


SCEPTREPLUS

Final Trial Report

Trial code:	2018. SP02
Title:	AHDB SCEPTREplus transplanted herb herbicide screen
Crop:	Leafy vegetables (herbs)
Target:	General broadleaf weeds and grasses, 3WEEDT EPPO1/89(3) Weeds in leafy and brassica vegetables
Lead researcher:	Angela Huckle
Organisation:	RSK ADAS
Period:	14 th May 2018 – 31 st December 2018
Report date:	10 th May 2019
Report author:	Angela Huckle Emily Lawrence
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

11.06.2019.....
Date


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Authors signature

Trial Summary

Introduction

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.

Linuron has been a key component of herbicide programs for a number of herb crops along with lenacil (Venzar Flow). These products formed the basis of commercial programs and are used in a tank mix both pre- and post-emergence, to complement the weed control spectrums of other actives. Linuron was withdrawn on 3 June 2018-; this left herb growers with limited options for pre-emergence weed control. Therefore it is a high priority for growers to find potential replacement products and understand their crop safety to a range of herb species.

Also, groundsel, mayweed, annual meadow grass and couch grass were identified as particular problems for outdoor herb growers in the AHDB Horticulture 'Gap Analysis' project CP 132 (2016). Crop selectivity of a range of herbicides, which target the above broad-leaved weeds were screened on six species of herbs grown from transplants. These herbs were selected by the British Herb Trade Association. In addition, a product was also included in the screen for improving grass weed control.

The objective of this trial was to identify potential new crop-safe herbicides which may be used to partly or fully replace the previous use of linuron.

Methods

The trial was sited on an uncovered hard standing at ADAS Boxworth. Treatments were either incorporated into the soil before potting (treatments 2, 3 and 4), applied over soil in pots prior to planting (treatments 5 to 10), or applied over the herbs nine days after planting (treatments 11 to 28). The herbs had approximately five side shoots present at the post-planting application.

Herbs of six species were included in the trial – chamomile (CHA), mint (MINT), oregano (ORE), sage (SAGE), tarragon (TAR), and thyme (THY). Pre-planting treatments (Application A) were applied on 20th June 2018. Post-plant treatments (Application B) were applied on 29th June 2018. The treatments were applied with a 0.5m lance and an Oxford Precision Sprayer knapsack at 200 L/ha water volume.

A fully randomised block design was used with four replicates of twenty-eight treatments, including an untreated control for comparison. Each 'plot' consisted of 2 x 2L pots, with the whole trial totaling 1344 pots. Crop safety was assessed twice; on 25th July and 13th August vigour scores were recorded, comparing the overall appearance of treated and untreated pots.

Results and discussion

Table 1. Summary of crop vigour at 6 weeks after the post planting application (13th August 2018) (treatment dose rates at half (0.5x), full (1x), or twice (2x) full normal rate). Scored from 0 to 9; 0 = complete crop death, 9 = no quality reduction, <7 commercially unacceptable damage (*highlighted in red*).

Pre-plant 20 th June 2018	Post-planting 29 th June 2018	CHA	MINT	ORE	SAGE	TAR	THY
Untreated	-	9.00	9.00	9.00	9.00	9.00	9.00
Devrinol 450 SC 1.4 L/ha	-	8.75	7.75	7.25	8.25	6.75	9.00

Pre-plant 20 th June 2018	Post-planting 29 th June 2018	CHA	MINT	ORE	SAGE	TAR	THY
Devrinol 450 SC SC 2.8 L/ha	-	7.75	8.75	4.75	7.50	5.75	8.25
Devrinol 450 SC SC 5.6 L/ha	-	6.50	7.00	6.25	6.50	3.50	6.25
AHDB 9918 (0.5x)	-	8.75	4.00	8.00	6.50	8.50	6.50
AHDB 9918 (1x)	-	7.00	2.75	0.75	6.50	7.25	3.25
AHDB 9918 (2x)	-	5.75	0.00	0.00	4.50	6.00	2.00
Aclonifen 0.5 L/ha	-	8.75	7.00	6.50	8.25	9.00	9.00
Aclonifen 1.0 L/ha	-	9.00	8.75	6.50	9.00	7.75	9.00
Aclonifen 2.0 L/ha	-	9.00	8.25	8.50	7.50	6.75	9.00
-	AHDB 9918 (0.5x)	7.75	7.50	5.25	8.25	7.00	4.75
-	AHDB 9918 (1x)	8.25	5.50	1.25	7.75	8.75	5.00
-	AHDB 9918 (2x)	8.25	2.00	1.25	6.75	7.25	2.50
-	Aclonifen 0.5 L/ha	6.75	5.25	6.25	6.00	7.50	7.50
-	Aclonifen 1.0 L/ha	7.25	7.75	6.50	5.75	8.25	5.50
-	Aclonifen 2.0 L/ha	8.00	7.00	7.50	6.50	7.50	6.50
-	AHDB 9981 (0.5x)	8.50	8.75	8.00	5.75	8.25	9.00
-	AHDB 9981 (1x)	8.50	8.50	9.00	6.00	6.50	8.75
-	AHDB 9981 (2x)	8.75	8.75	8.25	6.75	6.25	9.00
-	Centurion Max 0.5 L/ha	8.25	7.75	9.00	8.50	9.00	9.00
-	Centurion Max 1.0 L/ha	9.00	8.75	8.50	9.00	9.00	9.00
-	Centurion Max 2.0 L/ha	8.00	8.00	9.00	9.00	9.00	9.00
-	Oblix 500 1.0 L/ha	7.00	6.75	9.00	9.00	8.75	6.00
-	Oblix 500 2.0 L/ha	6.75	6.00	7.50	8.75	9.00	6.50
-	Oblix 500 4.0 L/ha	5.00	6.25	4.75	8.50	8.00	3.00
-	AHDB 9887 (0.5x)	6.25	6.75	8.50	8.50	9.00	8.00
-	AHDB 9887 (1x)	6.00	7.50	3.50	9.00	9.00	5.75
-	AHDB 9887 (2x)	5.75	6.00	1.00	8.75	9.00	3.00
	F prob. value	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	d.f.	84	84	84	84	84	84
	S.E.D.	1.018	1.186	0.818	0.6792	0.776	0.888
	L.S.D.	2.025	2.359	1.627	1.3507	1.544	1.766

Conclusions

Pre-planting

- Aclonifen was safe to nearly all the herb species (chamomile, mint, sage, tarragon and thyme) in the trial when applied at up to 2.0 L/ha, with the exception of oregano which was not safe to use pre-planting at any rate

- Devrinol 450 SC was safe to chamomile, mint, sage and thyme up to an application rate of 2.8 L/ha, and oregano up to 1.4 L/ha. However, it has subsequently been approved for use at a lower rate of 0.85 L/ha, which indicates it would be safe to use in all the herbs listed above at the current authorised rate
- AHDB 9918 was only safe to tarragon at this pre-planting application timing.

Post-planting

- Centurion Max was safe to all herbs in the trial (chamomile, mint, oregano, sage, tarragon and thyme) when applied up to a rate of 2.0 L/ha.
- Aclonifen was more damaging when applied at a post-planting timing, and was safe only to chamomile, tarragon and thyme at 0.5 L/ha. Above this rate scorch and chlorosis was seen.
- AHDB 9981 was safe to chamomile, mint, oregano and thyme.
- Oblix 500 (ethofumesate) was safe to mint and oregano up to 1.0 L/ha, and safe to sage and tarragon up to 4.0 L/ha.
- AHDB 9887 is safe to oregano and thyme at half dose, and mint, sage and tarragon at double dose.
- AHDB 9918 was only safe to use over chamomile and tarragon post-planting.

Take Home Message

There is at least one promising pre- and post-planting herbicide for each herb species which can be taken forward for testing in the field, as well warranting investigation for EAMU authorisation.

Objectives

1. To test the crop safety of pre- and post-emergence herbicides on six species of transplanted herbs.

Trial conduct

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

Relevant EPPO guideline(s)		Variation from EPPO
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

There were no deviations from EPPO guidance.

Test site

Item	Details
Location address	ADAS Boxworth (hard standing) Battle Gate Road Boxworth CB23 4NN Cambridgeshire Grid reference: TL 34330 63366
Crop	Herbs
Cultivar	Chamomile, mint, oregano, sage, tarragon, thyme
Soil or substrate type	Sterilised loam mix (Rothamsted 'weed mix' - sterilised Kettering loam and lime free grit 3-6mm in a 4:1 ratio, plus 2kg/m ³ Osmacote mini 5-6 months 4:1 loam:grit)
Agronomic practice	N/A
Prior history of site	N/A

Trial design

Item	Details
Trial design:	Fully randomised block
Number of replicates:	4
Plot size:	2L pot
Number of plants per plot:	10
<i>Leaf Wall Area calculations</i>	N/A

Treatment details

AHDB code	Active substance	Product name/ manufacturers code	Formulation batch number	Content of active substance in product (g/L)	Formulation type
N/A	Napropamide	Devrinol 450 SC	429H	450	Suspension Concentrate
AHDB 9918	N/D	N/D	N/D	N/D	N/D
N/A	Aclonifen	Bandur/ Emerger	EV56006446	600	Suspension Concentrate
AHDB 9981	N/D	N/D	N/D	N/D	N/D
N/A	Clethodim	Centurion Max	N/K	120	Emulsifiable Concentrate
N/A	Ethofumesate	Oblix 500	15018151	500	Suspension Concentrate
AHDB 9887	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/ha)	Application code
1	Untreated	-	-	-
2	Devrinol 450 SC	630	1.4 L/ha	A
3	Devrinol 450 SC	1260	2.8 L/ha	A
4	Devrinol 450 SC	2520	5.6 L/ha	A
5	AHDB 9918	N/D	0.24 L/ha	A
6	AHDB 9918	N/D	0.48 L/ha	A
7	AHDB 9918	N/D	0.96 L/ha	A
8	Aclonifen	300	0.5 L/ha	A
9	Aclonifen	600	1.0 L/ha	A
10	Aclonifen	900	2.0 L/ha	A
11	AHDB 9918	N/D	0.24 L/ha	B
12	AHDB 9918	N/D	0.48 L/ha	B
13	AHDB 9918	N/D	0.96 L/ha	B
14	Aclonifen	300	0.5 L/ha	B
15	Aclonifen	600	1.0 L/ha	B
16	Aclonifen	900	2.0 L/ha	B
17	AHDB 9981	N/D	1.0 kg/ ha	B
18	AHDB 9981	N/D	2.0 kg/ ha	B
19	AHDB 9981	N/D	4.0 kg/ ha	B
20	Centurion Max	60	0.5 L/ha	B
21	Centurion Max	120	1.0 L/ha	B
22	Centurion Max	240	2.0 L/ha	B
23	Oblix 500	500	1.0 L/ha	B
24	Oblix 500	1000	2.0 L/ha	B
25	Oblix 500	2000	4.0 L/ha	B
26	AHDB 9887	N/D	0.5 L/ha	B
27	AHDB 9887	N/D	1.0 L/ha	B
28	AHDB 9887	N/D	2.0 L/ha	B

Application details

	Application A	Application B
Application date	20/06/2018	29/06/2018
Time of day	14:00 – 15:00	09:00 – 14:00
Crop growth stage (Max, min average BBCH)	N/A	25
Crop height (cm)	N/A	5 – 10cm depending on species
Crop coverage (%)	N/A	65 - 70%
Application Method	spray	spray
Application Placement	soil	foliar
Application equipment	Oxford Precision Sprayer (knapsack)	Oxford Precision Sprayer (knapsack)
Nozzle pressure	2.4 bar	2.4 bar
Nozzle type	flat fan	flat fan
Nozzle size	02F110	02F110
Application water volume/ha	200	200
Temperature of air (°C)	27.8	25.4
Relative humidity (%)	36.8	31.5
Wind speed range (mph)	9.2 – 9.7	6.4 – 9.5
Dew presence (Y/N)	N	N
Temperature of soil - 10 cm (°C)	N/K	N/K
Wetness of soil - 2-5 cm	damp	damp
Cloud cover (%)	15	30

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)
25/07/2018	30	29	vigour	Crop vigour (% size reduction compared to UTC; visual comparison, scored 0-9)
13/08/2018	49	48-51	vigour	Crop vigour (% size reduction compared to UTC; visual comparison, scored 0-9)

* DA – days after application A

Statistical analysis

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

All data were analysed by ANOVA using Genstat 16.0 by Emily Lawrence at RSK ADAS.

Results

VIGOUR

The results for the mean vigour per treatment for each herb variety are presented in Table .

Vigour was recorded using the following scale:

Crop vigour score	Equivalent to crop damage (% quality reduction)
0	complete crop death
1	80-90% reduction
2	70-80%
3	60-70%
4	50-60%
5	40-50%
6	30-40%
7*	20-30%
8	10-20%
9	no quality reduction

* 7 = minimum level of acceptable vigour reduction, i.e. damage unlikely to reduce yield, and acceptable to grower.

Table 2. Mean vigour scores for each herb variety – final assessment, 13th August 2018. Scored from 0 to 9; 0 = complete crop death, 9 = no quality reduction, scores <7 deemed commercially unacceptable damage (*highlighted in red*).

Application A (pre-plant)	Application B (post-plant)	CHA	MINT	ORE	SAGE	TAR	THY
Untreated	-	9.00	9.00	9.00	9.00	9.00	9.00
Devrinol 450 SC 1.4 L/ha	-	8.75	7.75	7.25	8.25	6.75	9.00
Devrinol 450 SC SC 2.8 L/ha	-	7.75	8.75	4.75	7.50	5.75	8.25
Devrinol 450 SC SC 5.6 L/ha	-	6.50	7.00	6.25	6.50	3.50	6.25
AHDB 9918 (0.5x)	-	8.75	4.00	8.00	6.50	8.50	6.50
AHDB 9918 (1x)	-	7.00	2.75	0.75	6.50	7.25	3.25
AHDB 9918 (2x)	-	5.75	0.00	0.00	4.50	6.00	2.00
Aclonifen 0.5 L/ha	-	8.75	7.00	6.50	8.25	9.00	9.00
Aclonifen 1.0 L/ha	-	9.00	8.75	6.50	9.00	7.75	9.00
Aclonifen 2.0 L/ha	-	9.00	8.25	8.50	7.50	6.75	9.00
-	AHDB 9918 (0.5x)	7.75	7.50	5.25	8.25	7.00	4.75
-	AHDB 9918 (1x)	8.25	5.50	1.25	7.75	8.75	5.00

Application A (pre-plant)	Application B (post-plant)	CHA	MINT	ORE	SAGE	TAR	THY
-	AHDB 9918 (2x)	8.25	2.00	1.25	6.75	7.25	2.50
-	Aclonifen 0.5 L/ha	6.75	5.25	6.25	6.00	7.50	7.50
-	Aclonifen 1.0 L/ha	7.25	7.75	6.50	5.75	8.25	5.50
-	Aclonifen 2.0 L/ha	8.00	7.00	7.50	6.50	7.50	6.50
-	AHDB 9981 (0.5x)	8.50	8.75	8.00	5.75	8.25	9.00
-	AHDB 9981 (1x)	8.50	8.50	9.00	6.00	6.50	8.75
-	AHDB 9981 (2x)	8.75	8.75	8.25	6.75	6.25	9.00
-	Centurion Max 0.5 L/ha	8.25	7.75	9.00	8.50	9.00	9.00
-	Centurion Max 1.0 L/ha	9.00	8.75	8.50	9.00	9.00	9.00
-	Centurion Max 2.0 L/ha	8.00	8.00	9.00	9.00	9.00	9.00
-	Oblix 500 1.0 L/ha	7.00	6.75	9.00	9.00	8.75	6.00
-	Oblix 500 2.0 L/ha	6.75	6.00	7.50	8.75	9.00	6.50
-	Oblix 500 4.0 L/ha	5.00	6.25	4.75	8.50	8.00	3.00
-	AHDB 9887 (0.5x)	6.25	6.75	8.50	8.50	9.00	8.00
-	AHDB 9887 (1x)	6.00	7.50	3.50	9.00	9.00	5.75
-	AHDB 9887 (2x)	5.75	6.00	1.00	8.75	9.00	3.00
	F prob. value	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	d.f.	84	84	84	84	84	84
	S.E.D.	1.018	1.186	0.818	0.6792	0.776	0.888
	L.S.D.	2.025	2.359	1.627	1.3507	1.544	1.766

Chamomile

Pre-planting application of Aclonifen up to 4.0 L/ha or Devrinol 450 SC at up to 2.8 L/ha, and post-planting application of AHDB 9918, AHDB 9981 and Centurion Max had little effect on chamomile vigour (Table 2, Figure 1). Pre-planting application of AHDB 9918 at half rate appeared close to crop safe, but foliar bleaching was seen where the full rate of the treatment had been applied, and the double rate of the treatment caused a significant reduction in vigour exhibited as stunting. As the activity of this product is residual, it is not surprising that greater effects are seen pre-planting compared to post-planting. Chamomile treated after planting with Aclonifen at 1.0 L/ha showed some scorching, but this effect was not seen at a higher rate. However, there was still some reduction in vigour from a post-planting application of aclonifen. Post-planting application of Oblix 500 or AHDB 9887 at any rate gave a significant reduction in vigour of the chamomile, and caused foliar scorching (see *Appendix, section c*).

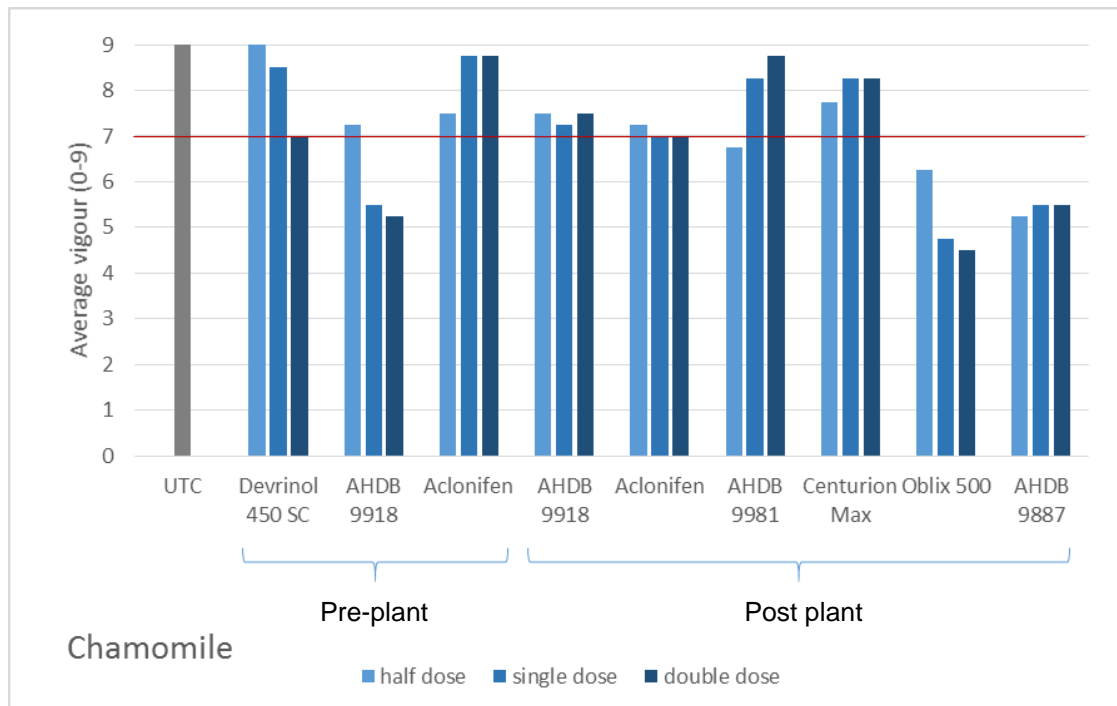


Figure 1. Mean vigour scores for chamomile treated with various herbicides, at half, single or double dose rate. Applications were onto soil (pre-planting), or foliar (post-planting). Assessment carried out 49 days after treatment. Scores of 7 or above deem acceptable vigour (as indicated by red line).

Mint

Pre-planting application of Devrinol 450 SC up to 2.8 L/ha, and post-planting application of, AHDB 9981, Centurion Max and AHDB 9887 appeared to have little effect on mint vigour and could be crop safe to mint (Table 2, Figure 2). Pre-planting application of AHDB 9918 at any rate had a notable significant reduction in vigour of the mint, causing scorching, stunting and plant death (see Appendix, section c). Post-planting application of AHDB 9918 did not cause plant death, but still gave a significant reduction in vigour and caused some foliar scorch, especially when applied at higher rates. Oblix 500 applied post-planting appeared crop safe when applied at 1.0 L/ha, but crop vigour was significantly reduced when applied above this rate. Post-planting application of Aclonifen at any rate gave a significant reduction in the vigour of mint, causing foliar scorching and yellowing.

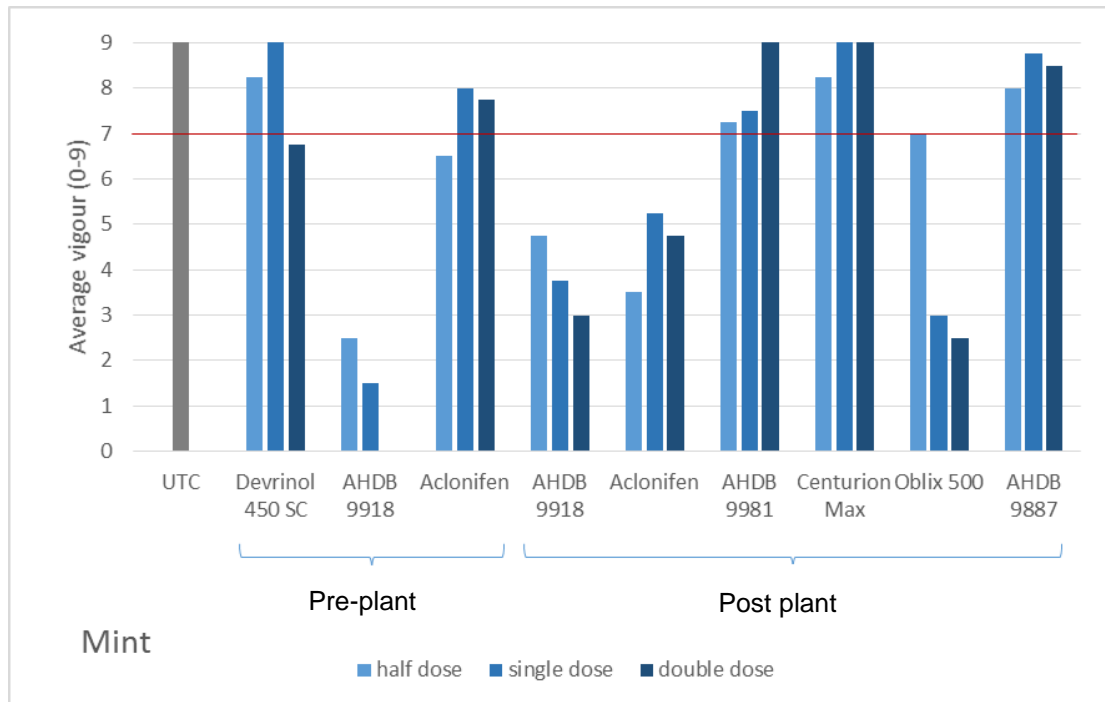


Figure 2. Mean vigour scores for mint treated with various herbicides, at half, single or double dose rate. Applications were onto soil (pre-planting), or foliar (post-planting). Assessment carried out 49 days after treatment. Scores of 7 or above deem acceptable vigour (as indicated by red line).

Oregano

Post-planting application of Centurion Max up to 2.0 L/ha (double dose) had little effect on oregano vigour (Table 2, Figure 3), and AHDB 9981 applied post-planting up to double dose only had a slight effect on vigour. Pre-planting application of Devrinol 450 SC at 1.4 L/ha (half dose) and Aclonifen up to 1.0 L/ha (single dose) appear to be crop safe, and although there was a reduction in vigour it was deemed acceptable. AHDB 9887 was crop safe at half rate, but application at full or twice full rate caused foliar scorch and plant death. Oblix 500 appeared crop safe at 1.0 L/ha (half dose) when applied post-planting but any oregano treated above this rate was significantly stunted. Application of AHDB 9918 either pre or post planting at any rate gave a significant reduction in the vigour of oregano, causing foliar scorching and plant death at higher rates. Aclonifen applied post-planting was also not safe causing significant stunting.

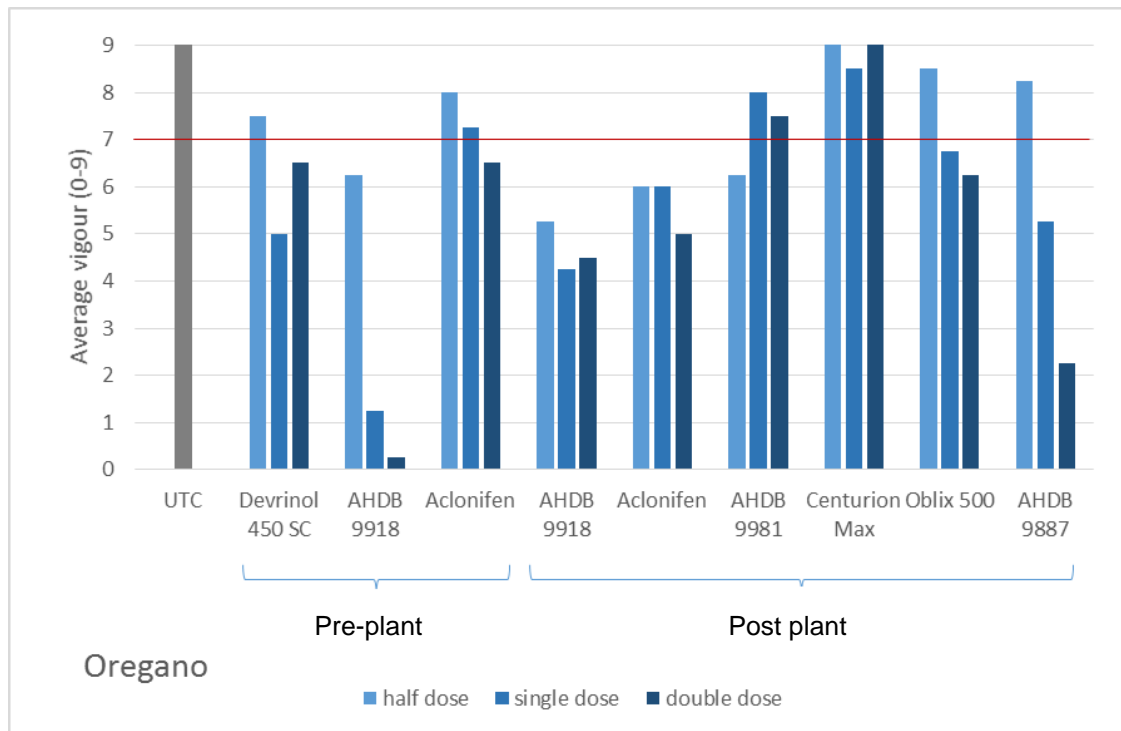


Figure 3. Mean vigour scores for oregano treated with various herbicides, at half, single or double dose rate. Applications were onto soil (pre-planting), or foliar (post-planting). Assessment carried out 49 days after treatment. Scores of 7 or above deem acceptable vigour (as indicated by red line).

Sage

Pre-planting application of Aclonifen, and post-planting application of Centurion Max, Oblix 500 or AHDB 9887 were crop safe at any of the treatment rates (Table 2, Figure 4). Pre- or post-planting application of AHDB 9918, and post-planting application of Aclonifen or AHDB 9981 at any rate had a significant effect on the vigour of the sage, with plants exhibiting foliar scorching and stunted growth. Devrinol 450 SC applied pre-planting up to 2.8 L/ha (single dose), appeared crop safe, but at twice normal application rate, the sage plants showed foliar scorching.

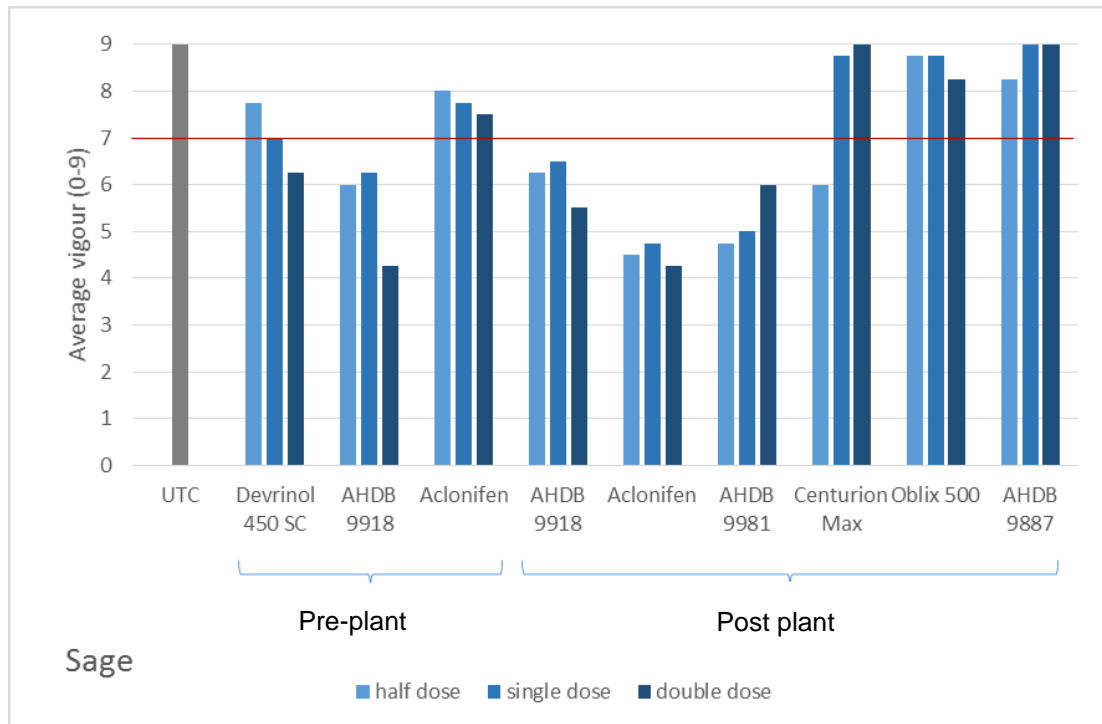


Figure 4. Mean vigour scores for sage treated with various herbicides, at half, single or double dose rate. Applications were onto soil (pre-planting), or foliar (post-planting). Assessment carried out 49 days after treatment. Scores of 7 or above deem acceptable vigour (as indicated by red line).

Tarragon

AHDB 9918, Centurion Max, Oblix 500 or AHDB 9887 appeared crop safe at all the rates tested in the trials post-planting (Table 2, Figure 5). Pre-planting application of Devrinol 450 SC or post-planting application of AHDB9981 was not crop safe at any treatment rate, with the tarragon showing foliar scorching and stunting. AHDB 9918 or Aclonifen applied up to 1.0 L/ha pre-planting appeared safe to tarragon when applied at lower rates (single dose or below), but application of double dose rate appeared to scorch and stunt plants.

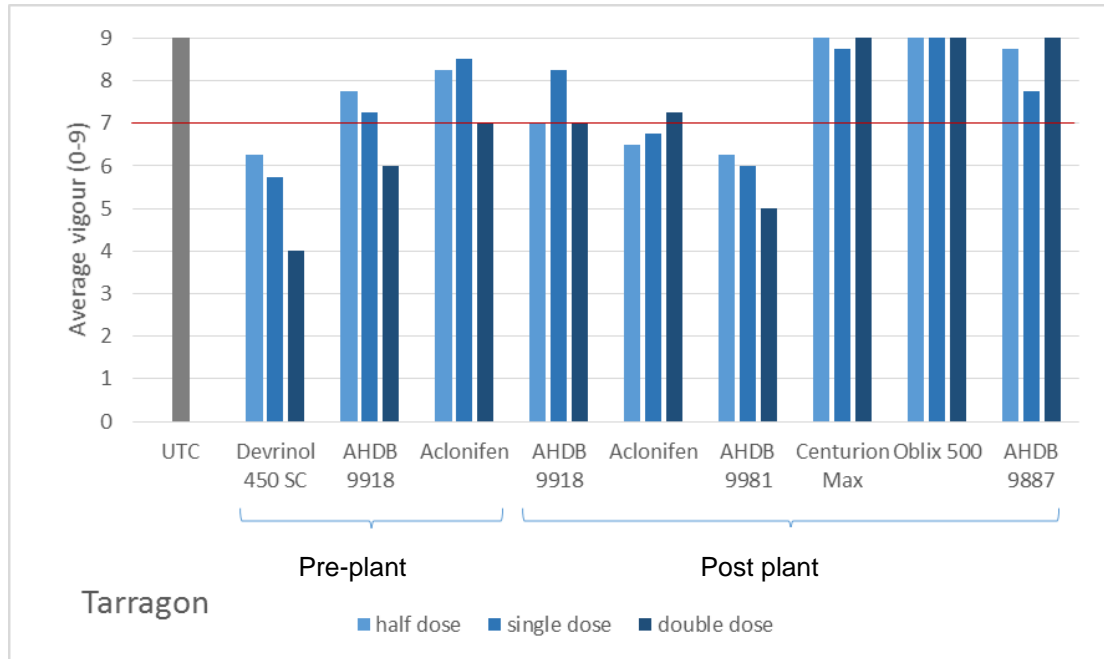


Figure 5. Mean vigour scores for tarragon treated with various herbicides, at half, single or double dose rate. Applications were onto soil (pre-planting), or foliar (post-planting). Assessment carried out 49 days after treatment. Scores of 7 or above deem acceptable vigour (as indicated by red line).

Thyme

Pre-planting application of Aclonifen, and post-planting application of AHDB 9981 or Centurion Max appeared crop safe at all the application rates used in the trials (Table 2, Figure 6). AHDB 9918 applied at any rate pre- or post-planting, and any rate of OBLIX 500 applied post-planting showed a significant impact on the vigour of the thyme plants, scorching the thyme, with dead leaf tips on the Oblix 500 treated plants. Pre-planting Devrinol 450 SC at 1.4 L/ha (half dose), and post-planting Aclonifen at 0.5 L/ha (half dose) or AHDB 9887 at half dose appeared crop safe, but higher rates of these treatments reduced crop vigour.

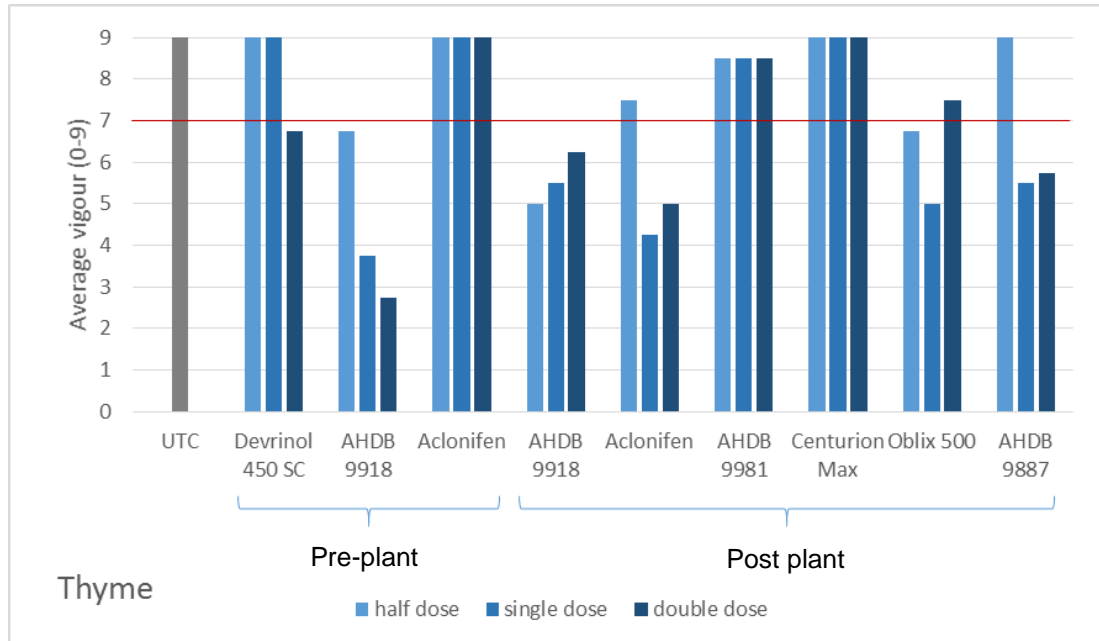


Figure 6. Mean vigour scores for thyme treated with various herbicides, at half, single or double dose rate. Applications were onto soil (pre-planting), or foliar (post-planting). Assessment carried out 49 days after treatment. Scores of 7 or above deem acceptable vigour (as indicated by red line).

Conclusions

Pre-planting

- Aclonifen was safe to nearly all the herb species (chamomile, mint, sage, tarragon and thyme) in the trial when applied at up to 2.0 L/ha, with the exception of oregano which it was not safe to use on pre-emergence at any rate
- Devrinol 450 SC was safe to chamomile, mint, sage and thyme up to an application rate of 2.8 L/ha, and oregano up to 1.4 L/ha. However, it has subsequently been approved for use at a lower rate of 0.85 L/ha, which indicates it would be safe to use in all the herbs listed above at the current authorised rate
- AHDB 9918 was only safe to tarragon at this application timing.

Post-planting

- Centurion Max was safe to all herbs in the trial (chamomile, mint, oregano, sage, tarragon and thyme) when applied up to a rate of 2.0 L/ha.
- Aclonifen was more damaging when applied at a post-planting timing, and was safe only to chamomile, tarragon and thyme at 0.5 L/ha. Above this rate scorch and chlorosis was seen.
- AHDB 9981 was safe to chamomile, mint, oregano and thyme.
- Oblix 500 (ethofumesate) was safe to mint and oregano up to 1.0 L/ha, and safe to sage and tarragon up to 4.0 L/ha.
- AHDB 9887 is safe to oregano and thyme at half dose, and mint, sage and tarragon at double dose.
- AHDB 9918 was only safe to use over chamomile and tarragon post-planting.

Acknowledgements

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Appendix

- a. Crop diary – events related to growing crop

Crop	Cultivar	Planting date
Herbs	Chamomile	20/06/18
	Mint	
	Oregano	
	Sage	
	Tarragon	
	Thyme	

Details of irrigation regime

Date	Type, rate and duration	Amount applied (mm)
N/A	Watering by hand as necessary	Not recorded, varied by weather conditions

- b. Table showing sequence of events by date – this relates to treatments and assessments

Date	Event
20/06/2018	Applied pre-planting treatments (Timing A, treatments 2 to 10).
29/06/2018	Applied post-planting treatment (Timing B, treatments 11 to 28).
25/07/2018	Carried out vigour assessment.
13/08/2018	Carried out vigour assessment.

- c. Climatological data during study period from each site.

Date	Min. temp. (°C)	Max. temp. (°C)	Av. Humidity (%)	Total rainfall (mm)
25/05/2018	9.2	15.9	94.0	5.3
26/05/2018	10.5	22.6	72.1	0.0
27/05/2018	9.6	24.8	75.3	1.1
28/05/2018	10.5	22.6	88.4	0.0
29/05/2018	9.6	13.6	97.4	0.5
30/05/2018	9.6	16.8	92.8	3.5
31/05/2018	12.7	22.2	85.8	0.0
01/06/2018	14.1	22.2	83.9	0.1
02/06/2018	15.0	16.4	93.6	0.0
03/06/2018	14.5	23.0	68.5	0.0
04/06/2018	10.5	14.5	90.6	0.1
05/06/2018	6.8	14.1	78.7	0.2
06/06/2018	5.6	19.1	73.4	0.0
07/06/2018	8.4	17.3	76.1	1.0
08/06/2018	8.4	18.2	77.1	0.0
11/06/2018	13.2	23.0	51.2	0.0
12/06/2018	9.2	16.4	78.6	0.0
13/06/2018	19.5	20.9	47.0	0.0
14/06/2018	10.0	18.2	67.1	0.0
15/06/2018	7.6	20.4	58.7	0.0
16/06/2018	10.5	19.1	68.5	0.0

Date	Min. temp. (°C)	Max. temp. (°C)	Av. Humidity (%)	Total rainfall (mm)
17/06/2018	9.2	17.3	75.8	0.0
18/06/2018	13.2	23.0	71.2	0.0
19/06/2018	15.0	23.0	71.5	0.0
20/06/2018	11.8	22.6	72.9	0.0
21/06/2018	7.6	17.7	54.9	0.0
22/06/2018	6.8	19.1	52.9	0.0
23/06/2018	8.0	21.3	55.7	0.0
24/06/2018	7.6	23.0	59.7	0.0
25/06/2018	10.5	27.4	50.3	0.0
26/06/2018	8.8	26.5	58.9	0.0
27/06/2018	10.0	24.8	63.7	0.0
28/06/2018	8.4	24.3	73.0	0.0
29/06/2018	9.6	24.3	69.8	0.0
30/06/2018	11.4	26.1	57.5	0.0
01/07/2018	9.6	27.0	52.8	0.0
02/07/2018	11.4	26.1	47.8	0.0
03/07/2018	9.2	23.5	54.6	0.0
04/07/2018	8.8	24.3	57.2	0.0
05/07/2018	13.2	28.3	55.1	0.0
06/07/2018	13.2	26.5	62.4	0.0
07/07/2018	15.0	27.8	58.1	0.0
08/07/2018	13.6	27.4	57.3	0.0
09/07/2018	13.6	25.2	60.9	0.0
10/07/2018	11.8	17.3	74.1	0.0
11/07/2018	10.5	18.6	80.2	0.0
12/07/2018	10.0	19.5	77.1	0.0
13/07/2018	9.2	23.0	67.5	0.0
14/07/2018	11.4	26.5	61.8	0.0
15/07/2018	12.3	28.7	50.6	0.0
16/07/2018	12.7	27.8	50.5	0.0
17/07/2018	12.3	22.2	57.1	0.0
18/07/2018	13.2	23.5	50.0	0.0
19/07/2018	14.5	26.1	50.9	0.0
20/07/2018	13.6	25.2	59.5	0.0
21/07/2018	13.6	26.1	59.4	0.0
22/07/2018	14.5	23.9	62.4	0.0
23/07/2018	15.9	29.6	53.5	0.0
24/07/2018	15.5	27.8	54.5	0.0
25/07/2018	15.5	28.3	54.2	0.0
26/07/2018	16.4	31.7	57.6	2.5
27/07/2018	17.3	31.1	67.8	16.6
28/07/2018	13.6	21.3	63.9	0.5
29/07/2018	13.6	19.5	82.3	0.5
30/07/2018	15.0	22.6	71.1	0.1
31/07/2018	14.1	23.5	62.5	0.7
01/08/2018	10.9	24.3	55.0	0.0
02/08/2018	12.3	28.3	57.7	0.0

d. Example of phytotoxic effects



Scorch from Oblix 500 at half, full and twice full rate (L-R), applied to foliage post-planting (crop pictured on 02/08/2018, 38 days after treatment).



Scorch and stunting from AHDB 9918 at half, full and twice full rate (L-R), applied to potted soil pre-planting of mint (crop pictured on 02/08/2018, 44 days after treatment).

e. Trial design (extract, block 1 of 4)

BLOCK 1

PLOT	1 24 Dill	2 18 Par	3 10 Fen	4 3 Par	5 9 Fen	6 24 Par	7 16 Cor	8 6 Par	9 7 Cor	10 5 Cor	11 19 Dill	12 17 Par	13 14 Fen	14 17 Dill
PLOT	15 26 Fen	16 6 Cor	17 3 Chiv	18 23 Chiv	19 11 Par	20 20 Cor	21 2 Cor	22 17 Fen	23 5 Bas	24 19 Par	25 12 Par	26 8 Bas	27 5 Chiv	28 23 Dill
PLOT	29 21 Cor	30 23 Fen	31 10 Cor	32 9 Cor	33 4 Bas	34 22 Chiv	35 25 Cor	36 11 Cor	37 27 Chiv	38 5 Par	39 2 Dill	40 14 Cor	41 11 Chiv	42 15 Chiv
PLOT	43 5 Dill	44 1 Dill	45 25 Par	46 22 Dill	47 10 Bas	48 21 Chiv	49 8 Par	50 14 Par	51 16 Par	52 10 Chiv	53 14 Bas	54 28 Bas	55 17 Bas	56 15 Dill
PLOT	57 3 Bas	58 4 Cor	59 14 Chiv	60 15 Bas	61 25 Fen	62 15 Cor	63 10 Par	64 24 Bas	65 7 Par	66 13 Dill	67 24 Fen	68 19 Cor	69 19 Fen	70 26 Cor
PLOT	71 9 Chiv	72 26 Bas	73 2 Bas	74 8 Dill	75 9 Dill	76 6 Bas	77 13 Fen	78 5 Fen	79 18 Chiv	80 2 Chiv	81 16 Chiv	82 7 Bas	83 20 Fen	84 28 Par
PLOT	85 26 Chiv	86 24 Cor	87 4 Chiv	88 6 Chiv	89 11 Fen	90 27 Dill	91 28 Chiv	92 25 Bas	93 19 Chiv	94 2 Par	95 23 Cor	96 22 Par	97 16 Bas	98 9 Par
PLOT	99 25 Dill	100 7 Dill	101 1 Bas	102 13 Bas	103 26 Par	104 18 Fen	105 20 Par	106 1 Cor	107 14 Dill	108 21 Dill	109 3 Cor	110 23 Par	111 23 Bas	112 6 Fen
PLOT	113 9 Bas	114 10 Dill	115 8 Chiv	116 15 Fen	117 11 Bas	118 12 Bas	119 28 Dill	120 6 Dill	121 27 Cor	122 18 Cor	123 1 Fen	124 8 Cor	125 13 Par	126 22 Bas
PLOT	127 17 Cor	128 12 Dill	129 12 Cor	130 20 Dill	131 21 Bas	132 22 Fen	133 3 Dill	134 3 Fen	135 7 Fen	136 1 Par	137 16 Dill	138 27 Bas	139 27 Fen	140 20 Bas
PLOT	141 17 Chiv	142 12 Fen	143 4 Par	144 4 Fen	145 21 Fen	146 26 Dill	147 25 Chiv	148 15 Par	149 13 Cor	150 12 Chiv	151 22 Cor	152 13 Chiv	153 8 Fen	154 1 Chiv
PLOT	155 16 Fen	156 4 Dill	157 2 Fen	158 20 Chiv	159 11 Dill	160 7 Chiv	161 19 Bas	162 18 Dill	163 18 Bas	164 28 Fen	165 28 Cor	166 27 Par	167 21 Par	168 24 Chiv

f. ORETO certificate



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

Signature

Alison Richardson
Authorised signatory

Certification Number

ORETO 409



Chemicals Regulation Division



Department of
**Agriculture and
Rural Development**