SCEPTREPLUS

Final Trial Report

Trial code:	2019.SP35
Title:	AHDB SCEPTREplus volunteer potato control screen (parsnips)
Crop	Group: Field vegetables – Parsnip (apiaceae), other umbelliferous root vegetables
Target	General broadleaf weeds and grasses, 3WEEDT EPPO1/99(3) Weeds in root vegetables
Lead researcher:	Angela Huckle
Organisation:	RSK ADAS
Period:	1st April 2019 – 31st March 2020
Report date:	31st March 2020
Report author:	Angela Huckle Emily Lawrence
ORETO Number: (certificate should be attached)	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

30th March 2020
Date

……
Authors signature

Trial Summary

Introduction

New products are required to supplement the limited list of actives currently available to parsnip growers, with control of volunteer potatoes an ongoing challenge. This trial focused on finding safe and effective options for post-emergence control of volunteer potatoes in parsnip crops and understanding how they are best included in current programmes.

There have not been any EAMU authorisations of herbicide products specifically targeting volunteer potatoes in parsnip crops since 2009. The herbicide products most recently approved for use on parsnips are authorised for pre-emergence use only—e.g. aclonifen (April 2019)—so identifying alternative post-emergence volunteer potato control options continues to be a priority. This trial examined the crop safety and efficacy of various novel actives and adjuvants, applied post-emergence, aiming to identify new control options.

Method

This trial was sited at a commercial field site in Nottinghamshire, with the crop drilled on 19th May 2019 (variety 'Javelin') and additional potatoes planted into the trial on 3rd June 2019 (variety 'Brooke').

Treatments were applied at three timings; the first on 28th June 2019 (BBCH09, >75% of potatoes emerged), with subsequent applications on 8th July (foliage approx. 10cm across, small rosette) and 17th July (foliage approx. 25cm across, large rosette).

All treatments were applied with a 2m boom, using a knapsack sprayer at 200L/ha water volume. a randomised block design was used for the trial layout, with three replicates of fifteen treatments, including two untreated controls. There were forty-five plots in total, each measuring 2 m x 6 m.

The plots were assessed on six occasions, focusing on the treatments' crop safety and phytotoxic effects on volunteer potatoes. Assessments were carried out at each application timings and approximately two, four, and seven weeks after the final treatment application timing.

Results and discussion

Of the treatments assessed in this trial, four appeared both crop safe on parsnips and caused statistically significant damage to the volunteer potatoes—**Hurricane SC + Phase II**, **Hurricane SC + Validate**, **AHDB9976 (rate 1)**, and **AHDB9976 (rate 2)**. By the conclusion of the trial, seven weeks after the final treatment application, all these treatments offered significant control of the volunteer potatoes compared to the untreated control, with none exhibiting any concerning phytotoxic symptoms in the parsnip crop (**Table 1**).

While **Hurricane SC** and **AHDB9976** showed promise in this trial, it was notable that their safety was compromised in the tank mixes trialed—**Hurricane SC + Defy** and both the **AHDB9976 + AHDB9984** mixes caused significant crop damage. This highlights the importance of choosing suitable tank-mix partners.

In this trial, **sodium chloride** was applied at 2.0 kg/ha—the basic substances approved rate for use of this product as a herbicide—and while the **sodium chloride** treatments did not cause any persistent phytotoxic effects on the parsnip crop, they did not offer any control of volunteer potatoes either. A higher rate of **sodium chloride** may prove more effective and could be considered in future work.

The use of **Hurricane SC** or **AHDB9976** on parsnips are not currently approved, though these products showed promise in this trial as post-emergence treatments for volunteer potato control. By the conclusion of the trial, both these products showed lasting efficacy without any persistent phytotoxic effects on the parsnip crop and would be valuable additions to parsnip growers' volunteer potato control options; pursual of EAMUs would be useful.

Table 1. Mean phytotoxicity scores at two, four, and seven weeks after Timing C treatment application. Scored on a 0 to 10 scale, with 0 being 'no effect', and 10 being 'dead'; scores ≤2 deemed commercially acceptable level of damage [for parsnips].

Treatment	Mean crop damage scores (0-10)					
	Parsnips			Volunteer potatoes		
	Timing C + 2 weeks	Timing C + 4 weeks	Timing C + 7 weeks	Timing C + 2 weeks	Timing C + 4 weeks	Timing C + 7 weeks
Untreated	0.0	0.7	0.3	0.0	0.0	2.4
Hurricane + Defy	***3.7**	***3.0**	***2.3**	***6.8**	***6.8**	***6.4**
Hurricane + Phase II	***3.3**	1.7	0.0	***6.3**	***6.3**	***5.8**
Hurricane + Toil	***3.7**	1.0	0.7	***3.4**	***3.4**	5.6
Hurricane + Validate	***3.3**	2.0	0.0	***6.7**	***7.1**	***7.6**
Sodium chloride	0.3	0.7	0.7	0.7	0.7	4.1
Sodium chloride + Defy	0.0	0.0	0.0	1.6	1.6	3.8
Sodium chloride + Phase II	0.0	1.0	1.0	0.8	0.8	5.1
Sodium chloride + Toil	***3.7**	1.3	1.0	***2.8**	***2.8**	3.9
Sodium chloride + Validate	0.0	0.0	0.0	0.7	0.7	2.3
AHDB9976 (rate 1)	2.0	***3.3**	0.7	***4.6**	***4.9**	***9.7**
AHDB9976 (rate 2)	***4.7**	***4.0**	1.3	***8.6**	***8.6**	***9.5**
AHDB9976 (rate 1) + **AHDB9984**	***9.3**	***8.7**	***8.3**	***7.9**	***8.3**	***8.7**
AHDB9976 (rate 2) + **AHDB9984**	***9.7**	***9.7**	***9.7**	***10.0**	***10.0**	***10.0**
p-value	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
d.f.	29	29	29	29	29	29
L.S.D.	0.984	1.598	1.546	2.400	2.370	2.570

* significantly higher than untreated control AND >2.0.

Conclusion

- **Hurricane SC** and **AHDB9976** are promising products for post-emergence control of volunteer potato control in parsnips and were shown in this trial to be particularly effective and crop safe in repeated low-dose applications. EAMU authorisation for post-emergence use of these products in parsnips would help growers improve weeds control.

- Post-emergence application of **AHDB9976 + AHDB9984** was not crop safe to parsnips.

Take home message

EAMU authorisations for post-emergence use of **Hurricane SC** and **AHDB9976** should be applied for, to expand the range of actives available to parsnip growers. This would improve volunteer potato control and reduce the risk of resistance development.

Objectives

To trial a number of herbicide and herbicide/adjuvant tank-mixes at three post-emergence application timings for selectivity (crop safety) and efficiency of control of volunteer potatoes in parsnips.

Trial conduct

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

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 PP1/181(4)	Conduct and reporting of efficacy evaluation trials including good experimental practice	None
EPPO PP1/214(3)	Principles of acceptable efficacy	None
EPPO PP1/224(2)	Principles of efficacy evaluation for minor uses	None
EPPO PP1/225(2)	Minimum effective dose	None
PP 1/99(3)	Weeds in root vegetables	Two (see below)

There were two deviations from EPPO guidance:

PP1/99(3) Section 1.4, Design and lay-out of trial:

"Replicates: at least 4"

Study only had 3 replicates – the large number of treatments provides an acceptable number of residual degrees of freedom.

Test site

Item	Details
Location address	Field: Willison 16 Cuckney Mansfield NG20 9LA Nottinghamshire Grid reference: SK 57714 72052
Crop	Parsnip
Cultivar	Javelin
Soil or substrate type	Freely draining slightly acid loamy soils
Agronomic practice	See Appendix
Prior history of site	See Appendix

Trial design

Item	Details
Trial design:	Randomised block
Number of replicates:	3
Row spacing:	8 rows per bed drilled in 4 double lines (bands); 85 mm b/w drill lines in band, 360 mm b/w bands.
Plot size: (w x l)	2 m x 6 m
Plot size:	12 m^2
Number of plants per plot:	N/K

Treatment details

AHDB Code	Product name	Active substance	Formulation batch number	Content of active substance (g/L)	Formulation type

AHDB9984	N/D	N/D	N/D	N/D	N/D
N/A†	Defy	prosulfocarb	BSN7H3020	800	Emulsifiable Concentrate
N/A	Hurricane SC	diflufenican	1708826/1711 8244	500	Suspension Concentrate
N/A*	Phase II	esterified rapeseed oil	ADJ0622	(95% w/w)	Adjuvant
N/A*	Sodium chloride	Sodium chloride	N/A	970	(Basic Substance)
AHDB9976	N/D	N/D	N/D	N/D	N/D
N/A*	Toil	methylated rapeseed oil	108827	(95% w/w)	Adjuvant
N/A*	Validate	lecithin, esterified vegetable oil, alcohol ethoxylate	N/K	(50% w/w) (25% w/w) (25% w/w)	Adjuvant

* label approval
† EAMU approval

Application schedule

Trt. No.	Treatment: product name or AHDB code	Application timing code	Rate of active substance(s) (g/ha)	Rate of product (L/ha)
1	Untreated	-	-	-
2	Untreated	-	-	-
3	Hurricane SC Defy	A, B, C	50 1600	0.1 2.0
4	Hurricane SC Phase II	A, B, C	50 (95% w/w)	0.1 1.0
5	Hurricane SC Toil	A, B, C	50 (95% w/w)	0.1 1.0
6	Hurricane SC Validate	A, B, C	50 (50%, 25%, 25% w/w)	0.1 0.5
7	Sodium chloride	A, B, C	1940	2.0
8	Sodium chloride Defy	A, B, C	1940 1600	2.0 2.0
9	Sodium chloride Phase II	A, B, C	1940 (95% w/w)	2.0 1.0
10	Sodium chloride Toil	A, B, C	1940 (95% w/w)	2.0 1.0
11	Sodium chloride Validate	A, B, C	1940 (50%, 25%, 25% w/w)	2.0 0.5
12	AHDB9976	A, B, C	48	0.1
13	AHDB9976	A, B, C	96	0.2
14	AHDB9976 AHDB9984	A, B, C	48 90	0.1 0.4
15	AHDB9976 AHDB9984	A, B, C	96 90	0.2 0.4

Application details

	Timing A	Timing B	Timing C
Application date	28/06/2019	08/07/2019	17/07/2019
Time of day	09:00 – 09:30	N/K	12:00 – 13:00
Crop growth stage (Max, min average BBCH)	BBCH09, >75% of	foliage approx. 10cm across, small rosette	foliage approx. 25cm across, large rosette

	Timing A	Timing B	Timing C
Application date	28/06/2019	08/07/2019	17/07/2019
	potatoes emerged		
Application Method	spray	spray	spray
Application Placement	foliar	foliar	foliar
Application equipment	Oxford Precision Sprayer (knapsack)	Oxford Precision Sprayer (knapsack)	Oxford Precision Sprayer (knapsack)
Nozzle pressure	2.0	2.0	2.0
Nozzle type	Flat fan	Flat fan	Flat fan
Nozzle size	03-F110	03-F110	03-F110
Application water volume (L/ha)	200	200	200
Temperature of air – shade (°C)	11.7 – 15.0	20.0	20.4
Relative humidity (%)	76.0 – 77.0	N/K	56.4
Wind speed range (mph)	2.6 – 3.5	N/K	6.7
Dew presence (Y/N)	Y	N/K	N
Temperature of soil - 10cm (°C)	15.4	N/K	23.1
Cloud cover (%)	90	N/K	85

Assessment details

Evaluation date	Evaluation Timing (DA)*	Crop Growth Stage (BBCH)	Evaluation type (efficacy, phytotox)	What was assessed and how (e.g. dead or live pest; disease incidence and severity; yield, marketable quality)
28/06/2019	0		phytotox	Plant population count (parsnip).
08/07/2019	10		phytotox, efficacy	Phytotoxicity (scale 0-10, 10 = dead) (parsnip/volunteer potato).
17/07/2019	19		phytotox, efficacy	Phytotoxicity (scale 0-10, 10 = dead) (parsnip/volunteer potato).
31/07/2019	33		phytotox, efficacy	Phytotoxicity (scale 0-10, 10 = dead) (parsnip/volunteer potato), plant population count (parsnip).
15/08/2019	48		phytotox, efficacy	Phytotoxicity (scale 0-10, 10 = dead) (parsnip/volunteer potato).
06/09/2019	70		phytotox, efficacy	Phytotoxicity (scale 0-10, 10 = dead) (parsnip/volunteer potato).

* DA – days after Timing A application

Statistical analysis

The trial had a randomised block design, comprising fifteen treatments and including two untreated controls. Treatments were replicated three times.

All data were analysed by ANOVA using Genstat (18th edition) by Emily Lawrence (ADAS).

Results

Phytotoxicity

The results of phytotoxicity assessments from three dates are presented in **Table 1** and **Figure 1**. These were scored on a scale from 0 to 10, with 0 being 'no effect', and 10 being 'dead'. Plots scored 2 or less were deemed to have a commercially acceptable level of damage.

Phytotoxicity was recorded using the following scale:

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

* ≤2 = acceptable damage, i.e. damage unlikely to reduce yield, and acceptable to the farmer.

Parsnips

Four treatments did not show any significant damage to the crop at any point during the assessment period—**Sodium chloride**, **Sodium chloride + Defy**, **Sodium chloride + Phase II**, and **Sodium chloride + Validate**. An additional six treatments appeared crop safe by the final assessment, despite some early phytotoxic damage. **Hurricane SC + Phase II**, **Hurricane SC + Toil**, and **Hurricane + Validate** treated crop initial showed some foliar discoloration, and **Sodium chloride + Toil, AHDB9976 (rate 1),** and **AHDB9976 (rate 2)** treated crop was slightly small in the early assessments. However, these effects were grown through and the crop was in good condition by the final assessment, seven weeks after the final treatment was applied.

While the ten aforementioned treatments showed no significant damage at the final assessment, the three remaining treatments did not appear crop safe at any assessment—**Hurricane SC + Defy**, **AHDB9976 (rate 1) + AHDB9984**, and **AHDB9976 (rate 2) + AHDB9984**. Treatment with **Hurricane SC + Defy** stunted the crop and caused some foliar distortion and whitening, while the **AHDB9976 + AHDB9984** mixes were particularly harsh, causing significant crop loss.

Volunteer potatoes

The most damage to the volunteer potatoes was caused by the **AHDB9976** treatments—**AHDB9976 (rate 1)**, **AHDB9976 (rate 2)**, **AHDB9976 (rate 1) + AHDB9984**, and **AHDB9976 (rate 2) + AHDB9984**. These treatments all caused significant potato stunting, and the most effective treatment—**AHDB9976 (rate 2) + AHDB9984—**killed all potatoes. These treatments showed significant effects on the volunteer potatoes from the first assessment, and effects persisted until the end of the trial.

The **Hurricane SC** treatments also offered effective volunteer potato control—**Hurricane SC + Defy**, **Hurricane SC + Phase II**, **Hurricane SC + Toil**, and **Hurricane SC + Validate**. These treatments caused foliar distortion and whitening and stunted the potatoes. Most effective was **Hurricane SC + Validate**, with treated potatoes significantly smaller than the untreated by the conclusion of the trial.

The **sodium chloride** treatments did not offer effective control of volunteer potatoes. While some damage was recorded at the final assessment of the **sodium chloride** treated potatoes,

this was not a significantly higher level of damage than was seen in the untreated control. The damage seen in the untreated potatoes at the final assessment can be attributed to natural senescence.

Table 1. Mean phytotoxicity scores at two, four, and seven weeks after Timing C treatment application. Scored on a 0 to 10 scale, with 0 being 'no effect', and 10 being 'dead'; scores ≤2 deemed commercially acceptable level of damage [for parsnips].

Treatment	Mean crop damage scores (0-10)					
	Parsnips			Volunteer potatoes		
	Timing C **+ 2 weeks**	Timing C **+ 4 weeks**	Timing C **+ 7 weeks**	Timing C **+ 2 weeks**	Timing C **+ 4 weeks**	Timing C **+ 7 weeks**
Untreated	0.0	0.7	0.3	0.0	0.0	2.4
Hurricane + Defy	***3.7**	***3.0**	***2.3**	***6.8**	***6.8**	***6.4**
Hurricane + Phase II	***3.3**	1.7	0.0	***6.3**	***6.3**	***5.8**
Hurricane + Toil	***3.7**	1.0	0.7	***3.4**	***3.4**	5.6
Hurricane + Validate	***3.3**	2.0	0.0	***6.7**	***7.1**	***7.6**
Sodium chloride	0.3	0.7	0.7	0.7	0.7	4.1
Sodium chloride + Defy	0.0	0.0	0.0	1.6	1.6	3.8
Sodium chloride + Phase II	0.0	1.0	1.0	0.8	0.8	5.1
Sodium chloride + Toil	***3.7**	1.3	1.0	***2.8**	***2.8**	3.9
Sodium chloride + Validate	0.0	0.0	0.0	0.7	0.7	2.3
AHDB9976 (rate 1)	2.0	***3.3**	0.7	***4.6**	***4.9**	***9.7**
AHDB9976 (rate 2)	***4.7**	***4.0**	1.3	***8.6**	***8.6**	***9.5**
AHDB9976 (rate 1) + **AHDB9984**	***9.3**	***8.7**	***8.3**	***7.9**	***8.3**	***8.7**
AHDB9976 (rate 2) + **AHDB9984**	***9.7**	***9.7**	***9.7**	***10.0**	***10.0**	***10.0**
p-value	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
d.f.	29	29	29	29	29	29
L.S.D.	0.984	1.598	1.546	2.400	2.370	2.570

* significantly higher than untreated control AND >2.0.

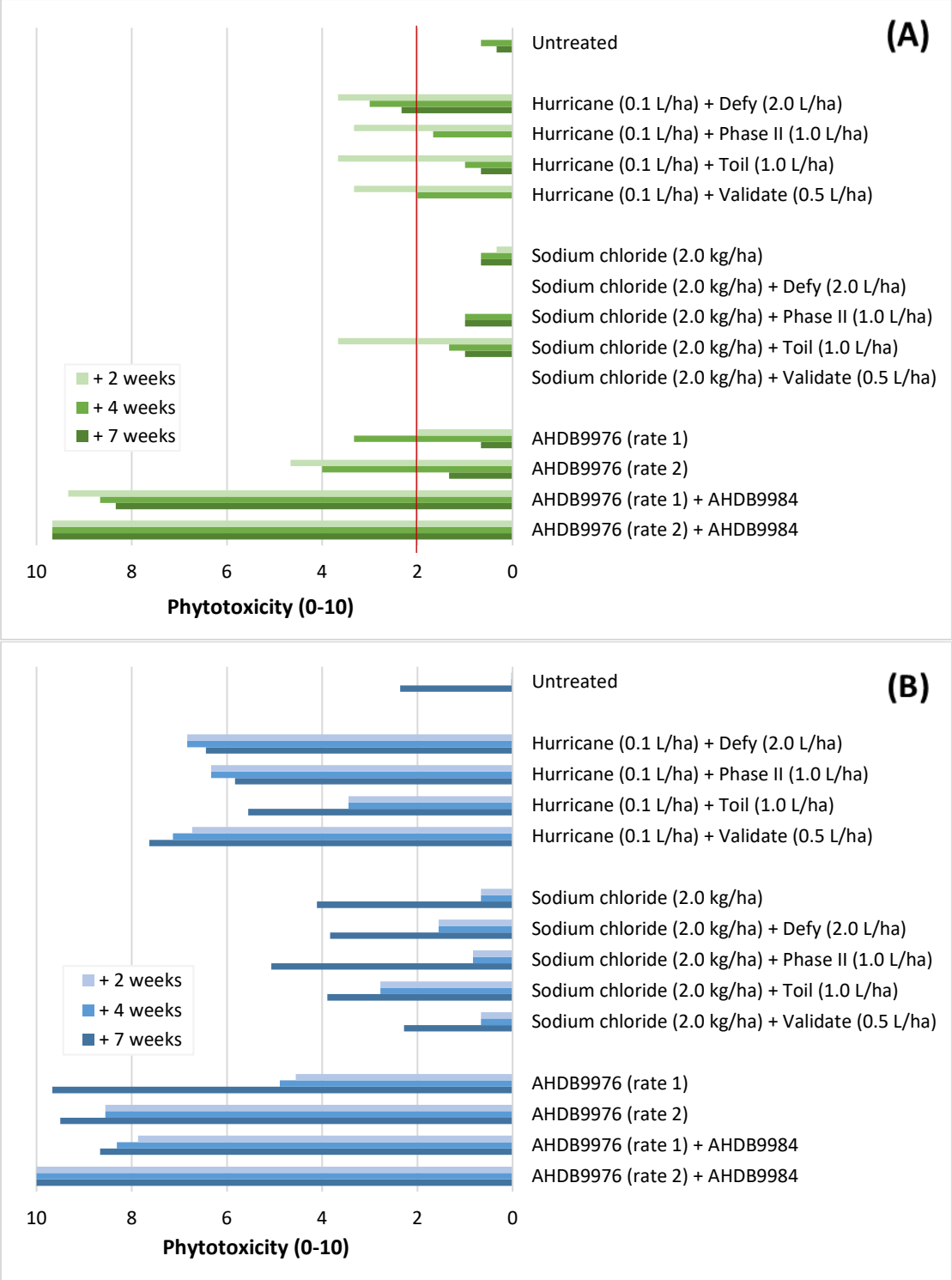


Figure 1. Mean phytotoxicity scores for parsnips (A) and potatoes (B) at Timing C, and two, four, and seven weeks after Timing C treatment application. (Graph A: scores ≤2 deemed commercially acceptable damage (as indicated by red line).

Plant population

When assessed two weeks after the final treatment application, four products showed significantly lower average plant population counts than the untreated control—**Hurricane + Toil** (21.5% reduction in plant population), **AHDB9976 (rate 1)** (22.6% reduction), **AHDB9976 (rate 1) + AHDB9984** (83.9%), and **AHDB9976 (rate 2) + AHDB9984** (94.6%). The remaining nine treatments did not cause any significant reductions in parsnip plant population.

Table 2. Average plant population counts two weeks after the final treatment application (Timing C); values are treatment averages of the number of parsnip plants present in a 0.5 m length of a single central row.

Trt. No.	(31/07/19) Timing C + **2 weeks**
Untreated	9.3
Hurricane + **Defy**	8.3
Hurricane + **Phase II**	7.8
Hurricane + **Toil**	***7.3**
Hurricane + **Validate**	7.8
Sodium chloride	8.8
Sodium chloride + **Defy**	9.3
Sodium chloride + **Phase II**	10.0
Sodium chloride + **Toil**	9.2
Sodium chloride + **Validate**	8.7
AHDB9976 (rate 1)	***7.2**
AHDB9976 (rate 2)	8.0
AHDB9976 (rate 1) + **AHDB9984**	***1.5**
AHDB9976 (rate 2) + **AHDB9984**	***0.5**
p-value	<0.001
d.f.	29
L.S.D.	1.463

Discussion

Of the treatments assessed in this trial, four appeared both crop safe on parsnips and caused statistically significant damage to the volunteer potatoes—**Hurricane SC + Phase II**, **Hurricane SC + Validate**, **AHDB9976 (rate 1)**, and **AHDB9976 (rate 2)**. By the conclusion of the trial, seven weeks after the final treatment application, all these treatments offered significant control of the volunteer potatoes compared to the untreated control, with none exhibiting any concerning phytotoxic symptoms in the parsnip crop.

While **Hurricane SC** and **AHDB9976** showed promise in this trial, it was notable that their safety was compromised in the tank mixes trialed—**Hurricane SC + Defy** and both the **AHDB9976 + AHDB9984** mixes caused significant crop damage. This highlights the importance of choosing suitable tank-mix partners.

In this trial, **sodium chloride** was applied at 2.0 kg/ha—the basic substances approved rate for use of this product as a herbicide—and while the **sodium chloride** treatments did not cause any persistent phytotoxic effects on the parsnip crop, they did not offer any control of volunteer potatoes either. A higher rate of **sodium chloride** may prove more effective and could be considered in future work.

The use of **Hurricane SC** or **AHDB9976** on parsnips are not currently approved, though these products showed promise in this trial as post-emergence treatments for volunteer potato control. By the conclusion of the trial, both these products showed lasting efficacy without any persistent phytotoxic effects on the parsnip crop and would be valuable additions to parsnip growers' volunteer potato control options; pursual of EAMUs would be useful.

Conclusions

- **Hurricane SC** and **AHDB9976** are promising products for post-emergence control of volunteer potato control in parsnips and were shown in this trial to be particularly effective and crop safe in repeated low-dose applications. EAMU authorisation for post-emergence use of these products in parsnips would help growers improve weeds control.

- Post-emergence application of **AHDB9976 + AHDB9984** was not crop safe to parsnips.

Acknowledgements

AHDB for funding the work, and the crop protection companies for their financial contributions as well as providing samples for the trials. Thanks also to Ian Holmes of Strawsons Ltd who provided the site and crop for the trial, as well as technical input.

Appendix

a. Crop diary – events related to growing crop

Crop	Cultivar	Drilling/planting date	Bed width
Parsnips	Javelin	19/05/2019	2 m wheel centres, 8 rows per bed drilled in 4 double lines (bands); 85 mm b/w drill lines in band, 360 mm b/w bands.
Potatoes	Brooke	03/06/2019	

Active ingredients(s)/fertiliser(s) applied to trial area

Date	Product	Rate	Unit
26/02/2019	Muriate of Potash (60% K_2O)	375.0	kg/ha
02/08/2019	Microthiol Special – Trace Element	5.0	kg/ha
	Yara Mantrac DF	2.0	kg/ha
13/08/2019	Bittersalz (EPSOTOP)	5.0	kg/ha
	Headland Boron (15%)	2.0	L/ha
16/08/2019	Nitram	115.0	kg/ha
30/08/2019	Microthiol Special	5.0	kg/ha
	Yara Mantrac DF	1.5	kg/ha
13/09/2019	Bittersalz (EPSOTOP)	5.0	kg/ha
	Headland Boron (15%)	1.0	L/ha
28/09/2019	Yara Mantrac DF	1.0	kg/ha
09/10/2019	Fazor (13679)	8.0	kg/ha
12/10/2019	Yara Mantrac DF	1.0	kg/ha

Pesticides applied to trial area

Date	Type	Product	Rate	Unit
19/05/2019	Insecticide	Vydate 10G (16595)	20.00	kg/ha
02/08/2019	Fungicide	Amistar Top	1.00	L/ha
	Insecticide	Hallmark with Zeon Technology (12629)	0.15	L/ha
13/08/2019	Fungicide	Reflect (18573)	1.00	L/ha
	Insecticide	Hallmark with Zeon Technology (12629)	0.15	L/ha
30/08/2019	Fungicide	Rudis (14122)	0.40	L/ha
	Insecticide	Hallmark with Zeon Technology (12629)	0.15	L/ha
13/09/2019	Fungicide	Amistar (18039)	1.00	L/ha
	Insecticide	Laidir 10 CS (17693)	0.15	L/ha
28/09/2019	Fungicide	Reflect (18573)	1.00	L/ha
12/10/2019	Fungicide	Rudis (14122)	0.40	L/ha
06/11/2019	Fungicide	Amistar Top (18050)	0.85	L/ha
	Fungicide	Clayton Spigot (11560)	0.50	L/ha

b. Sequence of trial events by date; treatments and assessments.

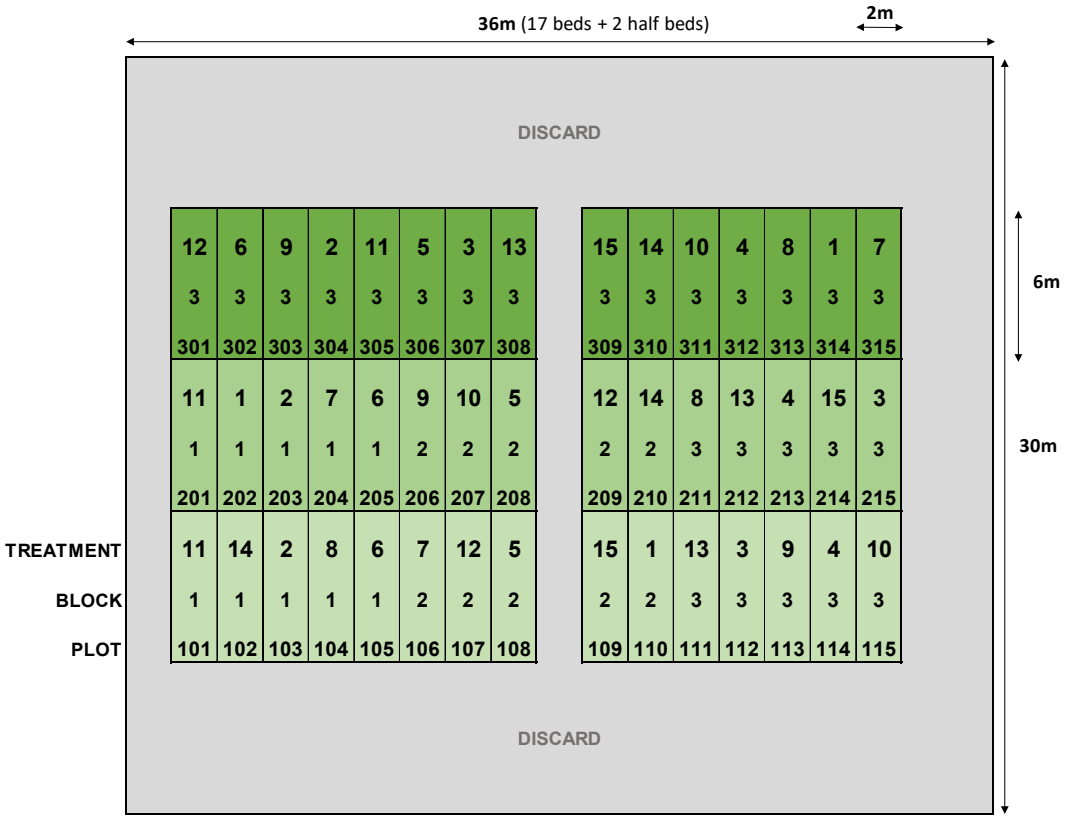
Date	Event
28/06/2019	Timing A treatment application. Trial assessment; parsnip plant population count.
08/07/2019	Timing B treatment application. Trial assessment; crop phyto, potato phyto.
17/07/2019	Timing C treatment application. Trial assessment; crop phyto, potato phyto.
31/07/2019	Trial assessment; crop phyto, potato phyto, parsnip plant population count.
15/08/2019	Trial assessment; crop phyto, potato phyto.
06/09/2019	Trial assessment; crop phyto, potato phyto.

c. Climatological data during study period.

Date	Min. temp. (°C)	Max. temp. (°C)	Precip. (mm)
28/06/2020	12	20	0.0
29/06/2020	10	29	0.0
30/06/2020	15	23	0.0
01/07/2020	11	19	0.0
02/07/2020	9	19	0.0
03/07/2020	9	21	0.0
04/07/2020	11	23	0.0
05/07/2020	15	23	0.0
06/07/2020	12	21	1.0
07/07/2020	10	20	0.0
08/07/2020	11	19	0.0
09/07/2020	12	19	0.0
10/07/2020	15	23	0.0
11/07/2020	15	24	1.0
12/07/2020	13	24	2.0
13/07/2020	13	22	3.0
14/07/2020	10	19	2.0
15/07/2020	10	23	0.0
16/07/2020	11	24	0.0
17/07/2020	15	25	1.0
18/07/2020	14	20	0.5
19/07/2020	10	19	4.1
20/07/2020	12	21	2.0
21/07/2020	12	22	0.0
22/07/2020	17	27	0.0
23/07/2020	14	30	0.0
24/07/2020	18	28	3.0
25/07/2020	16	35	0.0
26/07/2020	19	23	0.5

27/07/2020	15	19	18.8
28/07/2020	15	19	2.0
29/07/2020	14	23	1.0
30/07/2020	15	24	3.3
31/07/2020	16	20	12.2
01/08/2020	14	23	0.0
02/08/2020	14	21	0.0
03/08/2020	10	24	0.0
04/08/2020	16	25	0.5
05/08/2020	14	22	3.0
06/08/2020	13	22	3.3
07/08/2020	13	21	0.0
08/08/2020	12	23	0.0
09/08/2020	16	24	16.3
10/08/2020	15	21	1.5
11/08/2020	11	20	0.0
12/08/2020	9	17	0.0
13/08/2020	10	18	0.8
14/08/2020	10	16	7.1
15/08/2020	11	19	0.0
16/08/2020	11	17	16.0
17/08/2020	13	21	0.0
18/08/2020	12	21	0.8
19/08/2020	11	20	0.5
20/08/2020	10	18	1.0
21/08/2020	12	21	0.0
22/08/2020	15	22	0.0
23/08/2020	15	25	0.0
24/08/2020	13	27	0.0
25/08/2020	12	30	0.0
26/08/2020	14	29	0.0
27/08/2020	15	29	0.3
28/08/2020	11	20	4.6
29/08/2020	9	21	0.0
30/08/2020	15	22	0.0
31/08/2020	9	19	1.0
01/09/2020	9	17	1.8
02/09/2020	10	19	0.8
03/09/2020	15	22	0.0
04/09/2020	12	17	1.5
05/09/2020	9	17	0.0
06/09/2020	12	18	0.0

d. Trial design



e. 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

HSE
Chemicals Regulation Division

Department of Agriculture and Rural Development