.90	15.57	86.18
21-09-20	6.20	25.00	14.07	85.92
22-09-20	6.60	9.90	7.66	100.00
3-10-20	10.90	10.90	10.90	100.00
4-10-20	8.40	10.80	9.85	100.00
5-10-20	9.40	14.90	11.95	98.56
6-10-20	8.50	16.80	11.62	97.41
7-10-20	8.60	16.30	11.69	90.61
8-10-20	4.30	15.80	11.55	98.94
9-10-20	3.30	13.30	7.68	96.50
10-10-20	4.10	14.00	7.51	98.85
11-10-20	4.20	14.30	8.74	96.05
12-10-20	4.50	13.30	7.64	96.84

e. Trial design

	309 11	310 6	311 9	312 1	VCS 05 12	Tramline	VCS 10 10	VCS 11 3	VCS 12 7	Spare	Spare		
	301 4	302 7	303 12	304 3	VCS04 5		VCS 09 1	305 8	306 5	307 10	308 2		
	205 2	206 5	207 9	208 10	VCS 03 11		VCS 08 9	209 4	210 12	211 1	212 6		
	109 10	110 1	111 11	112 5	VCS 02 2	VCS 07 6	201 11	202 3	203 8	204 7			
	101 3	102 8	103 2	104 7	VCS 01 8	VCS06 4	105 6	106 9	107 12	108 4			

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
Stored Crops
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