SCEPTREPLUS

Final Trial Report

Trial code:	SP 10. 2018 (Yr 2)
Title:	**Weed control in celery**
Crop	Group: Field vegetables – Celery (*Apium graveloens*- apiaceae), - inc celeriac and celery root
Target	General broadleaf weeds and grasses, 3WEEDT EPPO1/089(3) Weeds in leafy and brassica vegetables
Lead researcher:	Angela Huckle
Organisation:	RSK ADAS, Boxworth
Period:	April 2019 - December 2019
Report date:	31st December 2019
Report author:	David Norman, Fresh Produce Consultancy Ltd,
ORETO Number: (certificate should be attached)	409

I the undersigned, hereby declare that the work was performed according to the procedures herein described and that this report is an accurate and faithful record of the results obtained

31st December 2019
Date

Authors signature

Trial Summary

Introduction

Since the revocation of approval for prometryne some years ago, linuron was the mainstay for celery post-emergence contact weed control. The loss of metamitron in 2017, and the revocation of approval for linuron in June 2018, has made weed control in celery very challenging. Inter-row hoes are used but if the cultivation is at the wrong growth stage they can reduce yield due to root damage. Therefore effective herbicides are still required.

The bulk of the UK celery crop is grown on peaty soils. Because of the high organic matter content, normally in the range 20-60% OM of these soils, the overall activity of residual herbicides is generally reduced and their length of persistence in the soil is shorter.

This trial therefore concentrated on the comparison of a number of novel residual and contact herbicides with the potential to replace the loss of approval for the main celery herbicide linuron, with assessments for (crop safety) and efficacy in outdoor celery.

The aim of this one year trial was to look at new pre and post-planting herbicide options for broadleaf weed control for transplanted celery, assessing both the level of weed control and crop damage, and their potential to be used to partly or fully replace linuron.

Methods

A randomised, replicated trial (three replicates) was carried out at a commercial celery grower site at Pioneer and Severals Farm, Methwold Hythe, Norfolk, (G's Norfolk Farms) on a peaty soil type, using transplanted celery cv. Victoria.

Pre-planting treatments were applied on the day of planting just in front of the planter on 2nd July, post-planting treatments were applied 14 days after planting on 16th July. There were eight pre-planting treatments including an untreated control and a standard of Stomp Aqua (pendimethalin) 2.5 L/ha plus Gamit (clomazone) 1.0 L/ha (note this is higher than the approved rate of 0.25 L/ha), with 17 post-planting treatments including two untreated controls and a standard of Stomp Aqua (pendimethalin) 2.5 L/ha plus Defy (prosulfocarb) 5.0 L/ha.

Results

Table 1. Crop damage scores for the post-planting trial (phytotoxicity score) at one, three, four and five weeks after application. Higher score = more crop damage

	Mean Crop Damage 0-10			
Date	**24 July**	**07 Aug**	**14 Aug**	**21 Aug**
Treatment				
1,2 Untreated	0	0	0	0
3 Emerger 0.5 L/ha	7.3	5.7	0	0
4 Emerger 0.75 L/ha	8.2	2.7	0	0
5 AHDB 9918 0.125 L/ha	6.1	0	0	0
6 AHDB 9918 0.25 L/ha	0	0	0	0
7 AHDB 9996 0.125 L/ha	0	0	0	0
8 AHDB 9996 0.25 L/ha	0	0	0	0
9 AHDB 9864 2.0 L/ha	1.9	0	0	0
10 AHDB 9864 4.0 L/ha	0	0	0	0
11 AHDB 9860 0.75 L/ha	0	0	0	0
12 AHDB 9860 1.0 L/ha	0	0	0	0
13 AHDB 9853 1.0 L/ha	0	0	0	0
14 AHDB 9853 2.0 L/ha	0	0	0	0
15 AHDB 9997 0.125 L/ha	9.9	6.5	0	0
16 AHDB 9997 0.25 L/ha	10.5	8.2	0	0
17 Pendimethalin 2.5 L/ha + Prosulfocarb 5.0 L/ha	0	0	0	0
P value	0.05	0.05	NS	NS
d.f	33	33	33	33

	Mean Crop Damage 0-10			
Date	**24 July**	**07 Aug**	**14 Aug**	**21 Aug**
Treatment				
Lsd	2.563	1.957	n/a	n/a
	Not significantly different from untreated control (p>0.05)			
	Significantly different from untreated control (p<0.05)			

Table 2. Weed control scores for post-planting treatments at one, three, four and five weeks after application. Shown as % weed ground cover, higher score, more weeds - over 50% unacceptable.

	% weed cover			
Date	**24 Jul**	**7 Aug**	**14 Aug**	**21 Aug**
Treatment				
1,2 Untreated	34.16	46.54	52.35	62.10
3 Emerger 0.5 L/ha	21.34	36.24	41.15	48.90
4 Emerger 0.75 L/ha	21.34	32.14	38.19	46.10
5 AHDB 9918 0.125 L/ha	27.22	37.14	45.00	53.40
6 AHDB 9918 0.25 L/ha	28.67	33.21	38.19	44.00
7 AHDB 9996 0.125 L/ha	35.22	41.15	54.78	71.80
8 AHDB 9996 0.25 L/ha	32.14	39.15	50.00	60.10
9 AHDB 9864 2.0 L/ha	32.14	34.18	47.01	49.20
10 AHDB 9864 4.0 L/ha	29.93	32.14	37.99	38.90
11 AHDB 9860 0.75 L/ha	29.53	31.00	44.10	66.10
12 AHDB 9860 1.0 L/ha	28.86	35.22	40.20	48.90
13 AHDB 9853 1.0 L/ha	30.00	41.15	45.97	55.90
14 AHDB 9853 2.0 L/ha	32.14	39.15	50.77	62.30
15 AHDB 9997 0.125 L/ha	19.89	32.14	42.12	38.00
16 AHDB 9997 0.25 L/ha	25.19	29.93	37.14	41.10
17 Pendimethalin 2.5 L/ha + Prosulfocarb 5.0 L/ha	21.34	33.08	35.22	35.20
P value	0.05	0.05	0.05	0.05
d.f	33	33	33	33
Lsd	6.428	7.392	9.961	19.01
	Not significantly different from untreated control (p>0.05)			
	Significantly lower than untreated control (p<0.05)			

Table 3. Weed control scores for pre-planting treatments at two, three, four and five weeks after application. Shown as % weed ground cover, higher score, more weeds - over 50% unacceptable.

	% weed cover			
Date	**17 Jul**	**24 Jul**	**7 Aug**	**14 Aug**
Treatment				
1 Untreated	21.2	39.1	70.7	100
2 AHDB 9997 0.125 L/ha	18.4	35.0	62.8	100
3 AHDB 997 0.25 L/ha	19.9	43.1	66.1	100
4 AHDB 9996 0.125 L/ha	18.1	38.1	76.9	100
5 AHDB 9996 0.25 L/ha	18.1	43.1	68.9	100
6 AHDB 9918 0.125 L/ha	19.9	36.1	71.1	100
7 AHDB 9918 0.25 L/ha	19.9	43.0	80.0	100
8 Pendimethalin 2.5 L/ha + Clomazone 1.0 L/ha*	16.6	39.2	61.2	100
P value	NS	NS	NS	n/a
d.f	14	14	14	n/a
Lsd	6.246	9.82	20.53	n/a
	Not significantly different from untreated control (p>0.05)			
	Significantly lower than untreated control (p<0.05)			

* Clomazone was applied at higher than the approved rate in error

Conclusions

- None of the pre-planting herbicides were effective on this peaty soil type.

- All of the post-planting herbicides with the exception of the lower rates of AHDB 9996 and AHDB9853 gave a significant level of weed control, reducing weed levels by between 31 to 53% compared to the untreated control at three weeks after application.

- The most effective weed control was the commercial standard of Stomp Aqua plus Defy (pendimethalin plus prosulfocarb).

- Emerger, AHDB9997 and AHDB 9864 performed well with regards to weed control with AHDB9864 at 4.0l/ha and AHDB997 at 0.125l/ha giving around a 50% weed reduction at the end of assessments.

- Both rates of Emerger and AHDB9997 gave some crop damage, showing as leaf spotting on the treated leaf at the initial assessments, although this had grown out after around 3 weeks.

Take home message:

None of the treatments on their own would give sufficient weed control to be commercially acceptable, however a combination of Stomp Aqua (pendimethalin) plus Defy (prosulfocarb) followed by AHDB9864 would likely be the best treatment and improve weed control for celery.

Emerger or AHDB9997 used sequentially following treatment by the commercial standard would also give a significant improvement to the current commercial practice.

Approvals should be sought for Emerger at a 60 day PHI and AHDB9864, AHDB9997 with a 60 day or shorter harvest interval.

Objectives

To compare a number of novel residual and contact herbicides with the potential to replace the loss of approval for the main celery herbicide linuron, with assessments for (crop safety) and efficacy in outdoor celery. This one year trial was to look at new pre and post-planting options for broadleaf weed control for transplanted celery.

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**
PP 1/152(3)	Design and analysis of efficacy evaluation trials	None
PP 1/135(3)	Phytotoxicity assessment	None
PP 1/181(3)	Conduct and reporting of efficacy evaluation trials including GEP	None

There was one deviation from EPPO guidance:

PP1/89(3) Section 1.4, Design and lay-out of trial:

"Replicates: at least 4"

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

Test site

Item	**Details**
Location address	Pioneer and Severals Farm, Broad Drove, Methwold Hythe, Norfolk, PE38 9SA
Crop	Self-blanching Celery
Cultivar	Victoria
Soil or substrate type	Peaty, 60% OM.
Agronomic practice	Commercial celery crop, planted 2nd July 2019, 100,000 plants/ha, 3.8cm peat blocks, irrigated day of planting and 7 days later. No pre or post-planting herbicides applied to trial area.
Prior history of site	Previous crop wheat, farm has a rotation of , wheat, sugar beet, onions, potatoes and lettuce.

Trial design

Item	**Details**
Trial design:	Fully randomised block design.
Number of replicates:	3
Row spacing:	20cm x 30cm
Plot size: (w x l)	2.0m X 6.0M
Plot size: (m^2)	12(m^2)
Number of plants per plot:	150
Leaf Wall Area calculations	n/a

Treatment details

AHDB Code	Active substance	Product name/ manufacturers code	Formulation batch number	Content of active substance in product	Formulation type
AHDB 9997	N/D	N/D	N/D	N/D	N/D
AHDB 9996	N/D	N/D	N/D	N/D	N/D
AHDB 9918	N/D	N/D	N/D	N/D	N/D
Stomp Aqua	pendimethalin	Stomp Aqua	16724770	455g/l	CS
Gamit 36SC	clomazone	Gamit 36SC	173113	360g/l	CS
AHDB 9864	N/D	N/D	N/D	N/D	N/D
AHDB 9860	N/D	N/D	N/D	N/D	N/D
AHDB 9853	N/D	N/D	N/D	N/D	N/D
N/A	prosulfocarb	Defy	BSN7H3020	800g/l	EC
N/A	aclonifen	Emerger	EV56006446	600g/l	SC

Application schedule post-plant

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	Untreated	0	0	B
2	Untreated	0	0	B
3	Emerger	300	0.5	B
4	Emerger	450	0.75	B
5	AHDB 9918	62.5	0.125	B
6	AHDB 9918	125	0.25	B
7	AHDB 9996	62.5	0.125	B
8	AHDB 9996	125	0.25	B
9	AHDB 9864	800	2.0	B
10	AHDB 9864	1600	4.0	B
11	AHDB 9860	375	0.75	B
12	AHDB 9860	500	1.0	B
13	AHDB 9853	157	1.0	B
14	AHDB 9853	314	2.0	B
15	AHDB 9997	62.5	0.125	B
16	AHDB 9997	125	0.25	B
17	Pendimethalin+ prosulfocarb	1125 4000	2.5 5.0	B

Application schedule pre-plant

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	Untreated	0	0	A
2	AHDB 9997	62.5	0.125	A
3	AHDB 9997	125	0.250	A
4	AHDB 9996	62.5	0.125	A
5	AHDB 9996	125	0.250	A
6	AHDB 9918	62.5	0.125	A
7	AHDB 9918	125	0.250	A
8	Pendimethalin clomazone	1137.5 360	2.5 1.0	A

Application details

	Application A	Application B
Application date	02/07/2019	16/07/2019
Time of day	15:00 – 15:40	12.10 – 13:30
Crop growth stage (Max, min average BBCH)	Pre-plant	BBCH 15-16
Crop height (cm)	0	10cm
Crop coverage (%)	0	15%
Application Method	Spray	Spray
Application Placement	Soil	Foliar
Application equipment	OPS	OPS
Nozzle pressure	2.0 bar	2.0 bar
Nozzle type	Flat fan	Flat Fan
Nozzle size	F02/110	F02/110
Application water volume/ha	400	400
Temperature of air - shade (°C)	19.5	27.5
Relative humidity (%)	54.5	41.85
Wind speed range (mph)	4.2	2.2
Dew presence (Y/N)	N	N
Temperature of soil - 2-5 cm (°C)	Not available	Not available
Wetness of soil - 2-5 cm	moist	moist
Cloud cover (%)	90%	65%

Untreated levels of pests/pathogens 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
Broadleaf weeds and grasses	*N/A*	3WEEDT	0 % ground cover	10% ground cover	100% ground cover

Assessment details

	Evaluation Timing (DA)*			

Evaluation date	After conventional herbicides	After Bio-herbicides	Crop Growth Stage (BBCH)	Evaluation type (efficacy, phytotox)	Assessment
17/07/2019	A -15	n/a	15-16	Efficacy Phytotox	Phytotox scale 10=dead 0=nil Weeds % ground covers
24/07/2019	A -22 B - 8	n/a	19	Efficacy Phytotox	Phytotox scale 10=dead 0=nil Weeds % ground covers
07/08/2019	A - 26 B - 22	n/a	41	Efficacy Phytotox	Phytotox scale 10=dead 0=nil Weeds % ground covers
14/08/2019	A – 33 B - 29	n/a	45	Efficacy Phytotox	Phytotox scale 10=dead 0=nil Weeds % ground covers
21/08/2019	B-36	n/a	49	Efficacy Phytotox	Phytotox scale 10=dead 0=nil Weeds % ground covers

* DA – days after application

At each assessment a score was made to record phytotoxicity and % weed ground cover, notes were made on weed species present and photographs taken of crop damage symptoms. Note: Celery is classified as a root and stem vegetable in the BBCH scale.

Statistical analysis

The post-planting trial was designed as a randomised block design with three replicates including two replicated untreated controls within the 17 treatments. The pre-planting treatments were aligned adjacent to the post-planting treatments, to allow the commercial planter to plant through the treated area once the sprays had been applied, as there were only eight treatments pre-planting treatments a single replicated untreated control was used.

As usual with weed trials the distribution of weeds was fairly uneven so the data for weeds had an angular transformation used. All data were analysed by ANOVA using Genstat 18.2 by Chris Dyer at RSK ADAS. For the % efficacy the data was calculated by Abbotts formula. An angular transformation was carried out and then the back transformed means are presented, from which Abbotts formula was used to calculate the % reduction in weeds.

Results

Phytotoxicity

Phytotoxicity results are presented in Table 4 for the post-planting trial. These were scored on a scale from 0 to 10, with 0 being 'no effect' and 10 being 'dead'. Plots scored 2 or below were deemed to have a commercially acceptable level of damage.

The data for the pre-planting trial is not shown as there was no crop effects and therefore all phytotoxicity scores were zero. The full data set is in the Appendix.

Phytotoxicity was recorded using the following scale:

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

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

Phytotoxicity – Post planting

Table 4. Crop damage scores for the post-planting trial (phytotoxicity score) at one, three, four and five weeks after application. Higher score, more crop damage, angular transformed data presented.

	Mean Crop Damage 0-10			
Date	**24 July**	**07 Aug**	**14 Aug**	**21 Aug**
Treatment				
1,2 Untreated	0	0	0	0
3 Emerger 0.5 L/ha	7.3	5.7	0	0
4 Emerger 0.75 L/ha	8.2	2.7	0	0
5 AHDB 9918 0.125 L/ha	6.1	0	0	0
6 AHDB 9918 0.25 L/ha	0	0	0	0
7 AHDB 9996 0.125 L/ha	0	0	0	0
8 AHDB 9996 0.25 L/ha	0	0	0	0
9 AHDB 9864 2.0 L/ha	1.9	0	0	0
10 AHDB 9864 4.0 L/ha	0	0	0	0
11 AHDB 9860 0.75 L/ha	0	0	0	0
12 AHDB 9860 1.0 L/ha	0	0	0	0
13 AHDB 9853 1.0 L/ha	0	0	0	0
14 AHDB 9853 2.0 L/ha	0	0	0	0
15 AHDB 9997 0.125 L/ha	9.9	6.5	0	0
16 AHDB 9997 0.25 L/ha	10.5	8.2	0	0
17 Pendimethalin 2.5 L/ha + Prosulfocarb 5.0 L/ha	0	0	0	0
P value	0.05	0.05	n/a	n/a
d.f	33	33	n/a	n/a
Lsd	2.563	1.957	n/a	n/a
	Not significantly different from untreated control (p>0.05)			
	Significantly different from untreated control (p<0.05)			

Weed control – Post planting

Table 5. Weed control scores for post-planting treatments at one, three, four and five weeks after application. Shown as % weed ground cover, higher score, more weeds - over 50% unacceptable. Angular transformed data presented.

	% weed cover			
Date	**24 Jul**	**7 Aug**	**14 Aug**	**21 Aug**
Treatment				
1,2 Untreated	34.16	46.54	52.35	62.10
3 Emerger 0.5 L/ha	21.34	36.24	41.15	48.90
4 Emerger 0.75 L/ha	21.34	32.14	38.19	46.10
5 AHDB 9918 0.125 L/ha	27.22	37.14	45.00	53.40
6 AHDB 9918 0.25 L/ha	28.67	33.21	38.19	44.00
7 AHDB 9996 0.125 L/ha	35.22	41.15	54.78	71.80
8 AHDB 9996 0.25 L/ha	32.14	39.15	50.00	60.10
9 AHDB 9864 2.0 L/ha	32.14	34.18	47.01	49.20
10 AHDB 9864 4.0 L/ha	29.93	32.14	37.99	38.90
11 AHDB 9860 0.75 L/ha	29.53	31.00	44.10	66.10
12 AHDB 9860 1.0 L/ha	28.86	35.22	40.20	48.90
13 AHDB 9853 1.0 L/ha	30.00	41.15	45.97	55.90
14 AHDB 9853 2.0 L/ha	32.14	39.15	50.77	62.30
15 AHDB 9997 0.125 L/ha	19.89	32.14	42.12	38.00
16 AHDB 9997 0.25 L/ha	25.19	29.93	37.14	41.10
17 Pendimethalin 2.5 L/ha + Prosulfocarb 5.0 L/ha	21.34	33.08	35.22	35.20
P value	0.05	0.05	0.05	0.05
d.f	33	33	33	33
Lsd	6.428	7.392	9.961	19.01
	Not significantly different from untreated control (p>0.05)			

	% weed cover			
Date	**24 Jul**	**7 Aug**	**14 Aug**	**21 Aug**
Treatment				
	Significantly lower than untreated control (p<0.05)			

Weed control – Pre planting

Table 6. Weed control scores for pre-planting treatments at two, three, four and five weeks after application. Shown as % weed ground cover, higher score, more weeds - over 50% unacceptable.

	% weed cover			
Date	**17 Jul**	**24 Jul**	**7 Aug**	**14 Aug**
Treatment				
1 Untreated	21.14	39.1	70.7	100
2 AHDB 9997 0.125	18.43	35.0	62.8	100
3 AHDB 9997 0.25	19.89	43.1	66.1	100
4 AHDB 9996 0.125	18.05	38.1	76.9	100
5 AHDB 9996 0.25	18.05	43.1	68.9	100
6 AHDB 9918 0.125	19.89	36.1	71.1	100
7 AHDB 9918 0.25	19.89	43.0	80.0	100
8 Pendimethalin 2.5 + Clomazone 1.0	16.60	39.2	61.2	100
P value	NS	NS	NS	n/a
d.f	14	14	14	n/a
Lsd	6.246	9.82	20.53	n/a
	Not significantly different from untreated control (p>0.05)			
	Significantly lower than untreated control (p<0.05)			

Weed control as % reduction by Abbotts formula – Post planting

Table 7. Mean % weed reduction for the post-planting trial at one, three, four and five weeks after application using back transformed means data for % Abbotts reduction**.**

	% weed reduction from untreated abbotts %			
Date	**24 Jul**	**7 Aug**	**14 Aug**	**21 Aug**
Treatment				
1,2 Untreated				
3 Emerger 0.5	58.02	33.68	30.91	27.23
4 Emerger 0.75	58.02	46.28	39.02	33.43
5 AHDB 9918 0.125	33.67	30.81	20.24	17.56
6 AHDB 9918 0.25	27.05	43.05	39.02	38.13
7 AHDB 9996 0.125	-5.45	17.79	-6.46	15.49
8 AHDB 9996 0.25	10.27	24.34	6.4	3.84
9 AHDB 9864 2.0	10.27	40.09	14.66	26.59
10 AHDB 9864 4.0	21.08	46.28	39.56	49.46
11 AHDB 9860 0.75	22.99	49.66	22.76	-7.08
12 AHDB 9860 1.0	26.16	36.86	33.55	27.23
13 AHDB 9853 1.0	20.74	17.79	17.55	12.32
14 AHDB 9853 2.0	10.27	24.34	4.29	-0.35
15 AHDB 9997 0.125	63.32	46.28	28.25	51.49
16 AHDB 9997 0.25	42.55	52.75	41.86	44.74
17 Pendimethalin 2.5+ Prosulfocarb 5.0	58.02	43.45	46.95	57.42
P value	0.05	0.05	0.05	0.05
d.f	37	37	37	37
Lsd	7.768	6.012	10.842	16.15
	Not significantly different from untreated control (p>0.05)			

	% weed reduction from untreated abbotts %			
Date	**24 Jul**	**7 Aug**	**14 Aug**	**21 Aug**
Treatment				
	Significantly different from untreated control (p<0.05)			

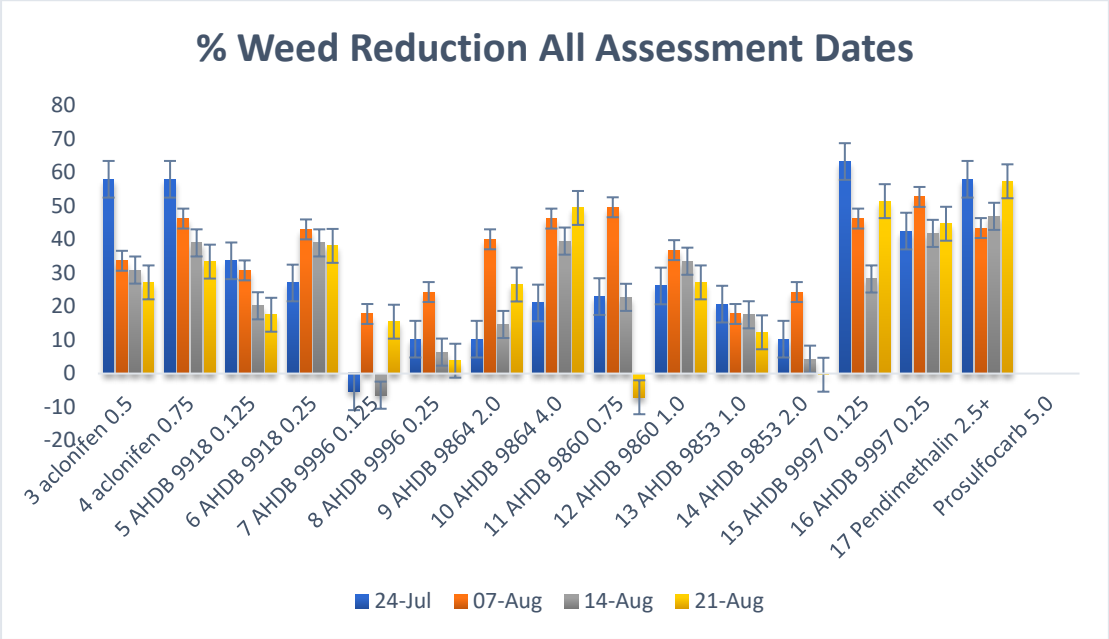


Figure 1. Percentage weed reduction using Abbotts formula, all assessment dates.

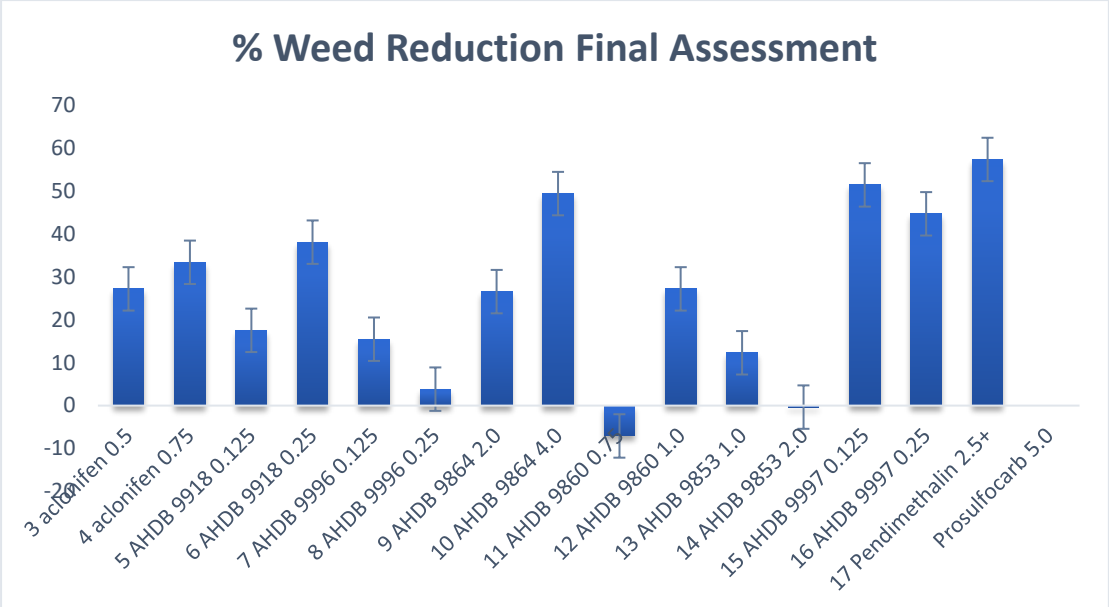


Figure 2, Percentage weed reduction using abbotts formula, final assessment date, 21st August. lsd 19.01@p=0.05%.

Discussion

Weed levels were very high at this site and provided some good test conditions for the trial herbicides. The main weeds were common amaranth (*Amaranthus retroflexus*), redshank (*Persicaria maculosa*), small nettle *(Urtica urens*), common chickweed *(Stellaria media*) and groundsel (*Senecio vulgaris*).

None of the pre-planting herbicides gave any significant reduction in weed % ground cover. Also, none of the pre-planting herbicides gave any crop damage (phtyotoxicity symptoms). This emphasizes the need for post-planting contact herbicides for celery growers as some 85% of the UK celery crop is grown on peaty and organic soil types.

Emerger was tested at 0.5 L/ha and 0.75 L/ha as the current emergency EAMU at 0.75 L/ha has a harvest interval of 90 days which is too long. Mid-summer planted celery only takes around 80 days from planting to harvest and the applications need to go on around 14 days after planting, so a maximum of a 60 day harvest interval is needed. It is hoped these lower rates can be secured with a shorter 60 day PHI. Both rates of Emerger (0.5 and 0.75 L/ha) gave a useful level of weed control with around a 30% reduction in weed cover by the end of the assessment period. Both rates caused some crop damage (see photo 4, in appendix) which was expressed as yellow spotting on the treated leaves. However, this did not seem to affect new growth and the new leaves developed normally without the symptoms. The symptoms were not noticeable by three weeks after treatment. It did not control common amaranth or small nettle well.

AHDB9918 gave some small reduction in weeds, however only the higher rate carried any weed suppression through to the final assessment. A small amount of phytoxicity was recorded at the first assessment but this quickly grew out.

AHDB9996 gave no significant or consistent reduction in weeds nor any crop damage, but this active is known for poor performance on peaty soils.

AHDB9864 gave a significant reduction in weeds with the higher rate of 4.0 L/ha especially effective. It was the only treatment to give some reduction in groundsel (*Senecio vulgaris*), and also had a good effect on chickweed and small nettle. It was crop safe at both rates giving no significant crop damage. This active looks very promising for celery, and would improve weed control if an approval is obtained.

AHDB9860 at the higher rate of 1.0 L/ha gave some useful control of weeds including redshank (*Persicaria maculosa*) and chickweed (Stellaria media). Neither rate gave any crop damage.

AHDB9853 gave a relatively poor control of weeds with only the higher rate giving a short-lived suppression. It was crop safe at both rates.

AHDB9997 gave one of the best weed reductions of the test actives, with both rates giving a similar level of weed reduction of around 50% by the end of the assessment period. Both rates gave some crop damage expressed as brown spots on the treated leaves, however the new growth seemed unaffected with the symptoms not noticeable by three weeks after treatment. This active look promising for use in celery.

The commercial standard of Stomp Aqua (pendimethalin) plus Defy (prosulfocarb) gave the best weed control of all treatments by the end of the assessment period, although even this treatment would have required some additional herbicide or hand weeding to be commercially acceptable, it did not control groundsel, which is where the approval for AHDB 9864 would be very useful.

None of the treatments on their own would give sufficient weed control to be commercially acceptable, however a combination of Stomp Aqua (pendimethalin) plus Defy (prosulfocarb) followed by AHDB9864 would likely be the best treatment.

Conclusions

None of the treatments on their own would give sufficient weed control to be commercially acceptable, however a combination of Stomp Aqua (pendimethalin) plus Defy (prosulfocarb) followed by AHDB9864 would likely be the best treatment.

Emerger or AHDB9997 used sequentially following treatment by the commercial standard would also give a significant improvement to the current commercial practice.

Attempts should be made to seek approvals for Emerger at a 60 day PHI and AHDB9864, AHDB9997 with a 60 day or shorter harvest interval.

Acknowledgements

Thanks are given to the hosts, G S Shropshire & Sons, Norfolk Farms for providing the site. To AHDB for providing funding and to technical input from Bolette Palle Neve, David Norman and Angela Huckle. Thanks also to the crop protection manufacturers for supporting the work and providing experimental samples and Syngenta for providing the climatological data.

Appendix

a. Crop diary – events related to growing crop

Crop	Cultivar	Planting Date	Row width
Celery	Victoria	02/07/2019	20cmx30cm

Crop Dairy – pesticide/fertiliser applications

Date	Product	Rate/ha	Type/Use
16/07/2019	Amistar (azoxystrobin) Hallmark zeon (lambda-cyhalothrin) Plenum(pymetrozine) Mn/Mg	1.0 0.075 0.4 3/3	Sclerotinia Caterpillar aphids Trace elements
30/07/2019	Switch (cyprodinil/fludioxynil) Tracer (spinosad) Plenum (pymetrozine) Mn/Mg	1.0 0.2 0.4 4/4	Sclerotinia Caterpillar/thrip aphids Trace elements
14/08/2019	Amistar (azoxystrobin) Hallmark zeon (lambda-cyhalothrin) Plenum(pymetrozine) Mn/Mg	1.0 0.075 0.4 3/3	Sclerotinia Caterpillar aphids Trace elements
30/08/2019	Switch (cyprodinil/fludioxynil) Tracer (spinosad) Mn/Mg	1.0 0.2 4/4	Sclerotinia Caterpillar/thrip Trace elements
07/09/2019	Decis (deltamethrin) Mn/mg	0.3 3/3	Caterpillar Trace elements

b. Trial diary

Date	Event
02-07-2019	Crop planted
02-07-2019	Treatments A applied
16-07-2019	Treatments B applied
24-07-2019	Weeds, phytotox assessment
07-08-2019	Weeds, phytotox assessment
14-08-2019	Weeds, phytotox assessment
21-08-2019	Weeds, phytotox assessment

c. Photographs

Photo 1, Whole trial, day of post-plant applications, 14 days after planting 16/07/2019.

Photo 2. Photo of whole trial at final assessment 21/08/2019

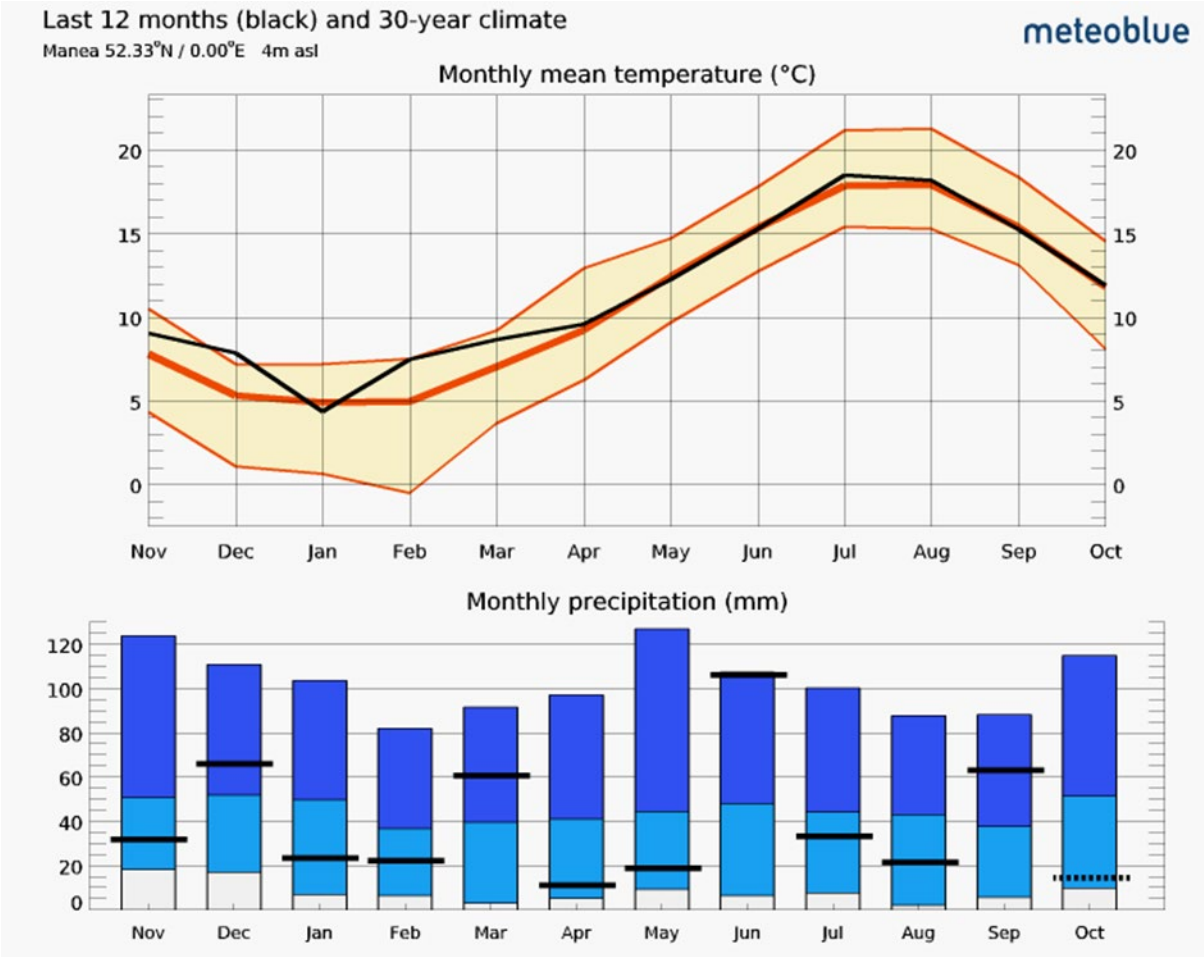
Photo 3, Emerger left 0.5l/ha, untreated control right, 31/07/2019, 15 days after treatment.

Photo 4, Yellow leaf spotting from Emerger 0.5l/ha, 7 DAT.

d. Climatological data during study period

June was a very wet month with some heavy rains during the middle of the month from 10-13th was heavy rainfall giving almost double the long term average for June. July was warmer than average with some very hot days, with rainfall a little below average. August was a little warmer than average with rainfall just below average. After the wet June the soils were still very moist running into early July when the crop was planted. The crop was irrigated after planting as normal and the crop then grew rapidly but normally through July and August.

Climate Data, Manea, Norfolk, actual temperature (black line) compared with 30 year mean and normal range is given by the colored area. Actual rainfall is give by the black line, with the dark blue area being greater than the 30 year average and the light blue line being les than the 30 year average.



e. Raw data from assessments, post-plant

Rep	Treatment	phyto	phyto	phyto	phyto	weed	weed	weed	weed
		24-Jul	07-Aug	14-Aug	21-Aug	24-Jul	07-Aug	14-Aug	21-Aug
1	1	0	0	0	0	25	50	50	75
1	2	0	0	0	0	40	75	75	90
1	3	1	1	0	0	15	40	40	60
1	4	2	0	0	0	10	25	30	25

Rep	Treatment	phyto	phyto	phyto	phyto	weed	weed	weed	weed
1	5	2	0	0	0	30	30	50	80
1	6	0	0	0	0	25	30	40	70
1	7	0	0	0	0	40	50	70	100
1	8	0	0	0	0	30	50	75	80
1	9	1	0	0	0	25	25	40	40
1	10	0	0	0	0	30	30	60	70
1	11	0	0	0	0	40	30	70	100
1	12	0	0	0	0	25	30	40	70
1	13	0	0	0	0	25	40	50	70
1	14	0	0	0	0	30	50	60	75
1	15	3	1	0	0	10	30	50	60
1	16	3	2	1	0	25	25	50	75
1	17	0	0	0	0	10	40	40	30
2	1	0	0	0	0	25	40	60	60
2	2	0	0	0	0	35	50	70	80
2	3	2	1	0	0	10	35	50	70
2	4	2	0	0	0	15	30	40	50
2	5	0	0	0	0	25	50	60	80
2	6	0	0	0	0	15	30	30	30
2	7	0	0	0	0	30	40	60	65
2	8	0	0	0	0	25	40	50	70
2	9	0	0	0	0	30	35	70	80
2	10	0	0	0	0	25	25	30	25
2	11	0	0	0	0	20	20	35	50
2	12	0	0	0	0	20	40	40	50
2	13	0	0	0	0	25	40	60	75
2	14	0	0	0	0	25	30	60	80
2	15	3	2	0	0	10	30	40	25
2	16	3	2	1	0	15	20	30	30
2	17	0	0	0	0	15	25	30	40
3	1	0	0	0	0	30	50	60	80
3	2	0	0	0	0	35	50	60	80
3	3	2	1	0	0	15	30	40	40
3	4	2	2	0	0	15	30	45	80
3	5	3	0	0	0	10	30	40	30
3	6	0	0	0	0	30	30	45	45
3	7	0	0	0	0	30	40	70	90
3	8	0	0	0	0	30	30	50	75
3	9	0	0	0	0	30	35	50	50
3	10	0	0	0	0	20	30	25	25

Rep	Treatment	phyto	phyto	phyto	phyto	weed	weed	weed	weed
3	11	0	0	0	0	15	30	40	80
3	12	0	0	0	0	25	30	45	50
3	13	0	0	0	0	25	50	45	60
3	14	0	0	0	0	30	40	60	80
3	15	3	1	0	0	15	25	45	30
3	16	4	2	1	0	15	30	30	25
3	17	0	0	0	0	15	25	30	30

f. Raw data from assessments pre-plant

Rep	Treatment	phyto	phyto	phyto	phyto	weed	weed	weed	weed
		17-Jul	24-Jul	07-Aug	14-Aug	17-Jul	24-Jul	07-Aug	14-Aug
1	1	0	0	0	0	20	50	100	100
1	2	0	0	0	0	10	50	90	100
1	3	0	0	0	0	15	50	80	100
1	4	0	0	0	0	10	50	100	100
1	5	0	0	0	0	5	40	80	100
1	6	0	0	0	0	15	50	100	100
1	7	0	0	0	0	10	50	100	100
1	8	0	0	0	0	5	40	80	100
2	1	0	0	0	0	10	30	80	100
2	2	0	0	0	0	10	25	70	100
2	3	0	0	0	0	10	50	90	100
2	4	0	0	0	0	15	40	100	100
2	5	0	0	0	0	15	50	90	100
2	6	0	0	0	0	10	25	75	100
2	7	0	0	0	0	15	60	100	100
2	8	0	0	0	0	10	40	70	100
3	1	0	0	0	0	10	40	70	100
3	2	0	0	0	0	10	25	75	100
3	3	0	0	0	0	10	40	80	100
3	4	0	0	0	0	5	25	60	100
3	5	0	0	0	0	10	50	90	100
3	6	0	0	0	0	10	30	80	100
3	7	0	0	0	0	10	30	75	100
3	8	0	0	0	0	10	40	80	100

g.Trial plan pre-plant trial

WRC:	1021141	Unique trial code:	BX19-147	Host farmer/grower:	0
Trial title:	SceptrePlus Celery Herbicide Screen - Early			Contact number:	0
ADAS site:	Boxworth	Trial Site Manager:	Owen Williams		
Field:	no. 4				
Grid ref.:	TL 66111 96021	Plan created by:	ORW		
Year:	2018/2019	Plan version number:			
Plot length (m):	6.00	Plan version date:			
Plot width (m):	2.00	Plan checked by:			
		Plan date checked:			

N

Treat number	Product	Rate
1	-	Untreated
2	Hurricane SC	0.125 L/ha
3	Hurricane SC	0.25 L/ha
4	Flexidor	0.125 L/ha
5	Flexidor	0.25 L/ha
6	Sunfire	0.125 L/ha
7	Sunfire	0.25 L/ha
8*	Stomp Aqua	2.5 L/ha
	Gamit 36 CS	1.0 L/ha

Discard

5m Discard

2m Discard

6m Discard

2m Discard

Treatment	5	8	1
Block	1	2	3
Plot	108	208	308
Treatment	7	1	7
Block	1	2	3
Plot	107	207	307
Treatment	4	6	2
Block	1	2	3
Plot	106	206	306
Treatment	3	2	4
Block	1	2	3
Plot	105	205	305
Treatment	6	4	6
Block	1	2	3
Plot	104	204	304
Treatment	1	7	3
Block	1	2	3
Plot	103	203	303
Treatment	2	5	8
Block	1	2	3
Plot	102	202	302
Treatment	8	3	5
Block	1	2	3
Plot	101	201	301

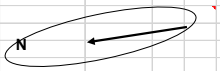
Discard

h.Trial plan post-planting.

1021141	Unique trial code:	BX19-146	
SceptrePlus Celery Herbicide Screen - Late			
Boxworth	Trial Site Manager:	Owen Williams	
no.4			
TL 66111 96021			
2018/2019			
6.00			
2.00			

Plan created by:	ORW
Plan version number:	1
Plan version date:	10/06/2019
Plan checked by:	
Plan date checked:	

Host farmer/grower:	0
Contact number:	0



Discard

5m discard

2m discard

6m plot

2m plot

Treatment			
Block	1	2	3
Plot	117	217	317
Treatment	15	1	12
Block	1	2	3
Plot	116	216	316
Treatment	1	11	3
Block	1	2	3
Plot	115	215	315
Treatment	17	12	13
Block	1	2	3
Plot	114	214	314
Treatment	9	4	16
Block	1	2	3
Plot	113	213	313
Treatment	5	16	1
Block	1	2	3
Plot	112	212	312
Treatment	6	5	15
Block	1	2	3
Plot	111	211	311
Treatment	3	6	17
Block	1	2	3
Plot	110	210	310
Treatment	2	17	6
Block	1	2	3
Plot	109	209	309
Treatment	10	7	9
Block	1	2	3
Plot	108	208	308
Treatment	8	9	7
Block	1	2	3
Plot	107	207	307
Treatment	12	2	14
Block	1	2	3
Plot	106	206	306
Treatment	13	8	10
Block	1	2	3
Plot	105	105	305
Treatment	14	10	8
Block	1	2	3
Plot	104	204	304
Treatment	16	13	11
Block	1	2	3
Plot	103	203	303
Treatment	11	14	4
Block	1	2	3
Plot	102	202	302
Treatment	7	3	2
Block	1	2	3
Plot	101	201	301

Discard

Discard

Treat number	Product	Rate
1	-	Untreated
2	-	Untreated
3	Bandur	0.5 L/ha
4	Bandur	0.75 L/ha
5	Sunfire	0.125 L/ha
6	Sunfire	0.25 L/ha
7	Flexidor	0.125 L/ha
8	Flexidor	0.25 L/ha
9	Asulox	2.0 L/ha
10	Asulox	4.0 L/ha
11	Ethostat 500	0.75 L/ha
12	Ethostat 500	1.0 L/ha
13	Corzal	1.0 L/ha
14	Corzal	2.0 L/ha
15	Hurricane SC	0.125 L/ha
16	Hurricane SC	0.25 L/ha
17*	Stomp Aqua Defy	2.5 L/ha 5.0 L/ha

i. 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