

SCEPTREPLUS

Final Trial Report

Trial code:	SP 27. Year 3
Title:	AHDB SceptrePlus Brassica post-plant herbicide screen 2020
Crop	Brassicas (Cauliflower)
Target	General broadleaf weeds and grasses, 3WEEDT EPPO1/089(3) Weeds in leafy and brassica vegetables
Lead researcher:	Angela Huckle
Organisation:	RSK ADAS Horticulture
Period:	1 st April 2020- 31 st March 2021
Report date:	27 th April 2021
Report author:	Angela Huckle (author and editor), Dave Kaye (editor) and Gabrielle Roxby (author)
ORETO Number: (certificate should be attached)	409 (ADAS) 376 (Allium and Brassica Centre)

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

27 April 2021.....
Date



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Authors signature

Trial Summary

Introduction

Growers of all field based crops experience problems with a wide range of weed species. The limited range of herbicides currently available for use in brassica crops leaves gaps in the weed control spectrum. In addition to having a short list of approved actives, only a small subset of these offer the longevity of control required to protect longer season brassicas, such as cauliflower.

In predominantly hand harvested crops such as brassicas, weeds are a physical impediment to those working in the crop, and species such as nettles can deter pickers. Weeds which obscure the crop further reduce harvesting efficiency; where excessive weeds mean heads are missed and harvested yields can be reduced by up to 30%. The increased humidity in the crop canopy can also increase the risk of disease development and weed seeds can contaminate the fresh product.

While mechanical hoeing can be successfully used as an alternative weed control method, it is limited by crop growth stage and ground conditions—if soil conditions are not suitable, this approach cannot always be used. Therefore, further options for weed control are required.

Methods

A trial was located at the H L Hutchinson Brassica Demonstration Site in Boston, Lincolnshire in a crop of the commercially grown cultivar, Skywalker. The trial was dependent on naturally occurring weeds and crops were planted with an autumn targeted harvest date. This was chosen based on the history of weed problems at this site and grower experience. The trial comprised a fully randomised block design with eleven treatments plus an untreated control (treatment 1) and was replicated three times. The trial was 18 m wide, with plots comprising 5.0 m of a 2.4 m bed with discard rows planted either side.

Treatments were applied at two timings. Application one was applied on 17th August 2020 with the second treatment applied to selected plots on 3rd September 2020 (Tables 1 and 2). All treatments were applied post-planting, with the first treatment applications (treatments 4, 5 and 6) applied within seven days of planting and the second treatment applications (treatments 2, 3 and 7-12) applied three weeks after planting. Weed levels were assessed six times throughout the crop from two weeks after the first herbicide application to 12 weeks post- application. Treatments were applied using a precision knapsack sprayer with a 2 m boom and 02F110 nozzles at medium quality using 200 litres per hectare water volume. All other pesticides and fertilisers were applied as per commercial practice by the host grower.

Overall weed levels were assessed on six occasions, by recording a whole-plot percentage total weed cover score. Weed species assessments were also made; all weed species present within a 0.25 x 0.25 m quadrat were recorded as a percentage of the quadrat area covered. The crop safety of the treatments was also assessed on the same dates as the weed assessments. Signs of phytotoxicity such as chlorosis or scorch (if present) were recorded. Phytotoxicity was measured on a crop tolerance score from 0 – 10, where 0 was equivalent to no damage and 10 was equivalent to complete crop kill due to phytotoxic symptoms. Any effects on head formation (if present) were studied at ten weeks post-application.

Results

Phytotoxicity

All treatments, including the untreated control displayed crop effects at the assessment two weeks after the second application (17 September). However Dow Shield 400 0.5 L/ha, AHDB 9917 and AHDB 9987 applied either alone or in a tank mix with Gamit 36 CS 0.25 L/ha exhibited no sign of phytotoxicity after this assessment (Table 1). Very slight crop effects were recorded for the untreated control as the trial was 'blind scored', but as the levels were very low (no higher than 0.33) this is likely a physiological effect on the crop being recorded. However, the results regarding the treatments are a true record of effects from the herbicides which can be determined from the comments made at assessment.

Phytotoxicity was well below the 'crop safe' threshold of 2.0 for AHDB 9875 and AHDB 9887 (at 0.5 L/ha), in the assessment two weeks after the second application, but after this phytotoxicity scores for these products increased to 3.0 and 2.7, respectively, due to a puckered appearance of the wrapper leaves. The cauliflower heads however were unaffected and therefore the products could be considered crop safe. There were other products which caused little or no effects on the cauliflower at harvest and would therefore be safer to use. These were; the commercial standards, Lentagran 2kg/ha and Dow Shield 400 0.5 L/ha, and AHDB 9917, AHDB 9840 and AHDB 9987, either alone or in a tank mix with Gamit 36 CS. All showed minimal to no phytotoxic symptoms.

There was slight scorch from the application of Lentagran 2 kg/ha at two weeks' after application, but this was transient and had abated to an acceptable level by harvest. This is an expected effect from this product.

Table 1. Mean phytotoxicity scores (0-10, 10 = dead, 0 = no effect) on seven assessment dates. Treatments applied on 10 August and 3 September 2020.

Date	Phytotoxicity score						
	17-Sep	02-Oct	09-Oct	15-Oct	28-Oct	10-Nov	25-Nov
Treatment							
Untreated	0.07	0.33	0.33	0.33	0.33	0.33	0.33
Lentagran 2.0 kg/ha	2.50	1.00	1.00	1.00	1.00	0.67	0.67
Dow Shield 0.5 L/ha	1.50	0.00	0.00	0.00	0.00	0.00	0.00
AHDB 9987	1.83	0.00	0.00	0.00	0.00	0.00	0.00
AHDB 9987+ Gamit 36 CS 0.25 L/ha	0.73	0.00	0.00	0.00	0.00	0.00	0.00
AHDB 9917	1.17	0.00	0.00	0.00	0.00	0.00	0.00
AHDB 9875	0.33	2.33	2.33	2.33	2.33	3.00	3.00
AHDB 9840 0.5 L/ha	0.33	1.00	1.00	1.00	1.00	1.00	1.00
AHDB 9840 0.75 L/ha	0.93	1.00	1.00	1.00	1.00	1.00	1.00
AHDB 9887 0.5 L/ha	1.20	3.00	3.00	3.00	3.00	2.67	2.67
AHDB 9887 0.75 L/ha	1.37	0.67	0.67	0.67	0.67	0.67	0.67
AHDB 9887 1.0 L/ha	1.00	2.00	2.00	2.00	2.00	2.00	2.00
d.f.	22	22	22	22	22	22	22
LSD	1.99	1.95	1.95	1.95	1.95	2.05	2.05
p.f. value	0.468	0.045	0.045	0.045	0.045	0.046	0.046
	Scores 2.00 or under represent commercially acceptable levels of phytotoxicity						
	Scores greater than 2.00 represent commercially unacceptable levels of phytotoxicity						

Weed cover

The six most common weed species present in this trial area were chickweed, mayweed, pale persicaria, fat hen, shepherds purse and groundsel.

Four treatments significantly reduced percentage weed cover for up to twelve weeks after the final application. These were AHDB 9875, AHDB 9840 0.75 L/ha and AHDB 9987 either applied alone or in a tank mix with Gamit 36 CS 0.25 L/ha (Table 2). AHDB 9987 in a tank mix with Gamit 36 CS 0.25 L/ha reduced the overall weed cover by the greatest percentage compared with the remaining treatments. AHDB 9840 applied at 0.75 L/ha showed a greater efficacy compared with the lower rate of 0.5 L/ha, with no difference in crop safety. By the trial end (25 November), untreated plots had 100% weed cover compared to AHDB 9987 and Gamit 36 CS 0.25 L/ha plots where the weed level was reduced by 88% leaving only 12% weed cover across the plots receiving this treatment.

Eight weeks after the first application and four weeks after the second application AHDB 9987 and Gamit 36 CS tank mix reduced weed cover by the greatest percentage, followed by AHDB 9875 and AHDB 9987 respectively. These treatments contain a common active ingredient (AHDB 9987) which was effective on many of the weed species present. When combined with a further active ingredient, either in a tank mix with Gamit 36 CS or in a co-formulated product as with AHDB 9875, this improved its effectiveness further. AHDB 9987 is a residual herbicide and needs to be applied before weed emergence, requiring moisture to work effectively. The soils were moist when these products were applied. AHDB 9875 has some contact activity which allows a more flexible timing with this product, and this could be applied at a later crop growth stage once weeds have emerged. AHDB 9840 and AHDB 9887 also have contact activity, and are best applied following weed emergence and during active weed growth.

In the total weed cover assessments, Dow Shield 500 0.5 L/ha did not cause a significant reduction in weed cover compared to the untreated control, indicating that this programme was not an effective treatment for weed cover reduction when used alone on the type and distribution of weeds at this site. Similarly, AHDB 9917 did not perform well with an increase in percent weed cover of treated plots on several assessment events as indicated by negative figures in the Abbots reduction formula (Table 5). These products have a narrower weed spectrum and were not as effective on all the weed species present at the trial site. Dow Shield 400 controls composite weeds such as mayweed effectively, but as chickweed was a predominant weed at the site, it did not significantly reduce overall percentage weed cover. AHDB 9887 was the only product to significantly reduce pale persicaria. In contrast to Dow Shield this product did not significantly reduce levels of composite weeds such as mayweed and groundsel, and therefore also did not significantly reduce overall weed cover. Despite the poorer overall performance of these products, they may still have a place within a weed control program used in combination or sequence with other products to target specific weed issues.

Table 2. Mean percentage weed cover at six assessment dates. Sprays applied on 10 August and 3 September 2020. WAA = weeks after final application.

Trt no	Date	Mean % weed cover					
		02-Oct 4 WAA	09-Oct 5 WAA	15-Oct 6 WAA	28-Oct 8 WAA	10-Nov 10 WAA	25-Nov 12 WAA
1	Untreated	73.3	73.3	88.3	96.7	98.3	100.0
2	Lentagran 2.0 kg/ha	35.0	40.3	65.0	78.3	91.7	96.7
3	Dow Shield 0.5 L/ha	70.0	74.0	90.0	93.3	100.0	100.0
4	AHDB9987	33.3	35.0	37.3	39.0	43.3	45.7
5	AHDB9987+ Gamit 36 CS 0.25 L/ha	3.7	4.5	6.3	7.7	9.7	11.7
6	AHDB9917	81.0	76.7	91.7	100.0	100.0	100.0
7	AHDB9875	24.2	16.7	24.3	33.3	43.3	50.3

	Date	Mean % weed cover					
		02-Oct 4 WAA	09-Oct 5 WAA	15-Oct 6 WAA	28-Oct 8 WAA	10-Nov 10 WAA	25-Nov 12 WAA
Trt no	Treatment						
8	AHDB9840 0.5 L/ha	37.7	30.7	45.0	50.7	61.7	67.7
9	AHDB9840 0.75 L/ha	17.7	18.0	25.0	41.7	50.0	60.0
10	AHDB9887 0.5 L/ha	53.3	57.3	65.7	71.7	81.7	88.3
11	AHDB9887 0.75 L/ha	40.0	36.7	61.7	78.3	88.3	91.7
12	AHDB9887 1.0 L/ha	42.0	41.7	51.7	62.3	66.7	71.7
d.f.		22	22	22	22	22	22
LSD		43.67	41.74	42.70	41.77	40.06	39.59
p.f. value		0.036	0.019	0.005	0.002	0.001	0.002
		Not significantly different from untreated control (p>0.05)					
		Significantly different from untreated control (p<0.05)					

Conclusions

- AHDB 9875, AHDB 9840 0.75 L/ha and AHDB 9987 either applied alone or in a tank mix with Gamit 36 CS 0.25 L/ha significantly reduced overall mean weed cover for up to twelve weeks after the second application timing.
- No phytotoxic effects were observed on the heads of the cauliflower, but in plots treated with AHDB 9875 and AHDB 9887 0.5 L/ha, some distortion of the wrapper leaves was observed which fell slightly above the acceptable threshold.
- All of the experimental products with the exception of AHDB9917 reduced the level of chickweed greater than the current available commercial standards, Lentagran and Dow Shield.
- AHDB 9887 significantly reduced the level of pale persicaria.

Take home message:

The authorisation of AHDB 9987 for use at soon after planting will provide an alternative residual herbicide to use in place of metazachlor, and improve weed control post-planting. Products AHDB 9875 and AHDB 9840 which have contact activity, would improve the spectrum of weeds controlled at a later post-planting timing. AHDB 9887 may have a place for control of pale persicaria as this is a troublesome weed for brassica growers.

Objectives

The objective of this trial is to compare a number of new and novel herbicides at the post-planting application timing for selectivity (crop safety) and efficacy in cauliflowers.

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 PP1/181(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
EPPO1/089(3)	Weeds in leafy and brassica vegetables	None

There were no deviations from EPPO guidance.

Test site

Item	Details
Location address	Field: H L Hutchinson Brassica Demonstration Site C/O F Daubney & Sons (Richard Daubney) Bayholme Farm Old Leake Boston Lincolnshire PE22 9HT
Crop	Cauliflower
Cultivar	Skywalker
Soil or substrate type	Silty clay loam
Agronomic practice	Modified – no herbicides applied
Prior history of site	See Appendix

Trial design

Item	Details
Trial design:	Randomised
Number of replicates:	3
Row spacing:	0.61 m rows x 0.46 m
Plot size: (w x l)	2.4 m x 5 m
Plot size: (m ²)	12
Number of plants per plot:	approx. 33

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	Pyridate	Lentagran	04287B1823	45% w/w	Wettable powder
N/A	Clopyralid	Dow Shield 400	DO571CK003	400	Soluble concentrate
N/A	Clomazone	Gamit 36 CS	197222a	360	Capsule suspension
AHDB 9987	Pethoxamid	Successor	10234721A	600	Emulsifiable concentrate
AHDB 9875	Pethoxamid + Picloram	Gajus	10311323	400 + 8	Emulsifiable concentrate
AHDB 9917	Cinmethylin	Luximo (BAS 684 03H)	FD-190606-0032	750	Emulsifiable concentrate
AHDB 9887	Halauxifen-methyl + propyzamide	GF3680	ENBK169021 .021	0.5 wt% a.i. + 75% a.i.	Emulsifiable concentrate
AHDB 9840	Halauxifen-methyl + clopyralid	Korvetto	F469I67P01	5 + 120	Emulsifiable concentrate

Application schedule

Treatment number	Treatment: product name or AHDB code	Rate of active substance (g/ha)	Rate of product (L/ ha or Kg/ha)	Application timing code
1	Untreated control	-	- -	-
2	Lentagran	900	2.00	B
3	Dow Shield 400	200	0.50	B
4	AHDB9987	1200	2.00	A
5	AHDB9987 + Gamit 36 CS	600 + 90	1.00 0.25	A
6	AHDB9917	525	0.70	A
7	AHDB9875	1200 + 24	3.00	B
8	AHDB9840	2.5 + 60	0.50	B
9	AHDB9840	3.75 + 90	0.75	B
10	AHDB9887	2.5 + 375	0.50	B
11	AHDB9887	3.75 + 562.5	0.75	B
12	AHDB9887	5 + 750	1.00	B

Application details

	Application A	Application B
Application date	10.08.2020	03.09.2020
Time of day	08:20- 09:15	12:30- 13:45
Crop growth stage (Max, min average BBCH)	16	19
Crop height (cm)	N/A	15
Crop coverage (%)	N/A	25
Application Method	Foliar spray	Foliar spray
Application Placement	Foliage and soil	Foliage and soil
Application equipment	AZO compressed air backpack sprayer	AZO compressed air backpack sprayer
Nozzle pressure (bar)	2.5	2.5
Nozzle type	Flat Fan	Flat Fan
Nozzle size	02-F110	02-F110
Application water volume (L/ha)	300	300
Temperature of air - shade (°C)	20	19
Relative humidity (%)	94	73
Wind speed range (kph)	8	22
Dew presence	Normal	No dew
Temperature of soil - 2-5 cm (°C)	17	17
Wetness of soil - 2-5 cm	Damp	Moist
Cloud cover (%)	15	10

Untreated levels of pests/pathogens at application and through the assessment period

Common name	Scientific Name	EPPO Code	% Infection level at start of assessment period (Timing 2+4 weeks)	% Infection level mid-assessment period (Timing 1+8 weeks)	% Infection level at end of assessment period (Timing 1+12 weeks)
Broad leaved weeds and grasses	N/A	3WEEDT	73.3	96.7	100.0

Assessment details

Evaluation date	Evaluation Timing (DA)*		Crop Growth Stage (BBCH)	Evaluation type (efficacy, phytotoxicity)	What was assessed and how (e.g. dead or live pest; disease incidence and severity; yield, marketable quality)
	Conventional herbicide application 1	Conventional herbicide application 2			
17/09/2020	38	14	19	Phytotoxicity	Phyto: scale 0-10, 10 = Dead.
02/10/2020	53	29	41	Efficacy, Phytotoxicity	Percentage of weed cover (whole plot score), weed species presence.
09/10/2020	60	36	42	Efficacy, Phytotoxicity	Percentage of weed cover (whole plot score), weed species presence. Phyto: scale 0-10, 10 = Dead.
15/10/2020	66	42	43	Efficacy, Phytotoxicity	Percentage of weed cover (whole plot score), weed species presence. Phyto: scale 0-10, 10 = Dead.
28/10/2020	79	55	44	Efficacy, Phytotoxicity	Percentage of weed cover (whole plot score), weed species presence. Phyto: scale 0-10, 10 = Dead.
10/11/2020	92	68	45	Efficacy, Phytotoxicity	Percentage of weed cover (whole plot score), weed species presence. Phyto: scale 0-10, 10 = Dead.
25/11/2020	107	83	49 (Harvest)	Efficacy, Phytotoxicity	Percentage of weed cover (whole plot score), weed species presence. Phyto: scale 0-10, 10 = Dead.

* DA – days after application

Statistical analysis

This trial had a randomised block design and comprised twelve treatments including an untreated control and standard grower treatment. Treatments were replicated three times.

The data were analysed using Analysis of Variance to determine whether any treatments were significantly different from one another. Duncan's multiple range post-hoc test was applied where there were significant differences between groups to identify where the differences lay. Abbott's formula was used to calculate the percent reduction in weed cover from a particular treatment in comparison to the untreated control.

All data were analysed by Chris Dyer using Genstat (18th edition) by Chris Dyer (ADAS).

Results

Phytotoxicity

Crop safety- 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 = Damage considered acceptable to the farmer, i.e. damage unlikely to reduce marketable yield

All treatments, including the untreated control displayed crop effects in the assessment two weeks after the second application (17 September). However Dow Shield 400 0.5 L/ha, AHDB 9917 and AHDB 9987 applied either alone or in a tank mix with Gamit 36 CS 0.25 L/ha exhibited no sign of phytotoxicity subsequently after this assessment (Table 1). Very slight crop effects were recorded for the untreated control as the trial was 'blind scored', but as the levels were very low (no higher than 0.33) this is likely a physiological effect on the crop being recorded. However, the results regarding the treatments are a true record of effects from the herbicides which can be determined from the comments made at assessment.

Phytotoxicity was well below the 'crop safe' threshold of 2.0 for AHDB 9875 and AHDB 9887 (at 0.5 L/ha), in the assessment two weeks after the second application, but after this phytotoxicity scores for these products increased to 3.0 and 2.7, respectively, due to a puckered appearance of the wrapper leaves. The cauliflower heads however were unaffected and therefore the products could be considered crop safe. There were other products which caused little or no effects on the cauliflower at harvest and would therefore be safer to use. These were; the commercial standards, Lentagran 2kg/ha and Dow Shield 400 0.5 L/ha, and AHDB 9917, AHDB 9840 and AHDB 9987, either alone or in a tank mix with Gamit 36 CS. All showed minimal to no phytotoxic symptoms. (Figure 1).

There was slight scorch from the application of Lentagran 2 kg/ha at two weeks' after application, but this was transient and had abated to an acceptable level by harvest. This is an expected effect from this product.

Figure 1. Mean phytotoxicity by treatment at two, eight and twelve weeks after the second application, with red line indicating the threshold of an 'acceptable' level of crop damage below a phytotoxicity score of 2. (0-10, 10= dead, 0 = no effect)

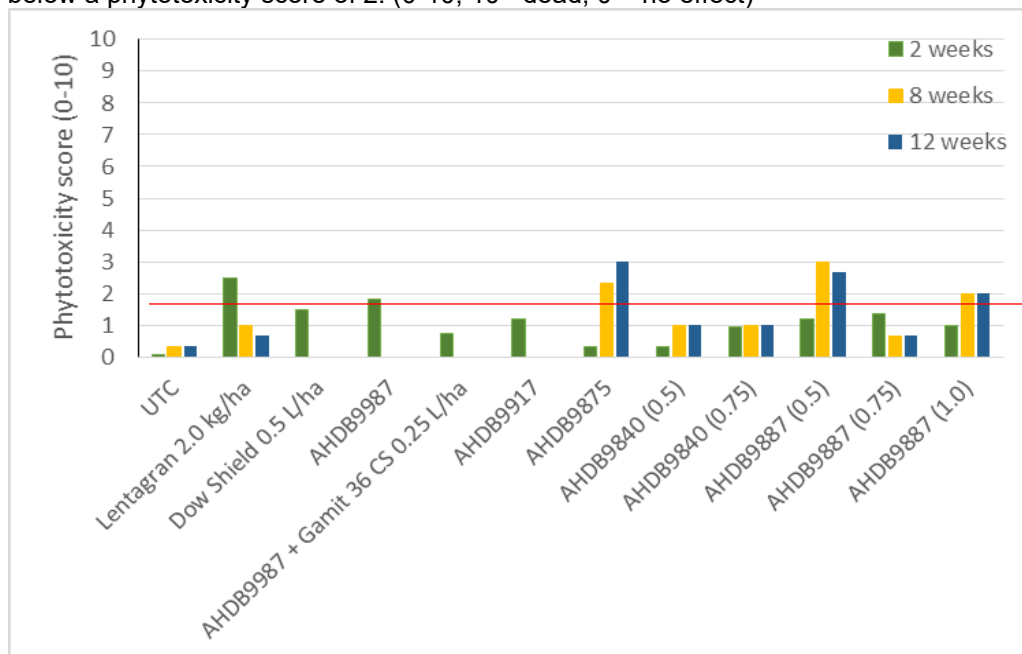


Table 3. Mean phytotoxicity scores (0-10, 10= dead, 0 = no effect) on plants receiving test herbicide treatment programmes at the seven assessment dates. Treatments applied on 10 August and 3 September 2020.

	Phytotoxicity score
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Date	17-Sep	02-Oct	09-Oct	15-Oct	28-Oct	10-Nov	25-Nov
Treatment							
Untreated	0.07	0.33	0.33	0.33	0.33	0.33	0.33
Untreated	2.50	1.00	1.00	1.00	1.00	0.67	0.67
Lentagran 2.0 kg/ha	1.50	0.00	0.00	0.00	0.00	0.00	0.00
Dow Shield 0.5 L/ha	1.83	0.00	0.00	0.00	0.00	0.00	0.00
AHDB 9987	0.73	0.00	0.00	0.00	0.00	0.00	0.00
AHDB 9987+ Gamit 36 CS 0.25 L/ha	1.17	0.00	0.00	0.00	0.00	0.00	0.00
AHDB 9917	0.33	2.33	2.33	2.33	2.33	3.00	3.00
AHDB 9875	0.33	1.00	1.00	1.00	1.00	1.00	1.00
AHDB 9840 0.5 L/ha	0.93	1.00	1.00	1.00	1.00	1.00	1.00
AHDB 9840 0.75 L/ha	1.20	3.00	3.00	3.00	3.00	2.67	2.67
AHDB 9887 0.5 L/ha	1.37	0.67	0.67	0.67	0.67	0.67	0.67
AHDB 9887 0.75 L/ha	1.00	2.00	2.00	2.00	2.00	2.00	2.00
d.f.	22	22	22	22	22	22	22
LSD	1.99	1.95	1.95	1.95	1.95	2.05	2.05
p.f. value	0.468	0.045	0.045	0.045	0.045	0.046	0.046
	Scores 2.00 or under represent commercially acceptable levels of phytotoxicity						
	Scores greater than 2.00 represent commercially unacceptable levels of phytotoxicity						

Weed control – mean percentage weed cover

Four treatments significantly reduced percentage weed cover for up to twelve weeks after the final application. These were AHDB 9875, AHDB 9840 0.75 L/ha and AHDB 9987 either applied alone or in a tank mix with Gamit 36 CS 0.25 L/ha (Table 4 and Figure 2). AHDB 9987 in a tank mix with Gamit 36 CS 0.25 L/ha reduced the overall weed cover by the greatest percentage compared to the remaining treatments. By the trial end (25 November), untreated plots had 100% weed cover compared to AHDB9987 and Gamit 36 CS 0.25 L/ha plots which had a mean of only 12% weed cover. The Abbott's reduction formula calculates that this is an 88% reduction in weed cover (Table 5).

The six most common weed species present in this trial area were chickweed, mayweed, pale persicaria, fat hen, shepherds purse and groundsel.

Figure 2. Total mean weed cover by treatment number and assessment date. Assessments carried out from four weeks after application 2 (2 Oct), to the final assessment on 25th November 2020, approximately 12 weeks after the second application. Sprays applied 10 August and 3 September 2020. Treatments marked with a * show significant reductions in weed cover compared with the untreated control at the final assessment.

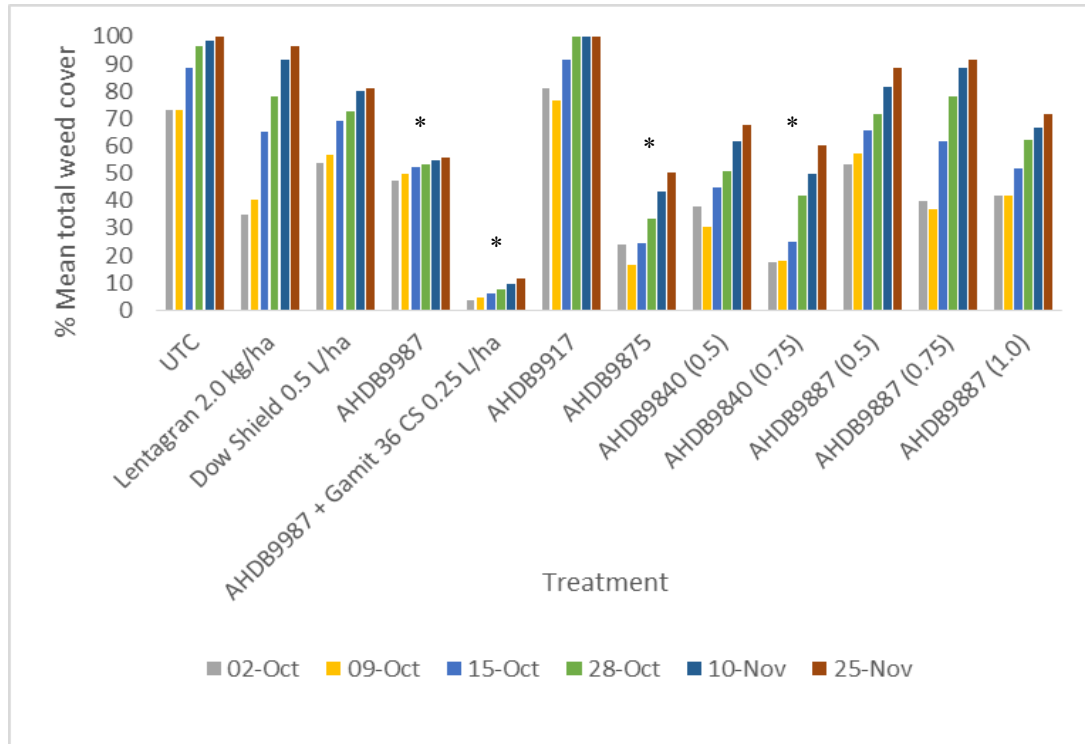


Table 4. Mean percentage weed cover at six assessment dates. Sprays applied on 10 August and 3 September 2020. WAA = weeks after final application.

Date	Mean % weed cover					
	02-Oct 4 WAA	09-Oct 5 WAA	15-Oct 6 WAA	28-Oct 8 WAA	10-Nov 10 WAA	25-Nov 12 WAA
Treatment						
Untreated	73.3	73.3	88.3	96.7	98.3	100.0
Lentagran 2.0 kg/ha	35.0	40.3	65.0	78.3	91.7	96.7
Dow Shield 0.5 L/ha	70.0	74.0	90.0	93.3	100.0	100.0
AHDB 9987	33.3	35.0	37.3	39.0	43.3	45.7
AHDB9987+ Gamit 36 CS 0.25 L/ha	3.7	4.5	6.3	7.7	9.7	11.7
AHDB 9917	81.0	76.7	91.7	100.0	100.0	100.0
AHDB 9875	24.2	16.7	24.3	33.3	43.3	50.3
AHDB 9840 0.5 L/ha	37.7	30.7	45.0	50.7	61.7	67.7
AHDB 9840 0.75 L/ha	17.7	18.0	25.0	41.7	50.0	60.0
AHDB 9887 0.5 L/ha	53.3	57.3	65.7	71.7	81.7	88.3
AHDB 9887 0.75 L/ha	40.0	36.7	61.7	78.3	88.3	91.7
AHDB 9887 1.0 L/ha	42.0	41.7	51.7	62.3	66.7	71.7
d.f.	22	22	22	22	22	22
LSD	43.67	41.74	42.70	41.77	40.06	39.59
p.f. value	0.036	0.019	0.005	0.002	0.001	0.002
	Not significantly different from untreated control (p>0.05)					
	Significantly different from untreated control (p<0.05)					

Table 5. Percent reduction in weed cover, compared to the untreated control at four, six, eight and twelve weeks after the Timing 2 post-planting treatment application (Abbott's formula).

Treatment	Weed cover reduction (%)			
	+ 4 weeks 02 Oct	+ 6 weeks 15 Oct	+ 8 weeks 28 Oct	+ 12 weeks 25 Nov
Lentagran 2.0 kg/ha	52.27	26.41	18.97	3.33
Dow Shield 0.5 L/ha	4.54	-1.89	3.46	0.00
AHDB9987	54.55	57.74	59.66	54.33
AHDB9987+ Gamit 36 CS 0.25 L/ha	95.00	92.83	92.07	88.33
AHDB9917	-10.46	-3.78	-3.44	0.00
AHDB9875	67.04	72.46	65.52	49.67
AHDB9840 0.5 L/ha	48.63	49.05	47.58	32.33
AHDB9840 0.75 L/ha	75.90	71.70	56.89	40.00
AHDB9887 0.5 L/ha	27.27	25.65	25.86	11.67
AHDB9887 0.75 L/ha	45.45	30.18	18.97	8.33
AHDB9887 1.0 L/ha	42.72	41.50	35.52	28.33

Eight weeks after the first application and four weeks after the second application, AHDB 9987 and Gamit 36 CS tank mix reduced weed cover by the greatest percentage, followed by AHDB 9875 and AHDB 9987 respectively (Table 5). These treatments contain a common active ingredient (AHDB 9987) which was effective on many of the weed species present. When combined with a further active ingredient either in a tank mix with Gamit 36 CS, or in a co-formulated product as AHDB 9875, this improved its effectiveness further. In the overall weed cover assessments, Dow Shield 500 0.5 L/ha did not cause a significant reduction in weed cover compared to the untreated control, indicating that this programme was not an effective treatment for weed cover reduction when used alone at this site. Similarly, AHDB 9917 did not perform well with an increase in per cent weed cover of AHDB 9917 treated plots on several assessment events as indicated by negative figures in the Abbots reduction formula (Table 5).

However, if we consider Table 6 this shows that these products have a narrower weed spectrum and were not as effective on all the weed species present at the trial site. Dow Shield 400 effectively controls composite weeds such as mayweed, but as chickweed was a predominant weed at the site, it therefore, did not significantly reduce overall percentage weed cover. AHDB 9887 was the only product to significantly reduce pale persicaria, but in contrast to Dow Shield this product did not significantly reduce levels of composite weeds such as mayweed and groundsel.

The most common weed in the trial chickweed, covered on average 46.7% plot cover which was double that of the next most dominant weed species, mayweed. All of the experimental products with the exception of AHDB9917 reduced the level of chickweed to a greater extent than the current available commercial standards, Lentagran and Dow Shield 400.

Variability of weed species occurrence across the trial areas has meant that where the weed populations of individual species were less predominant, then there was no significant results,

but expected trends could be observed for composite species such as mayweed and groundsel which were reduced where Dow Shield 400 or AHDB 9840 were applied.

Table 6. Mean weed cover (%) per plot of the different weed species at the final assessment, with letters displayed for Duncan's post-hoc test.

Trt no	Treatment	Rate (L/ha or Kg/ha)	Mean% cover per plot at the final assessment 25 November)					
			Chickweed	Mayweed	Pale Persicaria	Fat hen	Shepherds purse	Groundsel
1	Untreated	N/A	46.7 ^e	18.3 ^{abc}	13.3 ^{abcd}	10.0 ^{ab}	1.67 ^a	7.7 ^{abcd}
2	Lentagran	2.00	42.3 ^{de}	24.0 ^{bcde}	11.7 ^{abcd}	8.3 ^{ab}	0.0 ^a	8.7 ^{bcd}
3	Dow Shield 400	0.50	53.3 ^e	8.3 ^{ab}	15.7 ^{bcd}	11.7 ^{ab}	5.0 ^a	1.7 ^{ab}
4	AHDB 9987	2.00	17.7 ^{abc}	9.3 ^{ab}	9.7 ^{abcd}	5.7 ^{ab}	1.0 ^a	1.3 ^{ab}
5	AHDB 9987 Gamit 36	1.00 0.25	0.7 ^a	2.3 ^a	5.0 ^{abc}	1.7 ^{ab}	0.3 ^a	1.3 ^{ab}
6	AHDB 9917	0.70	43.3 ^{de}	18.3 ^{abcd}	21.7 ^d	15.0 ^b	4.3 ^a	4.7 ^{abc}
7	AHDB 9875	3.00	18.3 ^{abc}	5.7 ^{ab}	6.7 ^{abc}	0.7 ^a	0.7 ^a	9.7 ^{cde}
8	AHDB 9840	0.50	37.3 ^{cde}	5.3 ^{ab}	13.3 ^{abcd}	1.7 ^{ab}	0.3 ^a	1.3 ^{ab}
9	AHDB 9840	0.75	25.0 ^{bcd}	3.3 ^{ab}	17.7 ^{cd}	1.7 ^{ab}	2.3 ^a	0.0 ^a
10	AHDB 9887	0.50	20.0 ^{abc}	38.3 ^{cef}	3.3 ^{ab}	3.3 ^{ab}	1.7 ^a	19.7 ^f
11	AHDB 9887	0.75	35.0 ^{cde}	30.0 ^{cdef}	4.3 ^{ab}	3.7 ^{ab}	0.3 ^a	13.3 ^{def}
12	AHDB 9887	1.00	6.7 ^{ab}	45.0 ^f	1.7 ^a	1.7 ^{ab}	0.0 ^a	16.7 ^{ef}
F pr. p-value			<0.001	<0.001	0.03	NS	NS	<0.001
d.f.			22	22	22	22	22	22
L.S.D.			18.68	18.11	11.52	12.16	4.901	6.842
			Significantly different from the untreated control (p>0.05)					
			Not significantly different from the untreated control (p>0.05)					

NS: Not significantly different

Discussion

Phytotoxicity

All treatments, including the untreated control displayed crop effects in the assessment two weeks after the second application on 17 September. However Dow Shield 400 0.5 L/ha, AHDB 9917 and AHDB 9987 applied either alone or in a tank mix with Gamit 36 CS 0.25 L/ha exhibited no sign of phytotoxicity after this assessment. Very slight crop effects were recorded for the untreated control as the trial was 'blind scored', but as the levels were very low (no higher than 0.33). This is likely due to a physiological effect on the crop being recorded, and the results regarding the treatments are a true record of effects from the herbicides which can be determined from the comments made at assessment.

Phytotoxicity was well below the 'crop safe' threshold of 2.0 for AHDB9875 and AHDB9887 (at 0.5 L/ha), in the assessment two weeks after the second application, but after this phytotoxicity scores for these products increased to 3.0 and 2.7, respectively, due to a

puckered appearance of the wrapper leaves. The cauliflower heads however were unaffected and therefore the products could be considered crop safe. But, there were other products which caused little or no effects on the cauliflower by the time of harvest and would therefore be safer to use. These were; the commercial standards, Lentagran 2kg/ha and Dow Shield 400 0.5 L/ha, and AHDB 9917, AHDB 9840 and AHDB 9987, either alone or in a tank mix with Gamit 36 CS. All showed minimal to no phytotoxic symptoms.

There was slight scorch from the application of Lentagran 2 kg/ha at two weeks' after application, but this was transient and had abated to an acceptable level by harvest. This is an expected effect from this product.

Weed cover

The six most common weed species present in this trial area were chickweed, mayweed, pale persicaria, fat hen, shepherds purse and groundsel.

Four treatments significantly reduced percentage weed cover for up to twelve weeks after the final application. These were AHDB 9875, AHDB 9840 0.75 L/ha and AHDB 9987 either applied alone or in a tank mix with Gamit 36 CS 0.25 L/ha (Table 2). AHDB 9987 in a tank mix with Gamit 36 CS 0.25 L/ha reduced the overall weed cover by the greatest percentage compared with the remaining treatments. AHDB 9840 applied at 0.75 L/ha showed a greater efficacy compared with the lower rate of 0.5 L/ha, with no difference in crop safety. By the trial end (25 November), untreated plots had 100% weed cover compared to AHDB 9987 and Gamit 36 CS 0.25 L/ha plots where the weed level was reduced by 88% leaving only 12% weed cover on average across the trial.

Eight weeks after the first application and four weeks after the second application AHDB 9987 and Gamit 36 CS tank mix reduced weed cover by the greatest percentage, followed by AHDB 9875 and AHDB 9987 respectively. These treatments contain a common active ingredient (AHDB 9987) which was effective on many of the weed species present. When combined with a further active ingredient, either in a tank mix with Gamit 36 CS or in a co-formulated product as with AHDB 9875, this improved its effectiveness further. AHDB 9987 is a residual herbicide and needs to be applied before weed emergence, requiring requires moisture to work effectively. The soils were moist when these products were applied. AHDB 9875 has some contact activity which allows a more flexible timing with this product, and this could be applied at a later crop growth stage once weeds have emerged. AHDB 9840 and AHDB 9887 also have contact activity, and are best applied following weed emergence and during active weed growth.

In the total weed cover assessments, Dow Shield 400 0.5 L/ha did not cause a significant reduction in weed cover compared to the untreated control, indicating that this programme was not an effective treatment for weed cover reduction when used alone at this site. Similarly, AHDB 9917 did not perform well with an increase in percent weed cover of treated plots on several assessment events as indicated by negative figures in the Abbots reduction formula. These products have a narrower weed spectrum and were not as effective on all the weed species present at the trial site. Dow Shield 400 controls composite weeds such as mayweed effectively, but as chickweed was a predominant weed at the site, it did not significantly reduce overall percentage weed cover. AHDB 9887 was the only product to significantly reduce pale persicaria. In contrast to Dow Shield this product did not significantly reduce levels of composite weeds such as mayweed and groundsel, and therefore also did not significantly reduce overall weed cover. Despite the poorer overall performance of these products, they may still have a place within a weed control program used in combination or sequence with other products to target specific weed issues.

Chickweed was the main weed present at a mean of 46.7% plot cover which was double the amount of the next most dominant weed species, mayweed. All of the experimental products with the exception of AHDB9917 reduced the level of chickweed greater than the current available commercial standards, Lentagran and Dow Shield.

Conclusions

- AHDB 9875, AHDB 9840 0.75 L/ha and AHDB 9987 either applied alone or in a tank mix with Gamit 36 CS 0.25 L/ha significantly reduced overall mean weed cover for up to twelve weeks after the second application timing.
- No phytotoxic effects were observed on the heads of the cauliflower, but in plots treated with AHDB 9875 and AHDB 9887 0.5 L/ha, some distortion of the wrapper leaves was observed which fell slightly above the acceptable threshold
- All of the experimental products with the exception of AHDB9917 reduced the level of chickweed greater than the current available commercial standards, Lentagran and Dow Shield.
- AHDB 9887 significantly reduced the level of pale persicaria.

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Appendix

a. Crop information

Crop	Cultivar	Planting date	Row width (m)
Cauliflower	Skywalker	10/08/2020	2.4

b. Trial diary

Date	Event
10/08/2020	Crops planted
10/08/2020	Application A spray
03/09/2020	Application B spray
17/09/2020	Assessment, two weeks after Timing 2 treatment (phytotoxicity).
02/10/2020	Assessment, four weeks after Timing 2 treatment (phytotoxicity/weeds).
09/10/2020	Assessment, five weeks after Timing 2 treatment (phytotoxicity/weeds).
15/10/2020	Assessment, six weeks after Timing 2 treatment (phytotoxicity/weeds).
27/10/2020	Assessment, eight weeks after Timing 2 treatment (phytotoxicity/weeds).

c. Climatological data during study period

Date	Min temp (°C)	Max temp (°C)	Precipitation (mm)	Date	Min temp (°C)	Max temp (°C)	Precipitation (mm)
02/08/2020	12	22	0.0	29/08/2020	13	15	4.5
03/08/2020	11	18	0.1	30/08/2020	11	15	0.2
04/08/2020	8	22	0.0	31/08/2020	9	15	0.0
05/08/2020	16	25	0.0	01/09/2020	9	18	0.4
06/08/2020	18	25	0.0	02/09/2020	9	20	3.2
07/08/2020	16	28	0.0	03/09/2020	14	22	2.0
08/08/2020	16	22	0.0	04/09/2020	12	18	0.0
09/08/2020	16	20	0.0	05/09/2020	10	18	0.0
10/08/2020	16	24	0.0	06/09/2020	12	19	0.1
11/08/2020	17	26	0.0	07/09/2020	12	18	1.2
12/08/2020	18	26	0.0	08/09/2020	15	24	0.0
13/08/2020	16	19	0.0	09/09/2020	13	21	0.0
14/08/2020	16	19	0.7	10/09/2020	8	17	0.0
15/08/2020	16	19	4.1	11/09/2020	10	18	0.0
16/08/2020	16	18	22.2	12/09/2020	13	20	0.0
17/08/2020	16	22	3.0	13/09/2020	14	24	0.0
18/08/2020	15	23	3.0	14/09/2020	12	24	0.0
19/08/2020	16	21	6.8	15/09/2020	13	22	0.0
20/08/2020	16	25	0.4	16/09/2020	14	19	0.0
21/08/2020	17	23	0.5	17/09/2020	11	17	0.0
22/08/2020	15	22	1.1	18/09/2020	12	17	0.0
23/08/2020	14	21	0.5	19/09/2020	14	18	0.0
24/08/2020	13	21	0.1	20/09/2020	14	17	0.0
25/08/2020	16	22	8.6	21/09/2020	11	22	0.0
26/08/2020	14	19	0.2	22/09/2020	11	25	0.0
27/08/2020	12	18	7.9	23/09/2020	11	17	6.1
28/08/2020	13	15	18.7	24/09/2020	8	15	1.4
25/09/2020	9	13	11.7	06/11/2020	2	13	0.0

Date	Min temp (°C)	Max temp (°C)	Precipitation (mm)	Date	Min temp (°C)	Max temp (°C)	Precipitation (mm)
26/09/2020	7	13	0.3	07/11/2020	5	13	0.0
27/09/2020	11	13	0.0	08/11/2020	10	13	0.2
28/09/2020	9	16	0.0	09/11/2020	11	14	0.8
29/09/2020	11	15	1.4	10/11/2020	8	14	0.4
30/09/2020	10	15	5.6	11/11/2020	8	13	2.0
01/10/2020	8	14	1.3	12/11/2020	8	12	0.4
02/10/2020	10	15	2.4	13/11/2020	8	12	0.0
03/10/2020	13	15	7.2	14/11/2020	8	14	3.3
04/10/2020	10	13	0.8	15/11/2020	8	12	3.8
05/10/2020	10	15	9.2	16/11/2020	9	12	0.7
06/10/2020	9	15	5.0	17/11/2020	12	14	0.0
07/10/2020	10	15	1.2	18/11/2020	8	14	0.2
08/10/2020	8	16	5.7	19/11/2020	1	10	0.3
09/10/2020	6	12	0.6	20/11/2020	0	11	0.4
10/10/2020	7	13	1.9	21/11/2020	9	13	1.3
11/10/2020	8	13	0.1	22/11/2020	3	9	0.0
12/10/2020	7	11	0.7	23/11/2020	0	9	0.0
13/10/2020	8	12	2.0	24/11/2020	8	11	0.0
14/10/2020	10	14	0.5	25/11/2020	2	10	1.1
15/10/2020	7	13	5.7	26/11/2020	0	8	0.3
16/10/2020	9	13	1.1	27/11/2020	3	7	0.0
17/10/2020	9	13	0.1	28/11/2020	5	10	0.0
18/10/2020	9	11	0.0	29/11/2020	7	9	0.2
19/10/2020	9	14	0.0	30/11/2020	6	10	1.3
20/10/2020	11	17	0.3	01/12/2020	4	7	0.0
21/10/2020	13	14	6.4	02/12/2020	2	7	0.6
22/10/2020	8	14	0.9	03/12/2020	4	6	10.5
23/10/2020	6	14	4.5	04/12/2020	2	5	10.4
24/10/2020	6	15	5.2	05/12/2020	1	8	0.8
25/10/2020	8	13	0	06/12/2020	-1	6	0.1
26/10/2020	6	12	2.4	07/12/2020	-2	2	0.0
27/10/2020	6	12	1.7	08/12/2020	0	3	1.0
28/10/2020	7	12	0.0	09/12/2020	3	7	0.8
29/10/2020	6	14	3.6	10/12/2020	4	7	0.7
30/10/2020	11	16	0.1	11/12/2020	6	9	8.0
31/10/2020	11	15	2.0	12/12/2020	6	8	1.0
01/11/2020	10	17	1.2	13/12/2020	1	10	3.2
02/11/2020	8	17	2.6	14/12/2020	8	11	0.2
03/11/2020	6	9	7.0	15/12/2020	5	10	0.0
04/11/2020	3	11	0.1	16/12/2020	6	10	0.8
05/11/2020	3	11	0.0				

d. Raw data from assessments 1-7

Crop safety data

Plot	Treatment	Phytotoxicity score (0-10)						
		17-Sep	02-Oct	09-Oct	15-Oct	28-Oct	10-Nov	25-Nov
101	3	2.0	0.0	0.0	0.0	0.0	0.0	0.0
102	5	1.0	0.0	0.0	0.0	0.0	0.0	0.0
103	8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
104	10	1.4	3.0	3.0	3.0	3.0	2.0	2.0
105	9	1.0	0.0	0.0	0.0	0.0	0.0	0.0
106	7	0.0	3.0	3.0	3.0	3.0	5.0	5.0
107	4	3.5	0.0	0.0	0.0	0.0	0.0	0.0
108	6	3.0	0.0	0.0	0.0	0.0	0.0	0.0
109	2	1.0	0.0	0.0	0.0	0.0	0.0	0.0
110	11	2.0	0.0	0.0	0.0	0.0	0.0	0.0
111	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
112	12	1.0	3.0	3.0	3.0	3.0	3.0	3.0
201	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
202	2	6.0	0.0	0.0	0.0	0.0	0.0	0.0
203	5	1.2	0.0	0.0	0.0	0.0	0.0	0.0
204	8	0.0	3.0	3.0	3.0	3.0	3.0	3.0
205	3	1.5	0.0	0.0	0.0	0.0	0.0	0.0
206	11	2.0	0.0	0.0	0.0	0.0	0.0	0.0
207	10	1.5	3.0	3.0	3.0	3.0	3.0	3.0
208	12	1.0	3.0	3.0	3.0	3.0	3.0	3.0
209	9	1.0	3.0	3.0	3.0	3.0	3.0	3.0
210	7	0.0	1.0	1.0	1.0	1.0	1.0	1.0
211	3	2.0	0.0	0.0	0.0	0.0	0.0	0.0
212	6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
301	3	1.0	0.0	0.0	0.0	0.0	0.0	0.0
302	10	0.7	3.0	3.0	3.0	3.0	3.0	3.0
303	4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
304	9	0.8	0.0	0.0	0.0	0.0	0.0	0.0
305	7	1.0	3.0	3.0	3.0	3.0	3.0	3.0
306	8	1.0	0.0	0.0	0.0	0.0	0.0	0.0
307	6	0.5	0.0	0.0	0.0	0.0	0.0	0.0
308	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
309	2	0.5	3.0	3.0	3.0	3.0	2.0	2.0
310	11	0.1	2.0	2.0	2.0	2.0	2.0	2.0
311	1	0.2	1.0	1.0	1.0	1.0	1.0	1.0
312	12	1.0	0.0	0.0	0.0	0.0	0.0	0.0

Weed cover assessment data:

Average weed cover (%) per treatment on 2 October 2020

Trt	% total weed cover	Chickweed	Mayweed	Nettle	Pale persicaria	Fat Hen	Shepherds purse	Groundsel
1	73.3	31.7	16.7	1.2	8.3	10.7	2.0	2.7
2	35.0	12.3	10.3	1.0	5.5	1.7	0.3	3.7
3	70.0	31.7	13.3	0.2	13.0	12.3	1.8	0.0
4	33.3	15.7	1.7	0.0	11.3	3.7	0.0	0.0
5	3.7	0.0	0.0	0.0	2.3	1.0	0.2	0.0
6	81.0	23.3	17.3	2.0	13.3	16.0	0.7	5.7
7	24.2	8.2	0.2	0.0	6.0	0.5	0.8	9.0
8	37.7	17.3	1.0	0.0	14.3	2.2	1.3	0.0
9	17.7	7.7	0.7	0.2	3.3	2.5	1.2	1.0
10	53.3	4.7	33.3	0.0	3.0	0.0	0.3	11.0
11	40.0	19.7	17.3	0.0	1.3	1.7	0.0	1.0
12	42.0	2.7	24.2	0.0	1.3	0.2	0.7	12.8

Average weed cover (%) per treatment on 15 October 2020

Trt	% total weed cover	Chickweed	Mayweed	Nettle	Pale persicaria	Fat Hen	Shepherds purse	Groundsel
1	73.3	31.7	15.7	1.8	7.7	11.7	2.3	3.0
2	40.3	15.0	9.3	1.3	8.7	1.3	0.3	4.7
3	74.0	37.5	13.3	0.3	13.7	13.0	1.8	0.0
4	35.0	16.0	2.3	0.0	11.3	3.8	0.0	0.0
5	4.5	0.0	0.0	0.0	2.7	1.7	0.2	0.0
6	76.7	25.7	16.3	2.7	12.7	13.7	1.0	4.2
7	16.7	6.3	0.2	0.0	2.7	1.0	0.8	6.2
8	30.7	16.0	1.0	0.0	8.3	3.5	1.3	0.0
9	18.0	6.7	1.5	0.2	4.0	2.5	1.3	1.0
10	57.3	5.7	34.7	0.0	3.7	0.0	0.3	11.7
11	36.7	14.0	16.7	0.0	1.3	1.7	0.0	1.7
12	41.7	3.0	23.3	0.0	1.3	0.2	0.7	12.0

Average weed cover (%) per treatment on 28 October 2020

Trt	% total weed cover	Chickweed	Mayweed	Nettle	Pale persicaria	Fat Hen	Shepherds purse	Groundsel
1	96.7	96.7	7.0	46.7	15.0	2.0	13.3	10.0
2	78.3	78.3	8.3	36.7	18.3	0.0	11.7	5.7
3	93.3	93.3	1.7	51.7	6.7	5.0	15.7	11.7
4	39.0	39.0	1.0	16.0	6.5	0.3	9.7	5.0
5	7.7	7.7	0.3	0.5	0.3	0.0	3.3	1.7
6	100.0	100.0	4.7	46.7	19.3	4.7	23.3	15.0
7	33.3	33.3	7.3	16.7	4.7	8.0	5.0	0.0
8	50.7	50.7	1.3	35.0	4.3	0.7	8.7	1.0
9	41.7	41.7	0.0	16.0	2.7	3.3	15.7	1.7
10	71.7	71.7	17.3	18.3	34.0	3.3	1.7	3.3
11	78.3	78.3	10.0	30.0	24.0	1.0	3.3	3.7
12	62.3	62.3	16.7	2.3	41.7	1.0	1.7	0.7

Average weed cover (%) per treatment on 10 November 2020

Trt	% total weed cover	Chickweed	Mayweed	Nettle	Pale persicaria	Fat Hen	Shepherds purse	Groundsel
1	73.3							
2	35.0							
3	70.0							
4	33.3							
5	3.7							
6	81.0							
7	24.2							
8	37.7							
9	17.7							
10	53.3							
11	40.0							
12	42.0							

Trt	% total weed cover	Chickweed	Mayweed	Nettle	Pale persicaria	Fat Hen	Shepherds purse	Groundsel
1	98.3	98.3	46.7	18.3	2.0	13.3	10.0	1.7
2	91.7	91.7	40.0	22.3	3.3	11.7	7.7	0.0
3	100.0	100.0	51.7	6.7	5.0	15.7	11.7	5.0
4	43.3	43.3	17.7	7.7	1.0	9.7	5.7	1.0
5	9.7	9.7	1.3	1.3	0.0	4.7	1.7	0.3
6	100.0	100.0	46.7	19.3	4.7	23.3	15.0	4.3
7	43.3	43.3	15.3	5.7	10.0	6.7	0.7	0.7
8	61.7	61.7	34.7	5.3	1.7	10.3	1.7	0.3
9	50.0	50.0	24.0	3.3	3.3	17.7	1.7	2.3
10	81.7	81.7	18.3	36.7	3.3	3.3	3.3	1.7
11	88.3	88.3	33.3	30.0	2.0	4.3	3.7	0.3
12	66.7	66.7	5.7	43.3	1.3	1.7	1.7	0.0

Average weed cover (%) per treatment on 10 November 2020

Trt	% total weed cover	Chickweed	Mayweed	Nettle	Pale persicaria	Fat Hen	Shepherds purse	Groundsel
1	100.0	46.7	18.3	2.0	13.3	10.0	1.7	7.7
2	96.7	42.3	24.0	3.3	11.7	8.3	0.0	8.7
3	100.0	53.3	8.3	5.0	15.7	11.7	5.0	1.7
4	45.7	17.7	9.3	1.0	9.7	5.7	1.0	1.3
5	11.7	0.7	2.3	0.0	5.0	1.7	0.3	1.3
6	100.0	43.3	18.3	4.7	21.7	15.0	4.3	4.7
7	50.3	18.3	5.7	10.0	6.7	0.7	0.7	9.7
8	67.7	37.3	5.3	1.7	13.3	1.7	0.3	1.3
9	60.0	25.0	3.3	3.3	17.7	1.7	2.3	0.0
10	88.3	20.0	38.3	3.3	3.3	3.3	1.7	19.7
11	91.7	35.0	30.0	2.0	4.3	3.7	0.3	13.3
12	71.7	6.7	45.0	2.3	1.7	1.7	0.0	16.7

e. Trial design

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

f. ORETO certificates



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  Certification Number
ORETO 409



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

This certifies that
**Allium and Brassica Agronomy Limited
Allium & Brassica Centre Limited**
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

Date of issue: 3 March 2017
Effective date: 23 February 2017
Expiry date: 22 February 2022

Signature  Certification Number
ORETO 376