

SCEPTREPLUS

Final Trial Report

Trial code:	SP 02. 2019
Title:	AHDB SCEPTREplus Herb pre-emergence herbicide screen 2019
Crop	Group: Leafy Vegetables and Alliums Coriander – <i>Coriandrum sativum</i> Parsley – <i>Petroselinum crispum</i> Chives – <i>Allium schoenoprasum</i>
Target	General broadleaf weeds and grasses; 3WEEDT EPPO1/89(3) Weeds in leafy and brassica vegetables
Lead researcher:	Angela Huckle
Organisation:	RSK ADAS
Period:	27 th March 2019 – 31 st December 2019
Report date:	29 th February 2019
Report author:	Angela Huckle Oliver Thomas
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

3rd April 2020
Date



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Authors signature

Trial Summary

Introduction

The limited range of herbicides currently available to herb growers leaves gaps in the weed control spectrum, and problems are experienced with a wide range of weeds, particularly since the loss of linuron in June 2018. Groundsel (*Senecio vulgaris*) sow thistles (*Cirsium arvense*), scentless mayweed (*Tripleurospermum inodorum*), and small nettle (*Urtica urens*) are particularly problematic for growers. As well as competing with the crop for nutrients and water, these weeds can also become contaminants if missed by hand weeding, and are very similar in leaf shape to the herb being grown.

The wide range of herb species grown presents a challenge for growers to identify herbicides which are crop safe to each particular species; there is often little information from manufacturers as herbs are very minor crops. While the herb sector is small, these crops are highly valuable. Any defects or discolouration can lead to rejection, as many herbs are sold as fresh cut products, so knowledge of the crop safety of potential new herbicides is very important.

It is a high priority for growers to find potential replacement products for linuron which are safe for their crops. Therefore the objective of this trial was to identify crop safe and effective pre-emergence herbicides for two of the most widely grown herbs; coriander (*Coriandrum sativum*) and parsley (*Petroselinum crispum*,) and chives (*Allium schoenoprasum*). The aim was to expand the options available to growers for weed control.

Methods

A randomised replicated residual herbicide trial on coriander and parsley was carried out at a commercial grower site in Sussex, on light sand to silty loam soil. The trial field was drilled on 27 June 2019, with coriander cv. Cruiser and parsley cv. Laura. Treatment timing one (T1) was applied at a pre-drilling timing with a 1.5 m boom, using an Oxford Precision Sprayer at 200 L/ha water volume, while the other six treatments (T2) were applied at a pre-emergence but post-drilling timing with the same knapsack sprayer at 200 L/ha water volume. A randomised block design was used, with three replicates of eight treatments, with all replicates for both cultivars containing one untreated control plot, with a total of 24 plots for each cultivar, each measuring 1.8 m x 3.0 m (5.4 m²).

The trial was assessed on four separate occasions, focussing on weed species and crop phytotoxicity (safety); crop effects were scored on a 0 to 10 scale, and the effects were described e.g. crop loss, yellowing, twisting or scorching for example. In addition to the baseline weed assessment carried out prior to the first treatment application, assessments were carried out at two, four, six, and seven weeks following treatment application. For all weed assessments, each individual weed was counted per plot, for all weed species present as the population was low. Weed ground coverage was relatively low, so it was difficult to gauge an accurate percentage; this was therefore not included. Plant populations were also assessed six weeks post-application, and an additional phytotoxicity assessment for parsley was carried out ten weeks post application.

A further randomised replicated residual herbicide trial on chives cv. Fine-Leaved was carried out at a commercial grower site in Basingstoke, on light sand to silt loam soil. The existing chive crop was mowed on 20 June 2019 to give a post-harvest / pre- re-growth application timing.

The treatments were applied once, at a pre-emergence timing. The treatments were applied using an Oxford Precision Sprayer with a 1.5 m boom, and an application rate of 200 L/ha of water. A randomised block design was used, with three replicates of eight treatments, with each plot within all replicates placed above each other, along the growing bed to fit with the cropping at the trial site. All replicates contained an untreated control plot, and there was a total of 24 plots within the trial, each measuring 1.8 m x 3.0 m (5.4m²).

The trial was assessed for treatment efficacy and crop safety on four separate occasions; one, two, three and four weeks post treatment application. All assessments were carried out in accordance with the coriander and parsley trial methodology.

Results and discussion

Emerger 0.75 L/ha reduced weed numbers, while remaining reasonably safe to parsley, coriander and chives, but caused a slight stunting to the parsley. Emerger 1.75 L/ha was safe to both coriander and chives, but at this higher rate had a greater stunting effect on parsley. AHDB 9860 2.0 L/ha significantly reduced mean weed numbers in both coriander and parsley, but was only safe to use in coriander at this rate, and at the lower 1.0 L/ha rate efficacy was reduced. In parsley AHDB 9860 2.0 L/ha caused a moderate stunting of the crop, and in chives caused yellowing. Both of these symptoms persisted until harvest, and therefore this product is not safe to use on those herbs. AHDB 9855 was only safe to use in chives (**Table 1**).

Devrinol 0.85 L/ha was safe to use in coriander and chives, but caused a moderate stunting, and delayed speed of growth in parsley, and therefore would not be safe to use on this herb. It did not give any significant reduction in weed numbers in these trials, but it did not control sowthistle at the rate used, and as this was the main weed species present it influenced the efficacy results.

There were no significant reductions in plant population from Devrinol 0.85 L/ha, or Emerger and AHDB 9860 applied at either rate at a pre-emergence timing. Only AHDB 9855 gave a significant reduction in plant population of parsley and coriander, causing plant death at the highest rate. There was a trend for a slightly lower plant population with Emerger applied at 1.75 L/ha, compared to application at 0.75 L/ha, but this was not a statistically significant difference.

Emerger would add useful activity on annual meadow grass, chickweed, fat-hen, mayweed, nettles and sowthistle and would therefore still be a good addition for herb growers. But growers should be aware of crop safety when using the herbicide, especially in parsley as it is on the margin of crop safety and can cause a slight stunt, even at the 0.75 L/ha rate. AHDB 9860 2.0 L/ha would give control of annual meadow grass, chickweed, fat hen, groundsel, mayweed and polygonums, but would only be safe to use on coriander.

Table 1. Summary of crop safety and efficacy in coriander, parsley and chives assessed at harvest - 54 days after treatment application (DAA) for coriander and parsley and at 27 DAA for chives. Phytotoxicity; 0 -100; 0 = completely healthy crop, 100 = complete crop death. Scores <20 deemed commercially acceptable damage, and those >20 are highlighted in red.

Treatment	Mean Phytotoxicity Score as a Percentage (Days After Application)			Mean number of weeds per plot		
	Coriander 54 DAA	Parsley 54 DAA	Chives 27 DAA	Coriander 54 DAA	Parsley 54 DAA	Chives 27 DAA
Untreated	0.0	0.0	0.0	18.7	37.0	11.7
Devrinol 0.85 L/ha	10.0	43.4	0.0	12.7	27.7	16.7
AHDB 9860 1.0 L/ha	13.3	33.3	30.0	11.0	36.0	1.7
AHDB 9860 2.0 L/ha	10.0	40.0	50.0	1.7	24.0	5.3
Emerger 0.75 L/ha	6.7	30.0	0.0	6.3	12.7	0.7
Emerger 1.75 L/ha	16.7	33.3	0.0	5.7	2.3	0.3
AHDB 9855 0.75 L/ha	90.0	100.0	0.0	14.7	22.7	6.3
AHDB 9855 1.5 L/ha	96.7	100.0	0.0	4.0	6.7	3.3

Treatment	Mean Phytotoxicity Score as a Percentage (Days After Application)			Mean number of weeds per plot		
	Coriander 54 DAA	Parsley 54 DAA	Chives 27 DAA	Coriander 54 DAA	Parsley 54 DAA	Chives 27 DAA
F prob. value	<0.001	<0.001	<0.001	0.010	<0.001	0.520
d.f.	14	14	14	14	14	14
L.S.D.	8.55	20.71	*	8.55	10.32	18.22

Conclusions

- Emerger 0.75 L/ha reduced weed numbers and was safe to use in parsley, coriander and chives, causing only a slight stunt to parsley at this rate.
- The higher rate of Emerger - 1.75 L/ha was safe for coriander and chives only.
- Devrinol 0.85 L/ha was safe to coriander and chives only.
- AHDB 9860 2.0 L/ha reduced weed numbers, but was only safe to coriander at this rate.
- AHDB 9855 reduced weed numbers but is only safe to use in chives.

Take home message:

Emerger has an EAMU (4485/19) for coriander and parsley, and use as a pre-emergence herbicide should increase weed control in these crops. An authorisation for use in chives would be useful. It has not been tested in tank-mixes, therefore care should be taken if using this approach. Devrinol 450 SC has an EAMU (2121/19) for use in a range of herbs but was only safe to use on coriander and chives. It caused moderate stunting of parsley.

Objectives

To compare a number of novel residual herbicides for weed control in coriander, parsley and chives. This one year trial evaluated pre-emergence options for broadleaf weed control for drilled coriander, parsley and chives, assessing both weed control efficacy and crop safety.

Trial conduct

This study will be conducted in compliance with the requirements of the UK Official Recognition of Efficacy Testing scheme.

Protocol conforms to **EPPO1/89(3)** for **Weeds in brassicas and leafy vegetables**, with the following deviations:

“Replicates: at least 4”

Current study to have only 3 replicates – large number of treatments provides acceptable number of residual degrees of freedom.

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 PP1/225 (2)	Minimum effective dose	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

ADAS has Efficacy Testing Certificate No. ORETO 409.

Test sites

Item	Details	
	Coriander and Parsley	Chives
Location address	Flemmings Middle Jury Farm House Jury Lane Donnington Chichester West Sussex PO20 7PX	ORN Trowe's Lane Swallowfield Wokingham South East Berkshire RG7 1RN
Crop and cultivar	Coriander – Cruiser Parsley – Laura	Chive – Fine Leaved
Soil type	Sandy silt loam	Sandy loam
Agronomic practice	See Appendix A	See Appendix A
Prior history of site	See Appendix A	See Appendix A

Trial design

Item	Details	
	Coriander and Parsley	Chives
Trial design:	Fully Randomised Block	Fully Randomised Block
Number of replicates:	3	3
Row spacing:	17 mm and 13 mm	13 mm
Plot size: (w x l)	1.8 m x 3 m	1.8 m x 3 m
Plot size: (m ²)	5.4	5.4
Number of plants per plot:	N/K	N/K

Treatment details

AHDB Code	Active substance	Product name/ manufacturer code	Formulation batch number	Content of active substance in product (g/L)	Formulation type
N/A	napropamide	Devrinol	1704-20051	450	SC
AHDB 9860	N/D	N/D	N/D	N/D	N/D
N/A	aclonifen	Emerger	EV56006446	600	SC
AHDB 9855	N/D	N/D	N/D	N/D	N/D

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	
				Coriander and Parsley	Chives
1	Untreated	-	-	-	-
2	Devrinol	382.5	0.85	T1	T1
3	AHDB 9860		1.00	T2	T1
4	AHDB 9860		2.00	T2	T1
5	Emerger	450	0.75	T2	T1
6	Emerger	1050	1.75	T2	T1
7	AHDB 9855		0.75	T2	T1
8	AHDB 9855		1.50	T2	T1

Application details – CORIANDER and PARSLEY

	T1 Application	T2 Application
Application date	27/06/2019	27/06/2019
Time of day	09:40 - 09:45	11:45 – 12:05
Crop growth stage (Max, min average BBCH)	BBCH00 - Pre-Emergence	BBCH00 – Pre-Emergence
Crop height (cm)	N/A	N/A
Crop coverage (%)	N/A	N/A
Application Method	Spray	Spray
Application Placement	Soil	Soil
Application equipment	Oxford Precision Sprayer (Knapsack)	Oxford Precision Sprayer (Knapsack)
Nozzle pressure	2-3Bar	2-3Bar
Nozzle type	Flat Fan	Flat Fan
Nozzle size	02F110	02F110
Application water volume/ha	200	200
Temperature of air - shade (°C)	25.2 – 25.5	27.2 – 27.2
Relative humidity (%)	62.8 – 61.4	55.6 – 57.3
Wind speed range (m/s)	2.8 – 3.5	3.6 – 4.2
Dew presence (Y/N)	N	N
Temperature of soil - 2-5 cm (°C)	N/K	N/K
Wetness of soil - 2-5 cm	Dry	Dry
Cloud cover (%)	0	0

Application details - CHIVES

	T1 Application
Application date	20/06/2019
Time of day	13:25 – 13:50
Crop growth stage (Max, min average BBCH)	BBCH00 - Pre-Emergence
Crop height (cm)	N/A
Crop coverage (%)	N/A
Application Method	Spray
Application Placement	Soil
Application equipment	Oxford Precision Sprayer (Knapsack)
Nozzle pressure	2-3Bar
Nozzle type	Flat Fan
Nozzle size	02F110
Application water volume/ha	200
Temperature of air - shade (°C)	15.9 – 19.1
Relative humidity (%)	70.6 – 55.5
Wind speed range (m/s)	4.8 – 2.5
Dew presence (Y/N)	N
Temperature of soil - 2-5 cm (°C)	N/K
Wetness of soil - 2-5 cm	Dry
Cloud cover (%)	90

Untreated levels of broad leaved weeds and grasses at through the assessment period – CORIANDER and PARSLEY

Common name	Scientific Name	EPPO Code	Mean number of weeds per plot		
			Weed level early-assessment period (4 weeks)	Weed level mid-assessment period (6 weeks)	Weed level end-assessment period (8 weeks)
Coriander Broad leaved weeds and grasses	N/A	3WEEDT	3	16.3	18.7
Parsley Broad leaved weeds and grasses	N/A	3WEEDT	2.7	29	37

Untreated levels of broad leaved weeds and grasses at through the assessment period – CHIVES

Common name	Scientific Name	EPPO Code	Weed level early-assessment period (1 weeks)	Weed level mid-assessment period (3 weeks)	Weed level end-assessment period (4 weeks)
Broad leaved weeds and grasses	N/A	3WEEDT	1.7 mean no. weeds per plot	6.7 mean no. weeds per plot	11.7 mean no. weeds per plot)

Assessment details – CORIANDER and PARSLEY

Evaluation date	Evaluation Timing (DA)*	Crop Growth Stage (BBCH)	Evaluation type	What was assessed and how (e.g. dead or live pest; disease incidence and severity; yield, marketable quality)
09/07/2019	12	09	Efficacy Phytotox	Total weed numbers per species per plot, all treatments Crop damage (0-10 Scale; 0=no effect, 10=complete crop kill), all plots
25/07/2019	28	13	Efficacy Phytotox	Total weed numbers per species per plot, all treatments Crop damage (0-10 Scale; 0=no effect, 10=complete crop kill), all plots
05/08/2019	39	42	Efficacy Phytotox Populations	Total weed numbers per species per plot, all treatments Crop damage (0-10 Scale; 0=no effect, 10=complete crop kill), all plots Plant populations counted either side of 0.5m rod, twice in all plots
20/08/2019	54	48	Efficacy Phytotox	Total weed numbers per species per plot, all treatments Crop damage (0-10 Scale; 0=no effect, 10=complete crop kill), all plots
04/09/2019	69	50	Phytotox	Crop damage (0-10 Scale; 0=no effect, 10=complete crop kill), all plots, PARSLEY ONLY

* DA – days after application

Assessment details - CHIVES

Evaluation date	Evaluation Timing (DA)*	Crop Growth Stage (BBCH)	Evaluation type	What was assessed and how (e.g. dead or live pest; disease incidence and severity; yield, marketable quality)
26/06/2019	6	10	Efficacy Phytotox	Total weed numbers per species per plot, all treatments Crop damage (0-10 Scale; 0=no effect, 10=complete crop kill), all plots
04/07/2019	14	19	Efficacy Phytotox	Total weed numbers per species per plot, all treatments Crop damage (0-10 Scale; 0=no effect, 10=complete crop kill), all plots
09/07/2019	19	42	Efficacy Phytotox	Total weed numbers per species per plot, all treatments Crop damage (0-10 Scale; 0=no effect, 10=complete crop kill), all plots
17/07/2019	27	50	Efficacy Phytotox	Total weed numbers per species per plot, all treatments Crop damage (0-10 Scale; 0=no effect, 10=complete crop kill), all plots

* DA – days after application

Statistical analysis

Both trial sites were laid out in a randomised block design, with treatments replicated three times for all cultivars. An untreated control plot was included in each replicate, to provide comparison for treatment efficacy and crop safety.

As the distribution of weeds was low, only analysis of variance (ANOVA) was performed on the data as the statistician advised that transformation of the data would be inappropriate. Chris Dyer at RSK ADAS performed all the statistical analysis by ANOVA using GenStat 18.4.

Results

Phytotoxicity

The results of phytotoxicity assessments from three dates for coriander and four dates for parsley and chives are presented in Table 2 to 4 below. These were scored on a scale from 0 to 10, with 0 being 'no effect', and 10 being 'dead'. These scores were then converted to a percentage score based on the table below. Plots deemed to have commercially acceptable level of damage were scored 2 or below – see below for full scale:

Crop Tolerance Score	Equivalent to Crop Damage (% Phytotoxicity)
10	Complete Crop Kill
9	90%
8	80%
7	70%
6	60%
5	50%
4	40%
3	30%
2*	20%*
1	10%
0	No Damage

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

Coriander

Nearly all treatments were safe to coriander when applied pre-emergence. These were Devrinol 0.85 L/ha applied pre-drilling, and AHDB 9860 and Emerger applied within 24 hours of drilling. The exception was AHDB 9855 which caused a significant reduction in plant stand, and crop death (**Table 2**). Slight effects were seen in some of the other treatments, which was a stunting and delay to speed of growth, but this was at an acceptable level to the grower, and could be factored into schedules if they are made aware of this effect.

Table 2. Summary of crop safety in **Coriander** throughout trial period, assessed at 28, 39 and 54 days after treatment application. Phytotoxicity; 0 -100; 0 = completely healthy crop, 100 = complete crop death. Scores <20 deemed commercially acceptable damage, and those >20 are highlighted in red.

Treatment	Mean Phytotoxicity Score as a Percentage (Days after application)		
	28 DAA	39 DAA	54 DAA
Untreated	0.0	0.0	0.0
Devrinol 0.85 L/ha	0.0	6.7	10.0
AHDB 9860 1.0 L/ha	0.0	13.3	13.3
AHDB 9860 2.0 L/ha	0.0	6.7	10.0
Emerger 0.75 L/ha	0.0	3.3	6.7
Emerger 1.75 L/ha	0.0	20.0	16.7
AHDB 9855 0.75 L/ha	86.7	86.7	90.0
AHDB 9855 1.5 L/ha	96.7	96.7	96.7
F prob. value	<0.001	<0.001	<0.001
d.f.	14	14	14
L.S.D.	4.68	8.65	8.55

Parsley

Parsley is a more sensitive crop than coriander and a greater effect was seen on the crop from all the herbicides in the trial causing significant increases in the phytotoxicity score which persisted until harvest (**Table 3**). This effect was stunting which ranged from slight to moderate at the final assessment at harvest. Emerger gave the lowest effect on the crop by the point of harvest, with the herbicide causing least stunting, and at 0.75 L/ha was only just above an acceptable score. AHDB 9855 caused complete crop death.

Table 3. Summary of crop safety in **Parsley** throughout trial period, assessed at 28, 39, 54 and 69 days after treatment application. Phytotoxicity; 0 -100; 0 = completely healthy crop, 100 = complete crop death. Scores <20 deemed commercially acceptable damage, and those >20 are highlighted in red.

Treatment	Mean Phytotoxicity Score as a Percentage (Days after application)			
	28 DAA	39 DAA	54 DAA	69 DAA
Untreated	0.0	0.0	0.0	0.0
Devrinol 0.85 L/ha	23.3	36.7	43.4	53.3
AHDB 9860 1.0 L/ha	26.7	30.0	33.3	40.0

Treatment	Mean Phytotoxicity Score as a Percentage (Days after application)			
	28 DAA	39 DAA	54 DAA	69 DAA
AHDB 9860 2.0 L/ha	16.7	30.0	40.0	43.3
Emerger 0.75 L/ha	33.3	23.3	30.0	26.7
Emerger 1.75 L/ha	0.0	30.0	33.3	33.3
AHDB 9855 0.75 L/ha	100.0	100.0	100.0	100.0
AHDB 9855 1.5 L/ha	100.0	100.0	100.0	100.0
F prob. value	<0.001	<0.001	<0.001	<0.001
d.f.	14	14	14	14
L.S.D.	18.53	23.71	20.71	11.78

Chives

With the exception of AHDB 9860, all treatments were safe to apply pre-emergence in chives. AHDB 9860 caused a significant yellowing of the crop as it re-grew and the effect persisted until harvest. The yellowing increased in severity with increasing rate of application. Emerger also caused a little yellow spotting on about 10% of the leaves but the yellowing grew out as was on the first leaves which would have senesced by harvest (**Table 4**).

Table 4. Summary of crop safety in **Chives** throughout trial period, assessed at 6, 14, 19 and 27 days after treatment application. Phytotoxicity; 0 -10; 0 = completely healthy crop, 10 = complete crop death. Values have been converted to be presented on a 0 -100 scale. Scores <20 deemed commercially acceptable damage, and those >20 are highlighted in red.

Treatment	Mean Phytotoxicity Score as a Percentage (Days after application)			
	6 DAA	14 DAA	19 DAA	27 DAA
Untreated	0.0	0.0	0.0	0.0
Devrinol 0.85 L/ha	0.0	0.0	0.0	0.0
AHDB 9860 1.0 L/ha	0.0	43.3	30.0	30.0
AHDB 9860 2.0 L/ha	0.0	66.7	56.7	50.0
Emerger 0.75 L/ha	0.0	6.7	0.0	0.0
Emerger 1.75 L/ha	0.0	3.3	0.0	0.0
AHDB 9855 0.75 L/ha	0.0	0.0	0.0	0.0
AHDB 9855 1.5 L/ha	0.0	0.0	0.0	0.0
F prob. value	NS	<0.001	<0.001	<0.001
d.f.	14	14	14	14
L.S.D.	-	11.14	13.51	*

Plant population

There were no significant reductions in plant population from Devrinol 0.85 L/ha, or Emerger and AHDB 9860 applied at either rate at a pre-emergence timing. Only AHDB 9855 gave a significant reduction in plant population, causing plant death at the highest rate. There was a trend for a slightly lower plant population with Emerger applied at 1.75 L/ha, compared to application at 0.75 L/ha, but this was not a statistically significant difference. Results are shown in **Table 5** and **Figure 1**.

Table 5. Plant population counts per metre of crop for coriander and parsley at 39 days after the pre-emergence was applied. Figures in **bold** are significantly lower than the untreated control.

Treatment	Plant population per metre at 39 days after application	
	Coriander	Parsley
Untreated	58.6	74.4
Devrinol 0.85 L/ha	61.6	74.4
AHDB 9860 1.0 L/ha	54.6	71.6
AHDB 9860 2.0 L/ha	74.4	66.6
Emerger 0.75 L/ha	81.4	70.4
Emerger 1.75 L/ha	69.0	61.4
AHDB 9855 0.75 L/ha	21.4	0.0
AHDB 9855 1.5 L/ha	0.0	0.0
F prob. value	<0.001	<0.001
d.f.	14	14
L.S.D.	21.58	14.31

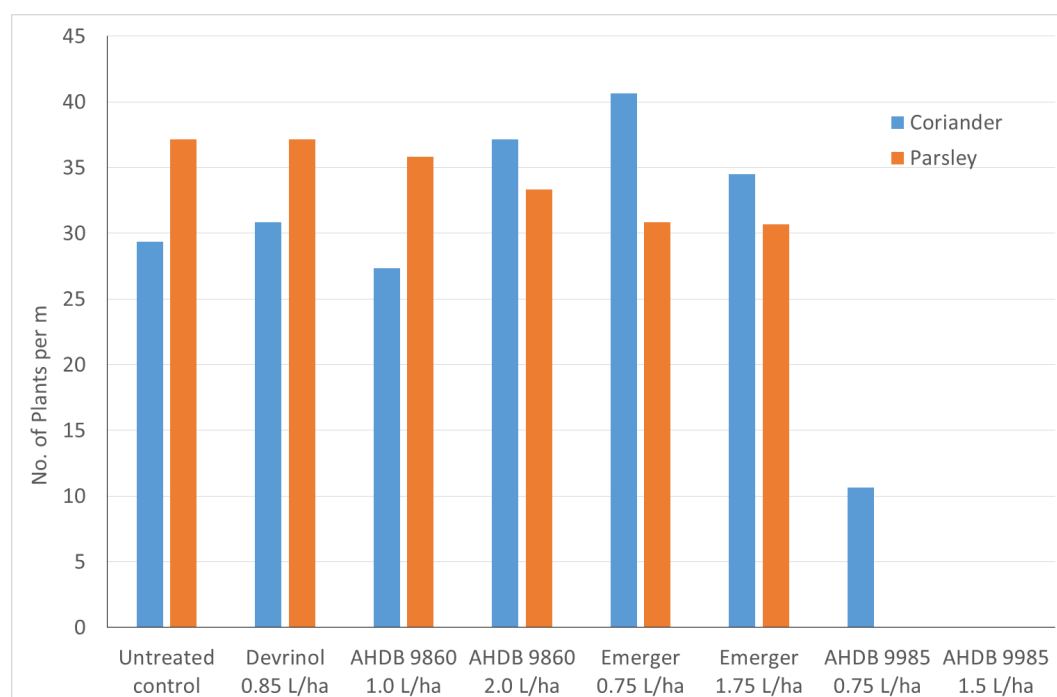


Figure 1. Plant population counts per metre of crop for coriander and parsley at 39 days after the pre-emergence was applied. LSD (Coriander, 21.58; Parsley, 14.31)

Efficacy

Coriander

There were low levels of weed with a mean of only 18.7 weeds per plot in the untreated control by the last assessment timing, therefore there were no strong significant differences at $P < 0.001$. There were significant differences at $P = 0.01$ level with lower levels of weeds in the plots treated with the higher rate of AHDB 9860 and Emerger at both rates used. The main weeds present in the trial were groundsel and sowthistle (**Table 6** and **Figure 2**).

Table 6. Mean weed counts for **Coriander** assessed at 28, 39 and 54 days after treatment application. Figures in **bold** are significantly different from the untreated.

Treatment	Mean number of weeds per plot		
	App + 28 Days	App + 39 Days	App + 54 Days
Untreated	3.0	16.3	18.7
Devrinol 0.85 L/ha	1.3	12.7	12.7
AHDB 9860 1.0 L/ha	1.7	8.3	11.0
AHDB 9860 2.0 L/ha	2.0	5.3	1.7
Emerger 0.75 L/ha	0.7	4.7	6.3
Emerger 1.75 L/ha	0.3	3.3	5.7
AHDB 9855 0.75 L/ha	0.7	3.3	14.7
AHDB 9855 1.5 L/ha	0.0	2.0	4.0
F prob. value	0.276 (NS)	0.012	0.010
d.f.	14	14	14
L.S.D.	2.53	7.64	8.55

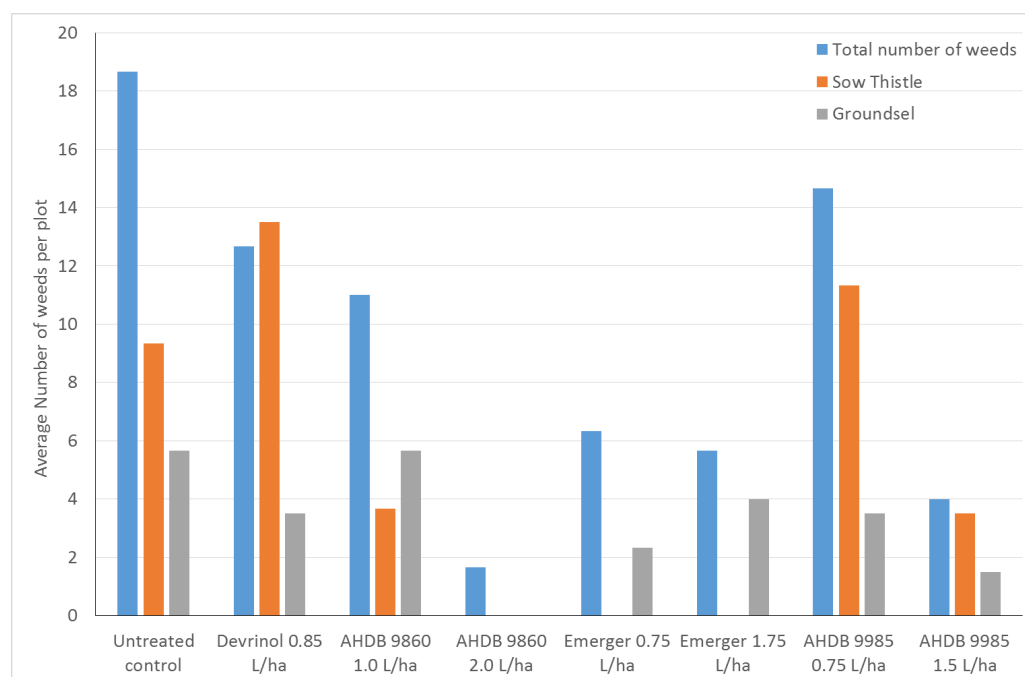


Figure 2. Weed numbers in the coriander trial at 54 days after the pre-emergence application. $F_{pr} = 0.01$, LSD, 8.55.

Parsley

In the parsley trial area there were greater weed numbers and statistical differences in levels of weed control, but numbers were still low with a mean of 37 weeds per plot in the untreated control. By the final assessment at nearly eight weeks after application, AHDB 9855 and Emerger at both rates, and AHDB 9860 at 2.0 L/ha gave statistically significant reductions in weed numbers. The main weeds present in the trial were groundsel and sowthistle. The best performing products in this trial were Emerger 1.75 L/ha and AHDB 9855 1.5 L/ha, which reduced weed numbers to under 10 weeds per plot (**Table 7** and **Figure 3**).

Table 7. Mean weed counts for **Parsley** assessed at 28, 39 and 54 days after treatment application. Figures in **bold** are significantly different from the untreated.

Treatment	Average Overall Weed Counts		
	App + 28 Days	App + 39 Days	App + 54 Days
Untreated	2.7	29.0	37.0
Devrinol 0.85 L/ha	1.7	19.3	27.7
AHDB 9860 1.0 L/ha	0.3	9.7	36.0
AHDB 9860 2.0 L/ha	2.0	14.3	24.0
Emerger 0.75 L/ha	4.0	12.3	12.7
Emerger 1.75 L/ha	0.0	2.3	2.3
AHDB 9855 0.75 L/ha	0.3	7.3	22.7
AHDB 9855 1.5 L/ha	0.3	0.3	6.7
F prob. value	0.002	0.003	<0.001
d.f.	14	14	14
L.S.D.	1.77	11.93	10.32

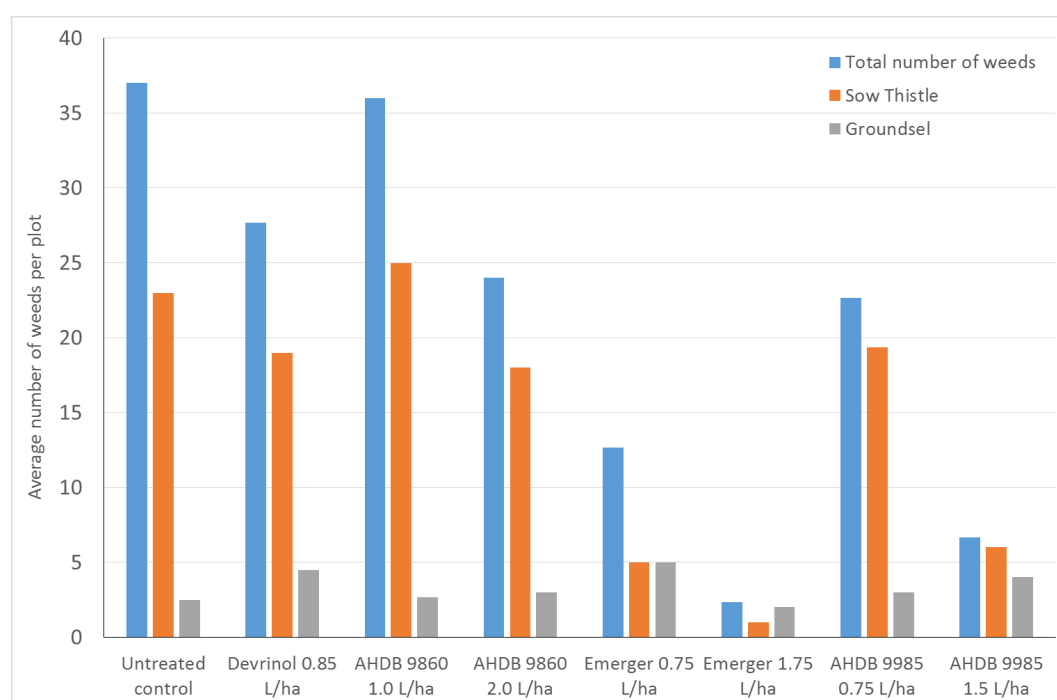


Figure 3. Weed numbers in the parsley trial at 54 days after the pre-emergence application. F pr = <0.001, LSD, 10.32

Chives

Weed numbers were very low in this trial, and there were no significant differences between treatments (**Table 8**).

Table 8. Mean weed counts in the **Chives** trial, assessed at 6, 14, 19 and 27 days after treatment application. Figures in **bold** are significantly different from the untreated.

Treatment	Average Overall Weed Counts			
	App + 6 Days	App + 14 Days	App + 19 Days	App + 27 Days
Untreated	1.7	4.3	6.7	11.7
Devrinol 0.85 L/ha	4.0	6.0	15.3	16.7
AHDB 9860 1.0 L/ha	0.0	1.0	1.0	1.7
AHDB 9860 2.0 L/ha	0.3	1.0	5.3	5.3
Emerger 0.75 L/ha	1.7	0.7	0.7	0.7
Emerger 1.75 L/ha	0.7	0.0	0.3	0.3
AHDB 9855 0.75 L/ha	2.7	7.3	2.0	6.3
AHDB 9855 1.5 L/ha	2.0	1.7	3.3	3.3
F prob. value	0.117	0.369	0.229	0.520
d.f.	14	14	14	14
L.S.D.	2.77	7.68	12.16	18.22

Discussion

Emerger 0.75 L/ha reduced weed numbers, while remaining reasonably safe to parsley, coriander and chives, but caused a slight stunting to the parsley. Emerger 1.75 L/ha was safe to both coriander and chives, but at this higher rate has a greater stunting effect on parsley. AHDB 9860 2.0 L/ha significantly reduced mean weed numbers in both coriander and parsley, but was only safe to use in coriander at this rate, and at the lower 1.0 L/ha rate efficacy was reduced. In parsley AHDB 9860 2.0 L/ha caused a moderate stunting of the crop, and in chives caused yellowing. Both of these symptoms persisted until harvest, and therefore this product is not safe to use on those herbs. AHDB 9855 was only safe to use in chives.

Devrinol 0.85 L/ha was safe to use in coriander and chives, but caused a moderate stunting, and delayed speed of growth in parsley, and therefore would not be safe to use on this herb. It did not give any significant reduction in weed numbers in these trials, but it does not control sowthistle at the rate used, and as this was the main weed species present then this would have influenced the efficacy results.

There were no significant reductions in plant population from Devrinol 0.85 L/ha, or Emerger and AHDB 9860 applied at either rate at a pre-emergence timing. Only AHDB 9855 gave a significant reduction in plant population of parsley and coriander, causing plant death at the highest rate. There was a trend for a slightly lower plant population with Emerger applied at 1.75 L/ha, compared to application at 0.75 L/ha, but this was not a statistically significant difference.

Emerger would add useful activity on annual meadow grass, chickweed, fat-hen, mayweed, nettles and sowthistle and would therefore still be a good addition for herb growers. But growers should be aware of crop safety when using the herbicide, especially in parsley as it is on the margin of crop safety and can cause a slight stunt, even at the 0.75 L/ha rate. AHDB

9860 2.0 L/ha would give control of annual meadow grass, chickweed, fat hen, groundsel, mayweed and polygonums, but would only be safe to use on coriander.

Conclusions

- Emerger 0.75 L/ha reduced weed numbers and was safe to use in parsley, coriander and chives, causing only a slight stunt to parsley at this rate.
- The higher rate of Emerger - 1.75 L/ha was safe for coriander and chives only.
- Devrinol 0.85 L/ha was safe to coriander and chives only.
- AHDB 9860 2.0 L/ha reduced weed numbers, but was only safe to coriander at this rate.
- AHDB 9855 reduced weed numbers but is only safe to use in chives.

Acknowledgements

Thanks are given to the hosts, Valley Herbs for providing both trial sites in Basingstoke and Sussex, and particularly to Omer Collins and Peter Waldock (Growing Earth Consultancy) for their technical assistance. AHDB for funding the work, and also the crop protection companies for their financial contributions as well as providing samples for the trials.

Appendix

a. Crop diary – events related to growing crop

Crop	Cultivar	Planting Date	Row Width
Coriander	Cruiser	27/06/2019	17mm spacing, 8 rows 75mm apart, 1.8 meter beds

Crop	Cultivar	Planting Date	Row Width
Parsley	Laura	27/06/2019	13mm spacing, 8 rows 75mm apart, 1.8 meter beds

Crop	Cultivar	Planting Date	Row Width
Chive	Fine Leaved	20/06/2019	13mm spacing, 8 rows 75mm apart, 1.8 meter beds

b. Previous cropping – CORIANDER and PARSLEY

Date	Crop
25/03/2019 –06/04/2019	Coriander, Chervil and Dill
2018	Potatoes

Previous cropping - CHIVES

Date	Crop
2017	Parsley
2018	Chives

c. Active ingredients/fertiliser applied to trial – CORIANDER and PARSLEY

Date/Timing	Product	Rate (kg/ha or L/ha)
25/03/2019	MOP	300
27/06/2019	CAN + S	250
2 True Leaf Stage	CAN + S	330

Active ingredients/fertiliser applied to trial – CHIVES

Date/Timing	Product	Rate (kg/ha or L/ha)
Seed Drill in 2018	CAN + S	350
05/03/2019	MOP	300
After Each Mow	CAN + S	450-500

d. Pesticides applied to trial area – CORIANDER and PARSLEY

Date	Product	Rate (L/ha)
21-Day HI	Signum (Parsley ONLY)	1.5
14-Day HI	Switch (PARSLEY ONLY)	0.8

e. Details of irrigation regime – CORIANDER, PARSLEY and CHIVES

Irrigation regime was weather-dependent – no official scheme followed.

f. Trial diary

CORIANDER and PARSLEY	
Date	Event
27 th June 2019	Trial plots drilled, T1 and T2 applications
9 th July 2019	First efficacy and phytotoxicity assessments
25 th July 2019	Second efficacy and phytotoxicity assessments
5 th August 2019	Third efficacy and phytotoxicity assessments. Plant populations assessed
20 th August 2019	Fourth efficacy and phytotoxicity assessments
4 th September 2019	Fifth phytotoxicity assessment (Parsley only)

CHIVES	
Date	Event
20 th June 2019	Trial plots mowed, T1 applications
26 th June 2019	First efficacy and phytotoxicity assessment
4 th July 2019	Second efficacy and phytotoxicity assessment
9 th July 2019	Third efficacy and phytotoxicity assessment
17 th July 2019	Fourth efficacy and phytotoxicity assessment

g. Climatological data during study period

CORIANDER and PARSLEY			
Date	Temperature °C (minimum)	Temperature °C (maximum)	Rainfall (mm)*
27 June 2019	16	23	
28 June 2019	17	24	
29 June 2019	19	26	
30 June 2019	19	22	
01 July 2019	16	21	
02 July 2019	16	21	
03 July 2019	16	24	
04 July 2019	18	25	

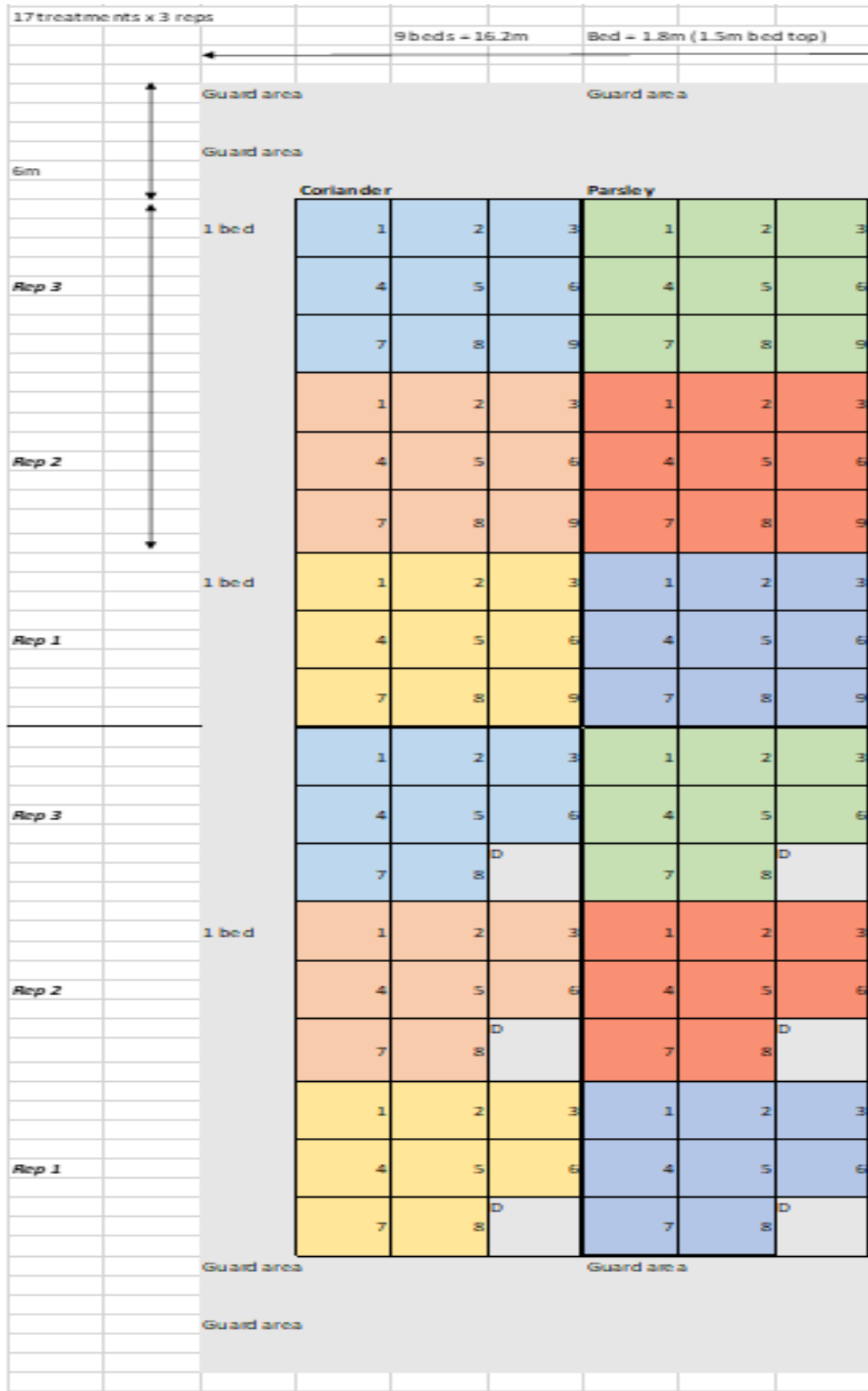
05 July 2019	19	26	
06 July 2019	19	23	
07 July 2019	18	24	
08 July 2019	18	24	
09 July 2019	20	23	
10 July 2019	20	22	
11 July 2019	19	22	
12 July 2019	19	23	
13 July 2019	20	23	
14 July 2019	18	24	
15 July 2019	18	25	
16 July 2019	19	24	
17 July 2019	19	23	
18 July 2019	20	22	
19 July 2019	18	20	
20 July 2019	18	21	
21 July 2019	17	21	
22 July 2019	19	23	
23 July 2019	20	31	
24 July 2019	23	29	
25 July 2019	17	33	
26 July 2019	18	24	
27 July 2019	16	24	
28 July 2019	14	26	
29 July 2019	11	25	
30 July 2019	17	20	
31 July 2019	17	22	
01 August 2019	11	27	
02 August 2019	14	30	
03 August 2019	13	24	
04 August 2019	14	26	
05 August 2019	17	25	
06 August 2019	16	22	
07 August 2019	16	24	
08 August 2019	11	24	
09 August 2019	18	26	
10 August 2019	17	20	
11 August 2019	16	21	
12 August 2019	12	21	
13 August 2019	8	22	
14 August 2019	15	18	
15 August 2019	14	23	
16 August 2019	11	18	
17 August 2019	16	22	
18 August 2019	14	21	
19 August 2019	14	22	
20 August 2019	11	23	
21 August 2019	8	25	
22 August 2019	8	22	
23 August 2019	10	30	
24 August 2019	10	30	

25 August 2019	14	31	
26 August 2019	12	30	
27 August 2019	13	33	
28 August 2019	18	22	
29 August 2019	11	22	
30 August 2019	13	22	
31 August 2019	11	22	
01 September 2019	10	22	
02 September 2019	7	20	
03 September 2019	16	20	
04 September 2019	16	22	

Rainfall data not available*

No climatological data for Chives.

h. Trial design - CORIANDER and PARSLEY



Trial design - CHIVES

REP 2			REP 3			REP 1			
TREATMENT	DISCARD	5	Post-Em Trial	DISCARD	7	Post-Em Trial	DISCARD	1	Post-Em Trial
BLOCK	DISCARD	1		DISCARD	2		DISCARD	3	
PLOT		108		DISCARD	208		DISCARD	308	
TREATMENT	DISCARD	2	Post-Em Trial	DISCARD	4	Post-Em Trial	DISCARD	7	Post-Em Trial
BLOCK	DISCARD	1		DISCARD	2		DISCARD	3	
PLOT		107		DISCARD	207		DISCARD	307	
TREATMENT	DISCARD	8	Post-Em Trial	DISCARD	6	Post-Em Trial	DISCARD	2	Post-Em Trial
BLOCK	DISCARD	1		DISCARD	2		DISCARD	3	
PLOT		106		DISCARD	206		DISCARD	306	
TREATMENT	DISCARD	7	Post-Em Trial	DISCARD	2	Post-Em Trial	DISCARD	4	Post-Em Trial
BLOCK	DISCARD	1		DISCARD	2		DISCARD	3	
PLOT		105		DISCARD	205		DISCARD	305	
TREATMENT	DISCARD	1	Post-Em Trial	DISCARD	8	Post-Em Trial	DISCARD	3	Post-Em Trial
BLOCK	DISCARD	1		DISCARD	2		DISCARD	3	
PLOT		104		DISCARD	204		DISCARD	304	
TREATMENT	DISCARD	4	Post-Em Trial	DISCARD	1	Post-Em Trial	DISCARD	5	Post-Em Trial
BLOCK	DISCARD	1		DISCARD	2		DISCARD	3	
PLOT		103		DISCARD	203		DISCARD	303	
TREATMENT	DISCARD	3	Post-Em Trial	DISCARD	5	Post-Em Trial	DISCARD	6	Post-Em Trial
BLOCK	DISCARD	1		DISCARD	2		DISCARD	3	
PLOT		102		DISCARD	202		DISCARD	302	
TREATMENT	DISCARD	6	Post-Em Trial	DISCARD	3	Post-Em Trial	DISCARD	8	Post-Em Trial
BLOCK	DISCARD	1		DISCARD	2		DISCARD	3	
PLOT		101		DISCARD	201		DISCARD	301	
	DISCARD	DISCARD	DISCARD						
	DISCARD	DISCARD	DISCARD						

- i. ORETO certificate



Certificate of
**Official Recognition of Efficacy Testing Facilities
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This certifies that
RSK ADAS Ltd
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Date of issue: 1 June 2018
Effective date: 18 March 2018
Expiry date: 17 March 2023

Signature 
Authorised signatory

Certification Number ORETO 409
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