CP 205 AHDB Horticulture Efficacy Trials 2022
Final Trial Report

Work package:	WP 18
Title:	Weed control in swede and turnip
Crop	Turnip
Target	Weeds
Lead researcher:	David Talbot/Lynn Tatnell
Organisation:	ADAS
Period:	June – September 2022
Report date:	FINAL 20/04/23
Report authors:	Douglas Brown/Lynn Tatnell
ORETO Number: (certificate should be attached)	22-69
ADAS references	1022151/ BX-3403/BW22-111

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

Date 20/04/23

Author's signature 

Trial Summary

Introduction

There is currently a lack of available herbicides that cover the full weed spectrum in turnip and swede production, in addition to the threat of revocation of a significant weed control option – metazachlor. Further options for pre-emergence weed control are required and were screened within this trial.

The project focused on control of specific broad-leaved weed species that have been identified as key issues for swede and turnip growers. In this field trial the predominant weed species present were fat-hen (*Chenopodium album*), and small nettle (*Urtica urens*).

Methods

- A randomized replicated trial was carried out in a farm-drilled crop on a sandy loam soil in Suffolk. Eleven pre-emergence herbicide treatments (including an untreated control) were applied within 72 hours of drilling. The crop was grown under insect-proof netting and irrigated, as per commercially standard practices.
- Assessments on crop and weed populations, and phytotoxicity were carried out 14, 28, and 56 days after application. A representative sample of roots was harvested from each plot, phytotoxic effects observed, and graded to industry standard size categories.

Results

Weed control

Table 1 **Weed cover (% cover)**

	Average % weeds cover		
Treatment	**14 DAA**	**28 DAA**	**56 DAA**
1	17.50	8.75	14.50
2	**6.75**	2.50	**1.75**
3	**7.50**	3.75	6.75
4	**3.50**	2.50	**2.00**
5	**8.75**	8.00	10.50
6	13.75	**2.25**	4.00
7	**8.75**	3.00	**2.25**
8	**4.25**	**1.75**	**1.50**
9	**5.00**	3.50	6.75
10	**7.50**	**20.75**	20.25
11	**5.50**	2.50	**1.75**
FPr	*< .001*	*< .001*	*0.03*
Sed	*2.789*	*3.146*	*5.64*
Lsd	*5.696*	*6.425*	*11.52*
Df	*30*	*30*	*30*
cv%	*48.9*	*82.6*	*121.9*

DAA = days after application

At the 14 DAA (days after application) % weed cover assessment timing, weed cover in all treatments except T6 was significantly lower than the untreated control (Table 4).

At the 28 DAA % weed cover assessment timing, weed cover in treatments T6 and T8 were significantly lower than the untreated control and weed cover in T10 was significantly higher than the untreated control (Table 1). There may have been some natural weed decline in this period due to the hot summer weather and rapid weed growth.

At 56 DAA, % weed cover in treatments T2, T4, T7, T8, and T11 was significantly lower than the untreated control (Table 4) and T10 showed no weed control compared to the untreated.

Crop cover

Table 2 **Crop cover (% cover)**

	Average % crop cover		
Treatment	14 DAA	28 DAA	56 DAA
1	70.00	94.25	66.25
2	**53.75**	90.50	70.00
3	60.00	94.75	73.75
4	62.50	96.50	70.75
5	65.00	95.25	77.50
6	68.75	97.25	62.50
7	68.75	98.00	67.50
8	**40.00**	89.25	65.00
9	**22.50**	**57.00**	50.00
10	**15.00**	**35.75**	66.25
11	**40.00**	95.00	70.00
FPr	*< .001*	*< .001*	*0.084*
Sed	*6.25*	*7.8*	*7.26*
Lsd	*12.76*	*15.92*	*14.82*
Df	*30*	*30*	*30*
cv%	*17.2*	*12.9*	*15.3*

At 14 DAA %, % crop cover in treatments T2, T8, T9, T10, and T11 was significantly lower than the untreated control (Table 5).

At 28 DAA, % crop cover in treatments T9 and T10 was significantly lower than the untreated control (Table 5).

At 56 DAA there was no significant effect of treatment on % crop cover.

Phytotoxicity

Treatments T4 and T7 were significantly different from the untreated control at the 14 DAA assessment for crop phytotoxicity (Table 6), seen as symptoms of chlorosis on the leaf tips. No phytotoxicity was observed in any plot at the 28 and 56 DAA assessments.

Table 3 **Phytotoxicity 14 DAA assessment**

	Phytotoxicity (% plot affected)
Treatment	14 DAA
1	0
2	0
3	0
4	**35.75**
5	0
6	0
7	**11.25**
8	0
9	0
10	0
11	0
FPr	*< .001*
Sed	*1.245*
Lsd	*2.542*
Df	*30*
cv%	*41.2*

Take home message:

- In general, all herbicide treatments improved weed control compared to the untreated, except for T10 (AHDB9999).
- Treatments 2 (metazachlor) (industry standard), T4 (AHDB9987 + AHDB9707), T7 (AHDB9779 + AHDB9707), T8 (AHDB9779 + AHDB9706), and T11 (AHDB9706) all had a significantly higher level of weed control compared to the untreated control at 56 DAA.
- Treatment 8 (AHDB9779 + AHDB9706) had the lowest weed cover at 56DAA, closely followed by the industry standard T2 (metazachlor) and T11 (AHDB9706).
- There were a few differences in crop cover recorded at the 14 and 28 DAA, with T9 (AHDB9779+AHDB9898) and T10 (AHDB9999), being statistically different to the untreated control at 28DAA. However, by 56 DAA there were no significant treatment differences in crop cover.
- Phytotoxicity was only observed on treatments T4 (AHDB9987 + AHDB9707) and T7 (AHDB9779 + AHDB9707) at 14DAA, with symptoms of leaf tip chlorosis. No other phytotoxicity symptoms were observed.
- There were no root deformations recorded in any treatment.
- Treatments 8 (AHDB9779 + AHDB9706), T9 (AHDB9779 + AHDB9898), T10 (AHDB9999) and T11 (AHDB9706) had significantly less roots per plot compared to the untreated control (T1).
- Treatment 12 (AHBD9782) had the highest percentage of 'baby and standard' size roots, resulting in the lowest percentage of undersized roots and no overweight roots. However, the sample size was smaller, and the plots were not included in the randomization due to farm-scale application. No root deformities were observed in any of the treatments.

The weather was hot and dry at treatment application and throughout the trial period. The crop was irrigated. However, the hot conditions may still have influenced herbicide efficacy. The weed burden was low throughout the trial, with two dominant species, fat hen (*Chenopodium album)* and small nettle (*Urtica urens)*.

SCIENCE SECTION

Objectives

To provide data on efficacy and phytotoxicity for new pre-emergence weed control options in drilled swede and turnip crops, with a focus on broad-leaved weeds such as fat-hen, redshank, shepherds purse and fumitory.

For the purpose of this trial a turnip crop was used, with fat-hen and small nettle being the predominant weed species at the trial site.

Methods

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**
PP1/099 (3)	Weeds in root vegetables	
PP1/135 (4)	Phytotoxicity assessment	
PP1/152 (4)	Guideline on design and analysis of efficacy evaluation trials	
PP1/225 (2)	Minimum effective dose	
PP1/181 (5)	Conduct and reporting of efficacy evaluation trials including good experimental practice	
PP 1/214 (4)	Principles of acceptable efficacy	
PP 1/224 (2)	Principles of efficacy evaluation for minor uses	

Test site

Item	**Details**
Location address	Hollesley, TM369444, Suffolk
Crop	Turnip
Cultivar	Armand
Soil or substrate type	Sandy Loam
Agronomic practice	Commercially managed irrigated farm crop, excluding herbicides
Prior history of site	Mixed arable and vegetable rotational cropping

Trial design

Item	**Details**
Trial design:	Fully randomised block
Number of replicates:	4
Row spacing:	4 x twin rows on a 1.83 m bed (40 cm between each twin row)
Plot size: (w x l)	1.8 x 6 m
Plot size: (m^2)	10.8
Number of plants per plot:	% crop cover was recorded

Treatment details

AHDB Code	Active substance	Product name/ manufacturer code	Formulation batch number	Content of active substance in product	Formulation type	Adjuvant
n/a	Metazachlor	Sultan 50SC*	21071901	500 g/L	SC	N/A
AHDB9987	N/A	N/A	N/A	N/A	N/A	N/A
AHDB9707	N/A	N/A	N/A	N/A	N/A	N/A
AHDB9875	N/A	N/A	N/A	N/A	N/A	N/A
AHDB9779	N/A	N/A	N/A	N/A	N/A	N/A
AHDB9706	N/A	N/A	N/A	N/A	N/A	N/A
AHDB9898	N/A	N/A	N/A	N/A	N/A	N/A
AHDB9999	N/A	N/A	N/A	N/A	N/A	N/A
*AHDB9782***	N/A	N/A	N/A	N/A	N/A	N/A

***treatment not in replicated plots but instead in a buffer strip on the trial border for demonstration. Only minimal harvest assessment data was recorded for this treatment.*

*Sultan 50SC had to be used instead of the planned Butisan S as we were unable to get hold of Butisan S in time for a spray application. The two products have the same amount of metazachlor, but Sultan 50SC is not currently authorised for use on these crops.

Application schedule

Treatment number	Treatment: product name or AHDB code	Rate of active substance (ml or g a.s./ha)	Rate of product (l or kg/ha)	Application code
1	NIL	N/a	N/a	N/a
2	Sultan 50SC	500 g/L	1.0 L/ha	B
3	AHDB9987	600 g/L	0.5 L/ha	B
4	AHDB9987 + AHDB9707	600 g/L + 360 g/L	0.5 L/ha + 0.2 L/ha	B
5	AHDB9875	400 g/L + 8 g/L	0.75 L/ha	B
6	AHDB9779	500 g/L	0.8 L/ha	B
7	AHDB9779 + AHDB9707	500 g/L + 360 g/L	0.8 L/ha + 0.2 L/ha	B
8	AHDB9779 + AHDB9706	500 g/L + 700 g/L	0.8 L/ha + 3.0 L/ha	B
9	AHDB9779 + AHDB9898	500 g/L + 720 g/L	0.8 L/ha + 0.5 L/ha	B
10	AHDB9999	800 g/L	5.0 L/ha	B
11	AHDB9706	700 g/L	3.0 L/ha	B

Application details

	Application A AHDB9782 Only	Application B All other Treatments
Application date	17.06.22	21.06.22
Time of day	07:15	11:30
Crop growth stage (Max, min average BBCH)	Pre-em	Pre-em
Crop height (cm)	n/a	n/a
Crop coverage (%)	n/a	n/a
Application Method	Manual plot spray and soil incorporation	Manual plot spray
Application Placement		
Application equipment	AZO plot sprayer & boom	
Nozzle pressure	2 bar	2 bar
Nozzle type	F04/110	F02/110
Nozzle size		
Application water volume/ha	200 L/ha	200 L/ha
Temperature of air - shade (°C)	19.25	21.05
Relative humidity (%)	72.35	62.4
Wind speed range (m/s)	4.6-7.5 mph	1.1-1.3 mph
Dew presence (Y/N)	N	N
Temperature of soil - 2-5 cm (°C)	19.2 (10cm)	Not recorded
Wetness of soil - 2-5 cm	Not recorded	Not recorded
Cloud cover (%)	0	35

Untreated levels of weed species at application and through the assessment period

Common name	Scientific Name	EPPO Code	Infestation level pre-application	Infestation level at start of assessment period	Infestation level at end of assessment period
Fat hen	*Chenopodium album*	CHEAL	N/A	67.25 weeds/ m²	31.25 weeds/ m²
Small nettle	*Urtica urens*	URTUR	N/A		

Weed counts were done in the untreated at each assessment timing. Weeds species were counted together at assessments and not split by species due to the overall relatively low number of weeds. (See Appendix c.1 and c.2 for raw data). At 14, 28 and 56 days after application (DAA) weeds were assessed by percentage ground cover per plot and phytotoxicity using a 0-100% scale (0 = no damage). There was a natural decline in weed level from the start to the end of the trial period as it was during the summer months when the weeds were naturally dying back.

Assessment details

Evaluation date	Evaluation Timing (DAA)*	Crop Growth Stage (BBCH)	Evaluation type (efficacy, phytotoxicity)	Assessment
06/07/22	14	4 true leaves	Efficacy & phytotoxicity	Weed species counts in untreated. % cover weeds and crop every plot % Phytotoxicity
18/07/22	28	7 true leaves	Efficacy & phytotoxicity	% cover weeds and crop every plot % Phytotoxicity
15/08/22	56	Harvest	Efficacy & phytotoxicity	Weed species counts in untreated. % cover weeds and crop every plot. % Phytotoxicity. Pre-Harvest samples from each plot.

* DAA – days after application

Pre-harvest samples

A sample of roots was manually harvested from each plot to check for deformities. At two points per plot, a 0.75m^2 quadrat area was hand harvested (15/08/22). Roots were taken back to the laboratory and were assessed for cracking, excessive root hairs, and deformation. Each plot was weighed as a whole and then roots graded in size categories and weighed/counted.

Statistical analysis

Analysis of variance (ANOVA) was performed on the crop cover, weed cover, and phytotoxicity data.

Data collected from the demonstration strip treated with AHDB 9782 were not included in statistical analyses.

Results

Weed control

Table 4 **Weed cover (% cover)**

	Average % weeds cover		
Treatment	**14 DAA**	**28 DAA**	**56 DAA**
1	17.50	8.75	14.50
2	**6.75**	2.50	**1.75**
3	**7.50**	3.75	6.75
4	**3.50**	2.50	**2.00**
5	**8.75**	8.00	10.50
6	13.75	**2.25**	4.00
7	**8.75**	3.00	**2.25**
8	**4.25**	**1.75**	**1.50**
9	**5.00**	3.50	6.75
10	**7.50**	**20.75**	20.25
11	**5.50**	2.50	**1.75**
FPr	*< .001*	*< .001*	*0.03*
Sed	*2.789*	*3.146*	*5.64*
Lsd	*5.696*	*6.425*	*11.52*
Df	*30*	*30*	*30*
cv%	*48.9*	*82.6*	*121.9*

At the 14 DAA % weed cover assessment timing, weed cover in all treatments except T6 were significantly lower than the untreated control (Table 4).

At the 28 DAA % weed cover assessment timing, weed cover in treatments T6 and T8 were significantly lower than the untreated control and weed cover in T10 was significantly higher the untreated control. Percentage weed cover in all other treatments was lower than in the untreated, though these differences were not significant (Table 4).

At the 56 DAA % weed cover assessment timing, weed cover in treatments T2, T4, T7, T8, and T11 were significantly lower than the untreated control (Table 4) and T10 showed no weed control compared to the untreated.

Crop cover

Table 5 **Crop cover (% cover)**

	Average % crop cover		
Treatment	14 DAA	28 DAA	56 DAA
1	70.00	94.25	66.25
2	**53.75**	90.50	70.00
3	60.00	94.75	73.75
4	62.50	96.50	70.75
5	65.00	95.25	77.50
6	68.75	97.25	62.50
7	68.75	98.00	67.50
8	**40.00**	89.25	65.00
9	**22.50**	**57.00**	50.00
10	**15.00**	**35.75**	66.25
11	**40.00**	95.00	70.00
FPr	*< .001*	*< .001*	*0.084*
Sed	*6.25*	*7.8*	*7.26*
Lsd	*12.76*	*15.92*	*14.82*
Df	*30*	*30*	*30*
cv%	*17.2*	*12.9*	*15.3*

At the 14 DAA % crop cover assessment timing, crop cover in treatments T2, T8, T9, T10, and T11 was significantly lower than the untreated control (Table 5).

At the 28 DAA % crop cover assessment timing, crop cover in treatments T9 and T10 was significantly lower than the untreated control (Table 5).

The P-value for the 56 DAA % crop cover is greater than 0.05 so there are no significant differences compared to the untreated control.

Phytotoxicity

Treatments T4 and T7 were significantly different from the untreated control at the 14 DAA assessment for crop phytotoxicity (Table 6). The symptoms were chlorosis of leaf tips (true leaves) (Figure 1). No phytotoxicity was observed in any plot at the 28 and 56 DAA assessments. However, there was reduced crop cover observed at 28 DAA (Table 5) in treatments T9 and T10, which is likely to be a symptom of herbicide treatments.

Figure 1 Example of leaf tip chlorosis in T4 and T7 on 06/07/22 (*trial had been netted so difficult to take close photographs*)

Table 6 **Phytotoxicity 14 DAA assessment**

	Phytotoxicity (% plot affected)
Treatment	14 DAA
1	0
2	0
3	0
4	**35.75**
5	0
6	0
7	**11.25**
8	0
9	0
10	0
11	0
FPr	*< .001*
Sed	*1.245*
Lsd	*2.542*
Df	*30*
cv%	*41.2*

Weather Conditions

Precipitation and temperature summaries for the months of June, July, and August 2022 were obtained from the Sutton (Woodbridge) weather station (52.066° N, 1.362° E).

The month of June saw a high of 31.4°C, average of 16.1°C, and precipitation of 20.81 mm. In July the high was 32.3°C, average 18.8°C, and precipitation of 42.16 mm. The month of August saw a high of 30.2°C, average of 19.6°C, and precipitation of 4.31 mm, therefore conditions were extremely dry.

Harvest root samples and observations

Root samples were harvested at two 0.75 m^2 areas in every plot. Roots were returned to ADAS Boxworth and assessed for phytotoxicity effects. No root phytotoxicity symptoms or root deformations were observed. Size differences were noted as observations and categorised into the following sizes based on commercial standards:

- undersize (<35 mm)
- baby (35-50 mm)
- standard (50-90 mm)
- overweight (>90 mm)

Root weights

Total fresh weight (kg) of each plot was assessed (Figure 2 and Table 7). Treatment 5 recorded the highest average weight per plot (7739 g) and T10 the lowest (4812 g). There were no significant differences between the weights of the different treatments.

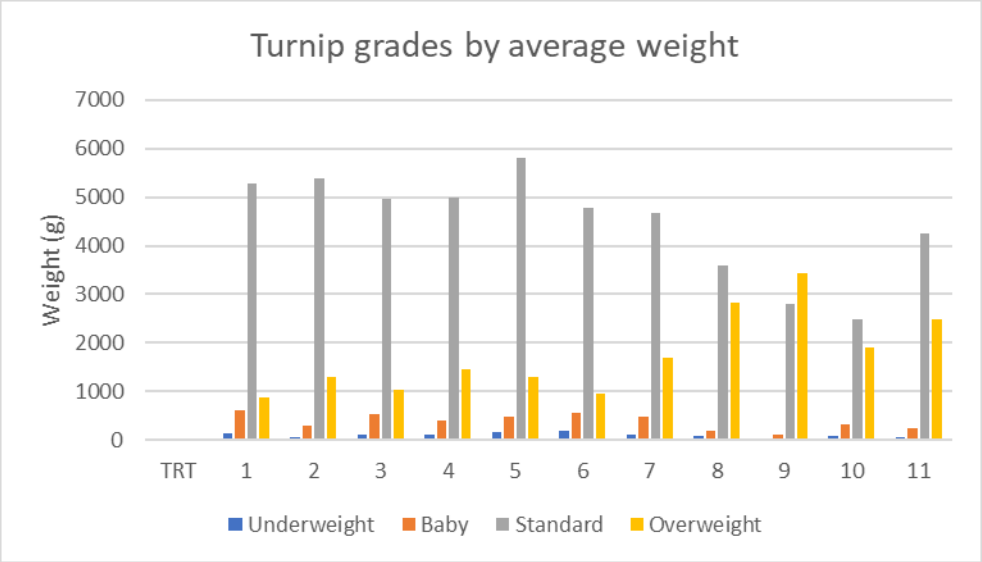

Figure 2 Turnip grading by weight

Table 7: Average turnip root weight per plot (g)

Treatment no.	Average weight / plot (g)
1	6926.3
2	7052.6
3	6644.6
4	6975.8
5	7739.2
6	6474.6
7	6956.8
8	6673.3
9	6370.2
10	4812.6
11	7050.5
12*	2141.3
FPr	*0.157*
Sed	*811.8*
Lsd	*1658.0*
Df	*30*
cv%	*17.1*

**Note: treatment 12 is not comparable to the other treatments as the sample taken was smaller and it was not included in the statistical analysis.*

Root number

There was a large variation in root size throughout. No root deformations were observed in any treatment. Treatment 5 had the highest average root number per plot (65.5) and T9 the lowest (25.75) (Table 8). Treatments 8, 9, 10 and 11 were significantly different to the untreated control (T1), with significantly less roots per plot (Table 8).

Table 8 Average number of roots per treatment

Treatment No.	Mean number of roots/plot
1	63.50
2	51.00
3	58.25
4	57.75
5	65.50
6	60.75
7	57.00
8	**39.00**
9	**25.75**
10	**37.25**
11	**43.75**
12*	*28.00*
FPr	*<0.001*
Sed	*7.47*
Lsd	*15.25*
Df	*30*
cv%	*20.8*

**Note: treatment 12 is not comparable to the other treatments as the sample taken was smaller and it has not been included in the statistical analysis.*

Root sizes

All treatments had most roots in the standard size category. In treatments T8, T9, T10 and T11 a higher percentage of roots were in the oversized category. Treatment 10 had the highest number of roots in the undersize category (Figure 3 and in each category

Table 9).

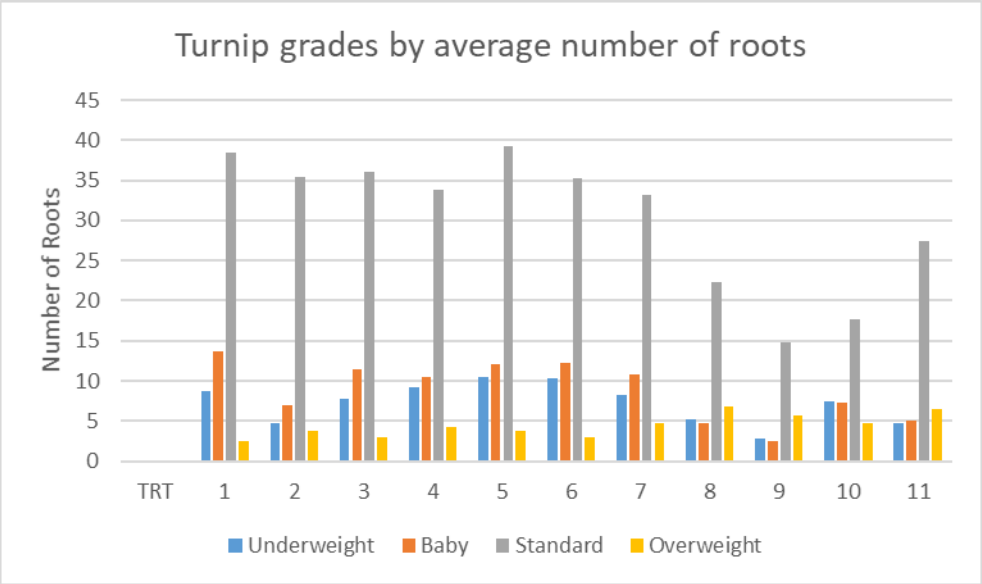

Figure 3 Turnip grading by average number of roots in each category

Table 9: Percentage of turnips in each size category

Trt no.	no. in undersize (%)	no. in baby (%)	no. in standard (%)	no. in processing (%)
1	13.8	21.7	60.6	3.9
2	9.3	13.7	69.6	7.4
3	13.3	19.7	61.8	5.2
4	16.0	18.2	58.4	7.4
5	16.0	18.3	59.9	5.7
6	16.9	20.2	58.0	4.9
7	14.5	18.9	58.3	8.3
8	13.5	12.2	57.1	17.3
9	10.7	9.7	57.3	22.3
10	20.1	19.5	47.7	12.8
11	10.9	11.4	62.9	14.9
12*	7.1	39.3	53.6	0.0

**Note: treatment 12 is not comparable to the other treatments as the sample taken was smaller*

The crop treated with AHDB9782 (T12, demonstration strip) had the most consistently sized roots, (baby to standard) in grade, having no oversized roots and the least and the lowest percentage of undersized roots. Note that this treatment was not included in the trial randomisation so harvest data are not directly comparable.

Figure 5 Example of an oversized turnip at harvest

Figure 4 Oversized turnip harvested from plot 211, with ruler for scale

Discussion

The weather conditions at the time of application and throughout most of the trial period were very hot and dry. The field was irrigated; therefore, water was not limited. However, the hot weather conditions may have influenced herbicide efficacy. There was also a low weed burden, with only two dominant weed species, small nettle (*Urtica urens*) and fat hen (*Chenopodium album*). The low weed numbers may have been a factor of the hot dry weather.

The level of weed control varied by treatment but was generally good, except for T10 (AHDB9999) which did not show a high level of weed control of the broad-leaved weed species in this trial. There was a 50% reduction or more in weed cover compared to the untreated control from the industry standard treatment T2 (metazachlor) and from all test treatments T3 (AHDB9987), T4 (AHDB9987 + AHDB97075), T5 (AHDB9875), T7 (AHDB9779 + AHDB9707), T8 (AHDB9779 + AHDB9706), T9 (AHDB9779 + AHDB9898), T10 (AHDB9999) and T11 (AHDB9706), when assessed 14 DAA. By 28 DAA, T6 (AHDB9779) and T8 (AHDB9779 + AHDB9706) were the only treatments that significantly reduced % weed cover compared to the untreated control. At the 56 DAA % weed cover assessment, treatments T2, T4, T7, T8, and T11 had significantly improved weed control compared to the untreated control.

There were a few differences in crop cover recorded at the 14 and 28 DAA, with significantly lower % crop cover for T9 (AHDB9779+AHDB9898) and T10 (AHDB9999), compared to the untreated control at 28DAA. This coupled with the oversized roots in these same treatments suggest that plant population may have been reduced by the treatments. However, by 56 DAA there were no significant treatment differences in crop cover for any treatments.

Crop phytotoxicity was recorded at 14DAA, with T4 (AHDB9987 + AHDB97075) and T7 (AHDB9779 + AHDB9707) significantly different from the untreated control. Symptoms included leaf scorching (chlorosis) on the crop leaf tips. No phytotoxicity was recorded on any of the other treatments at 14DAA. No phytotoxicity was observed in any plot at the 28 and 56 DAA assessments.

No root deformations were observed in any treatment. Treatments 8 (AHDB9779 + AHDB9706), T9 (AHDB9779 + AHDB9898), T10 (AHDB9999) and T11 (AHDB9706) had significantly less roots per plot compared to the untreated control (T1). Treatment 5 (AHDB9875) had the highest average root number per plot (65.5) and T9 (AHDB9779 + AHDB9898) the lowest number (25.75).

There was a large variation in root size throughout. The AHDB9782 (T12) demonstration plots had the most consistently sized roots of all treatments with no roots in the oversized category and the lowest percentage of roots in the undersized category compared to the other treatments. However, it must be noted that this treatment was not included in the trial randomisation, so harvest data are not directly comparable.

Conclusions

Weed Control

- In general, all treatments, except treatment 10 (AHDB9999), gave improved control of weeds (dominated by fat hen and small nettle) compared to the untreated.
- In treatments 2 (metazachlor) (industry standard), T4 (AHDB9987 + AHDB97075), T7 (AHDB9779 + AHDB9707), T8 (AHDB9779 + AHDB9706), and T11 (AHDB9706) the weed control was significantly better than the untreated control at 56DAA.
- Treatment 8 (AHDB9779 + AHDB9706) resulted in the lowest weed cover at 56DAA, closely followed by the industry standard T2 (metazachlor) and T11 (AHDB9706).

Phytotoxicity

- Treatments T4 (AHDB9987 + AHDB97075) and T7 (AHDB9779 + AHDB9707) had phytotoxicity symptoms (of scorching and chlorosis) at 14DAA but no symptoms were present by 28DAA.
- No phytotoxicity effects were observed for any other treatments.

Root observations

- Treatments 8 (AHDB9779 + AHDB9706), T9 (AHDB9779 + AHDB9898), T10 (AHDB9999) and T11 (AHDB9706) had significantly less roots per plot compared to the untreated control (T1).
- The AHDB9782 (T12) demonstration plots had the highest percentage of roots in the baby and standard size categories, with no roots in the oversized category and the lowest percentage of roots in the undersized category. However, this treatment was not included in the trial randomisation and the sample was smaller so harvest data is not directly comparable to the other treatments.
- Straight metazachlor (T2) and AHDB9987 (T3) had the next highest percentage of roots in the 'baby and standard' category when compared to the other herbicide treatments.

Acknowledgements

Thanks to Deben Agronomy for assisting with trial inputs including site location, marking out and spraying and incorporating the demonstration buffer strip. Many thanks to the host farmer and the ADAS Boxworth field team for trial inputs.

Appendices

a. Trial diary

Date	Notes
21/06/2022	Met Angela Huckle at the site and marked out the plots. Took a soil sample for background analysis and GPS points of trial edges. Applied treatment sprays. Field was subsequently irrigated in the afternoon to aid emergence.
06/07/2022	First assessment timing. Weed counts in the untreated plots, % cover of weeds and of crop recorded in every plot. Phytotoxicity assessment - leaf scorching observed on trts 4 & 7. Dominant weed species *Urtica urens* and *Chenopodium sp*.
18/07/2022	Visited trial. Unable to accurately record quadrat counts due to the netting and density of crop. Recorded visual percentage covers of weeds and crop to best of abilities. Dominant weed species still Urtica *urens* and *Chenopodium sp*., some *Senecio vulgaris* emerging.
15/08/2022	Netting unrolled and weed counts assessed in untreated. Crop and weed cover scores recorded in every plot. Root samples harvested.
17/08/2022	Root samples weighed and checked for phytotoxicity and size. No obvious phytotoxicity seen but size differences between plots. Observation of benfluralin line (incorporated trt) roots being noticeably smaller than others. Trt 10 much lower number of roots but larger in size. Fresh weights of each plot recorded.
07/09/2022	Root samples from each plot graded for size. Note that the amount collected from the benfluralin line was not the same as all the regular plots (0.75m² x2), so comparison on yield cannot be made. Prelim data sort for treatment averages.

b. **Trial area at 14 DAA**

b. Raw data

c.1 - Untreated weed counts at 14DAA assessment

	14 DAA		
Plot	Quadrat	Weed count	Weeds/m2
110	1	5	50
110	2	5	50
110	3	1	10
110	4	6	60
110	5	1	10
110	6	4	40
110	7	2	20
110	8	2	20
110	9	0	0
110	10	4	40
208	1	20	200
208	2	21	210
208	3	10	100
208	4	14	140
208	5	12	120
208	6	13	130
208	7	9	90
208	8	10	100
208	9	8	80
208	10	10	100
304	1	2	20
304	2	3	30
304	3	2	20
304	4	0	0
304	5	2	20
304	6	6	60
304	7	4	40
304	8	1	10
304	9	4	40
304	10	4	40
411	1	8	80
411	2	11	110
411	3	7	70
411	4	6	60
411	5	7	70
411	6	14	140
411	7	10	100
411	8	7	70
411	9	7	70
411	10	7	70

c.2 – Untreated weed counts 56 DAA assessment

	56 DAA		
Plot	Quadrat	Weed count	Weeds/m2
110	1	3	30
110	2	3	30
110	3	2	20
110	4	2	20
110	5	1	10
110	6	3	30
110	7	2	20
110	8	1	10
110	9	4	40
110	10	1	10
208	1	5	50
208	2	4	40
208	3	4	40
208	4	5	50
208	5	4	40
208	6	8	80
208	7	6	60
208	8	3	30
208	9	2	20
208	10	5	50
304	1	1	10
304	2	1	10
304	3	3	30
304	4	3	30
304	5	4	40
304	6	2	20
304	7	3	30
304	8	0	0
304	9	1	10
304	10	1	10
411	1	3	30
411	2	4	40
411	3	6	60
411	4	3	30
411	5	7	70
411	6	3	30
411	7	4	40
411	8	2	20
411	9	5	50
411	10	1	10

d. Trial design

	DISCARD												
Trt.	DISCARD	AHDB 9782	11	DISCARD	4	DISCARD	WHEELING	4	DISCARD	9	DISCARD	DISCARD	NOT BEDFORMED
Plot			106		206			306		406			
Trt.			10	6	7	9		7	3	6	1		
Plot			105	111	205	211		305	311	405	411		
Trt.			2	1	2	5		1	9	10	5		
Plot			104	110	204	210		304	310	404	410		
Trt.			3	7	6	11		5	10	8	3		
Plot			103	109	203	209		303	309	403	409		
Trt.			5	4	10	1		6	2	7	4		
PLOT			102	108	202	208		302	308	402	408		
6.0m			9	8	3	8		11	8	11	2		
			101	107	201	207		301	307	401	407		
	DISCARD												

36m

12 beds

Full trial plan and location of trial within field, showing plot 101

e. ORETO certificate

Certificate of

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

This certifies that

RSK ADAS Ltd

complies with the minimum standards laid down in Regulation (EC) 1107/2009 for efficacy testing.

The above Facility/Organisation has been officially recognised as being competent to carry out efficacy trials/tests in the United Kingdom in the following categories:

Agriculture/Horticulture
Stored Crops
Biologicals and Semiochemicals

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

Signature Alison Richardson
Authorised signatory

Certification Number
ORETO 409

HSE
Chemicals Regulation Division

Department of Agriculture and Rural Development