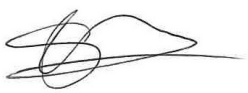
SCEPTREPLUS

Final Trial Report

Trial code:	SP31. 2019
Title:	AHDB SCEPTREplus blackcurrant contact herbicide screen
Crop	Blackcurrant, *Ribes,* Bush fruit
Target	General broadleaf weeds and grasses, 3WEEDT Field bindweed, C*onvolvulus arvensis*, CONAR
Lead researcher:	Dr Sonia Newman
Organisation:	RSK ADAS Ltd, ADAS Boxworth, Cambridgeshire, CB23 4NN
Period:	April 2019 to Dec 2019
Report date:	28/11/2019
Report author:	Dr Sonia Newman
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



28/11/2019
Date

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Trial Summary

Introduction

The limited range of contact herbicides currently available to blackcurrant growers has left gaps in the weed control spectrum. The recent withdrawal of diquat from the market has further reduced options available. Field bindweed is not controlled well by herbicide programmes used in blackcurrants. If uncontrolled it climbs over the bush making it impossible to harvest fruit. The only remedy is to manually pull the bindweed off by hand prior to harvest, a time consuming and expensive task. Some control can be achieved by directed hooded sprays of glyphosate (approved under EAMU) but this is not always sufficiently effective in suppressing the field bindweed prior to harvest.

The objective of this trial was to build on work done in 2018 to identify crop safe and effective contact herbicides for weed control in blackcurrants, aiming to expand the options available to growers with a focus on field bindweed control.

Methods

A trial was sited at a commercial blackcurrant grower in Suffolk. Treatments were applied to the weed foliage after bindweed germination in the blackcurrant row. The blackcurrant crop (Ben Dorain) was planted in 2006. The treatments were applied on 15th May using a single nozzle hooded lance and an Oxford Precision Sprayer knapsack at 200 L/ha water volume with plots 1.5 m wide by 10 m long.

A randomised block design was used with four replicates of seven treatments, including an untreated control and grower standard for comparison, totalling 28 plots. Plots were assessed for weed control on four occasions, recording the percentage of weed ground cover. Crop damage was also assessed; recorded first at two weeks after the first treatment application, and on two subsequent occasions (four and six weeks after treatment).

Results

All of the herbicide treatments caused some phytotoxicity symptoms on leaves that had been hit by the treatment. The Roundup PowerMax + Shark treatment and AHDB9979 both caused phytotoxicity damage that was above the threshold, causing scorch where chemical had hit the blackcurrant leaves. At the four week assessment the damage was less visible in all treatments and by the final assessment, prior to harvest, none of the treatments were showing symptoms (Table 1). The early effects were transient and did not affect the crop at harvest.

Table 1. Phytotoxicity scores for of plots treated with test products for three assessment dates. Scores analysed by ANOVA with Duncan's multiple range test.

Treatment	Mean crop damage scores		
	28-May	11-Jun	28-Jun
Untreated	0.0	0.0	0.0
Roundup PowerMax	1.5	1.0	0.0
AHDB9868	1.3	1.0	0.0
AHDB9866	2.0	1.0	0.0
AHDB9897	1.3	1.0	0.0
AHDB9979	2.8	1.8	0.0
Roundup PowerMax + Shark	3.3	1.8	0.0
F prob. value	<0.001	<0.001	N/S
d.f.	18	18	18
S.E.D.	0.519	0.1942	N/A

L.S.D.	1.091	0.4079	N/A
	Not significantly different from untreated control (p>0.05)		
	Significantly different from untreated control (p<0.05)		

Overall weed control

The initial baseline of weeds was generally quite even across plots, with a baseline average weed cover of 45.9 % per plot. The weed species present were dominated by field bindweed, as well as some perennial weeds such as creeping thistles.

All of the contact herbicide treatments tested reduced the overall weed cover compared to the untreated control (Table 2). Some of the treatments provided significantly better control than others.

All herbicide treatments reduced the weed cover compared to the control, however, the best performing treatments were Roundup PowerMax (grower standard), Roundup PowerMax + Shark, AHDB9866 and AHDB9897.

Table 2. Mean total plot percentage weed cover per treatment for each of the four assessment dates. Means analysed by ANOVA with Duncan's multiple range test, percentage reduction in weeds calculated using Abbotts Formula

Treatment	15-May		29-May		11-Jun		28-Jun	
	Mean %	Abbott's	Mean %	Abbott's	Mean %	Abbott's	Mean %	Abbott's
Untreated	43.75		63.75		81.25		96.25	
Roundup PowerMax	38.75	11.43	42.50	33.33	40.00	50.77	68.75	28.57
AHDB9868	53.75	-22.86	56.25	11.76	65.00	20.00	92.50	3.90
AHDB9866	48.75	-11.43	38.75	39.22	36.25	55.38	61.25	36.36
AHDB9897	40.00	8.57	31.25	50.98	61.25	24.62	92.50	3.90
AHDB9979	50.00	-14.29	53.75	15.69	68.75	15.38	92.50	3.90
Roundup PowerMax + Shark	46.25	-5.71	23.75	62.75	52.50	35.38	87.50	9.09
P value	0.05		<0.001		<0.001		0.002	
d.f.	18		18		18		18	
s.e.d.	4.71		5.64		8.07		8.00	
l.s.d.	9.89		11.85		16.95		16.81	
	Not significantly different from untreated control (p>0.05)							
	Significantly different from untreated control (p<0.05)							
	Positive Abbott's formula percentage reduction							

Bindweed cover

The bindweed cover prior to treatment application was generally even with no significant difference between the treatments (average 22.7% per plot), although the untreated control had the lowest baseline bindweed cover.

The Roundup PowerMax + Shark treatment showed a good initial knockdown of the bindweed in the plots, but the effect was not long lasting and by 4 weeks after treatment the bindweed levels were similar to the untreated control. The only other treatment to show an initial reduction in bindweed was AHDB9897.

AHDB9866 was the best performing treatment on bindweed over the whole trial period and outperformed the grower standard (Roundup PowerMax) at six weeks after treatment. There was a slight increase in bindweed cover at two weeks after treatment in these plots, but this was due to the active ingredient being a synthetic auxin (HRAC Group O), which causes excessive growth to plant death. There was a 69.05 % reduction in the bindweed cover

compared to the control in this treatment at four weeks after application and it was significantly lower than the control at six weeks.

Table 3. Mean total plot percentage bindweed cover per treatment for each of the four assessment dates. Means analysed by ANOVA with Duncan's multiple range test, percentage reduction in bindweed calculated using Abbotts Formula

Treatment	15-May		29-May		11-Jun		28-Jun	
	Mean	Abbott's	Mean	Abbott's	Mean	Abbott's	Mean	Abbott's
Untreated	17.50		33.75		52.50		68.75	
Roundup PowerMax	18.75	-7.14	27.50	18.52	26.25	50.00	56.25	18.18
AHDB9868	25.00	-42.86	38.75	-14.81	48.75	7.14	78.75	-14.55
AHDB9866	20.00	-14.29	22.50	33.33	16.25	69.05	45.00	34.55
AHDB9897	26.25	-50.00	20.00	40.74	45.00	14.29	82.50	-20.00
AHDB9979	25.00	-42.86	28.75	14.81	42.50	19.05	68.75	0.00
Roundup PowerMax + Shark	26.25	-50.00	15.00	55.56	42.50	19.05	77.50	-12.73
P value	0.346		0.293		0.102		0.004	
d.f.	18		18		18		18	
s.e.d.	4.86		9.99		12.68		8.59	
l.s.d.	10.21		20.98		26.63		18.05	
	Not significantly different from untreated control (p>0.05)							
	Significantly different from untreated control (p<0.05)							
	Positive Abbott's formula percentage reduction							

At four weeks after application the greatest reduction in bindweed cover was in plots treated with AHDB9866, where there was a 69.05 % reduction compared to the untreated control (Table 3). All other treatments had an increase in the bindweed cover, but there was still a reduction in cover compared to the control. Where Roundup PowerMax was applied in a tank mix with Shark the efficacy was reduced compared to Roundup PowerMax alone.

By six weeks after application AHDB9866 had significantly lower bindweed cover than the untreated control and gave the best persistence in bindweed suppression. The only other treatment to show an Abbott's percentage reduction in bindweed cover at this point was the grower standard (Roundup PowerMax).

Conclusions

- Roundup PowerMax, Roundup PowerMax + Shark, AHDB9866 and AHDB9897 reduced total weed cover compared to the untreated control up to four weeks after application. AHDB9866 had the lowest weed cover at the end of the six week trial.
- AHDB9866 had the lowest bindweed cover at the end of the trial and was comparable to the grower standard in terms of efficacy.
- Roundup PowerMax + Shark performed worse than Roundup PowerMax alone, indicating that the addition of Shark desiccated the weed leaf before the Roundup PowerMax could be absorbed by the weed.
- Phytotoxic effects were seen in all herbicide treatments, including the grower standard, however the effect was generally minor and the bushes grew through any damage.
- AHDB9866 and AHDB9897 performed well both in efficacy and crop safety during the trial and would be suitable products to boost the limited contact herbicide options available to blackcurrant growers.

Take home message:

AHDB9866 and AHDB9897 gave the best general weed control in the plots during the trial, with AHDB9866 performing best against field bind weed. These products should be considered for EAMU applications based on the efficacy and crop safety during the trial.

Objectives

1. To evaluate the effectiveness of six herbicide treatments, applied to an actively growing crop, for the control of broadleaved weeds (with a focus on bindweed) and grasses in blackcurrants as measured by crop safety and weed control efficacy.
2. To compare the performance of novel treatments against the commercial standard (Roundup PowerMax).
3. To monitor the treated crop for phytotoxicity

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(4)	Guideline on design and analysis of efficacy evaluation trials	None
PP 1/135(4)	Phytotoxicity assessment	None
PP 1/181(3)	Conduct and reporting of efficacy evaluation trials including good experimental practice	None
PP 1/119(3)	Weed control in *Ribes* and *Rubus*	None

There were no deviations from EPPO guidance:

Test site

Item	**Details**
Location address	Hall Farm, Woodbridge, Suffolk IP13 7PW
Crop	Blackcurrants
Cultivar	Ben Dorain
Soil or substrate type	Sandy clay loam
Agronomic practice	See appendix
Prior history of site	Blackcurrants

Trial design

Item	**Details**
Trial design:	Randomised block design
Number of replicates:	4
Row spacing:	1.5 m
Plot size: (w x l)	3 m x 10 m
Plot size: (m^2)	30
Number of plants per plot:	Approx. 33
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**	**Adjuvant**
Untreated	N/A	N/A	N/A	N/A	N/A	N/A
N/A	glyphosate	Roundup PowerMax	AXJ272910O	720 g/L	Water soluble granule	N/A
AHDB9868	N/D	N/D	N/D	N/D	N/D	N/A

AHDB9866	N/D	N/D	N/D	N/D	N/D	N/A
AHDB9897	N/D	N/D	N/D	N/D	N/D	N/A
AHDB9979	N/D	N/D	N/D	N/D	N/D	N/A
N/A	glyphosate + carfentrazone-ethyl	Roundup PowerMax + Shark	AXJ272910O	720 g/L + 60 g/L	Water soluble granule	N/A

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	Untreated	N/A	N/A	N/A
2	Roundup PowerMax	1440 g	2.00	A
3	AHDB9868	N/D	1.50	A
4	AHDB9866	N/D	2.80	A
5	AHDB9897	N/D	2.00	A
6	AHDB9979	N/D	0.50	A
7	Roundup PowerMax + Shark	1440 g + 48 g	2.00 + 0.80	A

Application details

	Application A
Application date	15/05/2019
Time of day	12:30
Crop growth stage (Max, min average BBCH)	BBCH 61-65 (F2)
Crop height (cm)	100
Crop coverage (%)	25
Application Method	Spray
Application Placement	In row under crop canopy
Application equipment	Oxford Precision Sprayer (knapsack)
Nozzle pressure	2 bar
Nozzle type	Flat fan
Nozzle size	F02/110
Application water volume/ha	200
Temperature of air - shade (°C)	16.5
Relative humidity (%)	41.0
Wind speed range (m/s)	2.2-2.4
Dew presence (Y/N)	N
Temperature of soil - 2-5 cm (°C)	19
Wetness of soil - 2-5 cm	Moist
Cloud cover (%)	15

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
Broad leaved weeds and grasses	*N/A*	3WEEDT	43.75% *(untreated average)*	43.75% *(untreated average)*	96.25% *(untreated average)*
Field bindweed	*Convolvulus arvensis*	CONAR	17.5% *(untreated average)*	17.5% *(untreated average)*	68.75% *(untreated average)*

Assessment details

The herbicide applications were timed for when emergence of bindweed had occurred in the herbicide strip rows in the blackcurrant crop. An initial weed assessment was carried out in all plots, with the total weed cover, bindweed cover and weed species present in each plot being recorded before the herbicide treatments were applied. At each subsequent assessment date these criteria were recorded as well as a phytotoxicity score from 0 to 10, with 0 being 'no damage' and 10 being 'dead' (Table 1). Plots scoring 2 or below were deemed to have commercially acceptable level of damage.

	Evaluation Timing (DA)*				
Evaluation date	**After conventional herbicides**	**After Bio-herbicides**	**Crop Growth Stage (BBCH)**	**Evaluation type (efficacy, phytotox)**	**Assessment**
15/05/2019	0	N/A	65	efficacy	Percentage of weed and bindweed cover (whole plot score)
29/05/2019	14	N/A	75	efficacy, phytotox	Percentage of weed and bindweed cover (whole plot score) Phytotox (scale 0-10, 10 = dead)
11/06/2019	27	N/A	81	efficacy, phytotox	Percentage of weed and bindweed cover (whole plot score) Phytotox (scale 0-10, 10 = dead)
28/06/2019	44	N/A	87	efficacy, phytotox	Percentage of weed and bindweed cover (whole plot score) Phytotox (scale 0-10, 10 = dead)

* DA – days after application

Table 4. Scale used for the assessment of the extent of phytotoxic damage in treated plots

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 grower.

Statistical analysis

The trial design was a randomised block design, with four replicates of seven treatments, including one untreated control and one grower standard.

All data were analysed by ANOVA using Genstat 18.4 by Chris Dyer - Statistician at RSK ADAS. *Post hoc* analyses were performed on the data using Duncan's multiple range test. Transformations were not deemed necessary by the statistician, as the weed data was considered suitably uniform. Abbotts Formula was used to calculate the percentage reduction in weeds and is presented alongside the means below.

Results

Phytotoxicity

All of the herbicide treatments, including the grower standard, caused some phytotoxicity symptoms in places that had been directly hit by the treatment (Figure 1). The symptoms at two weeks after application varied between treatments, with some bushes exhibiting scorch, chlorosis or twisting of growing tips. Pictures of typical damage in each treatment can be found in the Appendix (Appendix c).

Figure 1. Mean phytotoxicity scores at 2 and 4 weeks after application of treatments. Values at or below 2 are deemed as commercially acceptable. Bars represent ± one standard error.

The Roundup PowerMax + Shark treatment and AHDB9979 both caused phytotoxicity damage that was above the threshold, causing scorch where chemical had hit the blackcurrant leaves. At the four week assessment the damage was less visible in all treatments and by the final assessment, prior to harvest, none of the treatments were showing symptoms.

Table 5. Phytotoxicity scores for of plots treated with test products for three assessment dates. Scores analysed by ANOVA with Duncan's multiple range test.

Treatment	Mean crop damage scores		
	28-May	11-Jun	28-Jun
Untreated	0.0	0.0	0.0
Roundup PowerMax	1.5	1.0	0.0
AHDB9868	1.3	1.0	0.0
AHDB9866	2.0	1.0	0.0
AHDB9897	1.3	1.0	0.0
AHDB9979	2.8	1.8	0.0

Roundup PowerMax + Shark	3.3	1.8	0.0
F prob. value	<0.001	<0.001	N/S
d.f.	18	18	18
S.E.D.	0.519	0.1942	N/A
L.S.D.	1.091	0.4079	N/A
	Not significantly different from untreated control (p>0.05)		
	Significantly different from untreated control (p<0.05)		

Efficacy

Overall weed control

The initial baseline of weeds was generally quite even across plots, with a baseline average weed cover of 45.9 % per plot. The weed species present were dominated by field bindweed, but sow-thistle, creeping thistle and groundsel were also present in the majority of plots. Cranesbill, dandelion and bristly oxtongue were also present in some plots.

The overall weed cover in all herbicide treatment plots at the two week assessment was lower than the untreated control (Figure 2). Of these treatments, Roundup PowerMax, Roundup PowerMax + Shark, AHDB9866 and AHDB9897 had significantly lower weed cover than the untreated control. Roundup PowerMax + Shark, AHDB9866 and AHDB9897 in particular showed a good reduction in weed cover during the first two weeks of the trial.

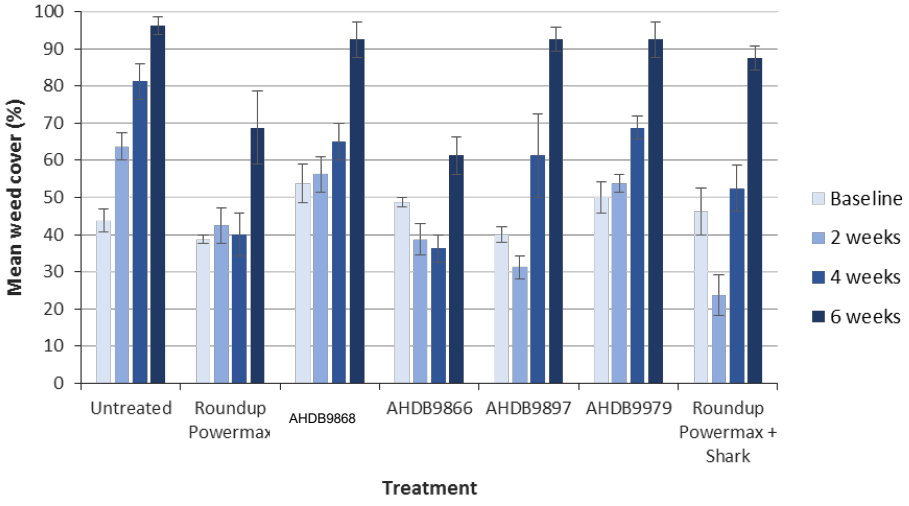


Figure 2. Mean percentage weed cover in plots. Bars represent ± one standard error.

At the four week assessment the same four treatments still had significantly lower weed cover compared to the untreated control. At this point the weed cover in the plots treated with Roundup PowerMax and AHDB9866 had continued to decrease slightly from the two week assessment levels. At the end of the trial period the untreated control had the most weeds present (96.3 %) and this was significantly higher than Roundup PowerMax and AHDB9866, which had 68.8 % and 61.3 % cover respectively (Table 6). AHDB9866 and AHDB9897 appeared to have some efficacy against creeping thistles, whilst AHDB9979 was noted as having little effect.

Table 6. Mean total plot percentage weed cover per treatment for each of the four assessment dates. Means analysed by ANOVA with Duncan's multiple range test, percentage reduction in weeds calculated using Abbotts Formula

Treatment	15-May		29-May		11-Jun		28-Jun	
	Mean %	Abbott's	Mean %	Abbott's	Mean %	Abbott's	Mean %	Abbott's
Untreated	43.75		63.75		81.25		96.25	
Roundup PowerMax	38.75	11.43	42.50	33.33	40.00	50.77	68.75	28.57
AHDB9868	53.75	-22.86	56.25	11.76	65.00	20.00	92.50	3.90
AHDB9866	48.75	-11.43	38.75	39.22	36.25	55.38	61.25	36.36
AHDB9897	40.00	8.57	31.25	50.98	61.25	24.62	92.50	3.90
AHDB9979	50.00	-14.29	53.75	15.69	68.75	15.38	92.50	3.90
Roundup PowerMax + Shark	46.25	-5.71	23.75	62.75	52.50	35.38	87.50	9.09
P value	0.05		<0.001		<0.001		0.002	
d.f.	18		18		18		18	
s.e.d.	4.71		5.64		8.07		8.00	
l.s.d.	9.89		11.85		16.95		16.81	
	Not significantly different from untreated control (p>0.05)							
	Significantly different from untreated control (p<0.05)							
	Positive Abbott's formula percentage reduction							

Bindweed cover

The bindweed cover prior to treatment application was generally even with no significant difference between the treatments (average 22.7% per plot), although the untreated control had the lowest baseline bindweed cover (Figure 3). A reduction in bindweed cover was seen in Roundup PowerMax + Shark and AHDB9897 two weeks after application of the treatments. The bindweed cover in the Roundup PowerMax + Shark plots was lower than that of the untreated control at this point. In addition, at two weeks after application, the grower standard (Roundup PowerMax) had stopped the bindweed cover increasing. However where Roundup PowerMax was applied in a tank mix with Shark, by four weeks after application this had reduced the efficacy and the weed level increased from the two week assessment. This may be because the Shark desiccated the bindweed before the Roundup was fully absorbed.

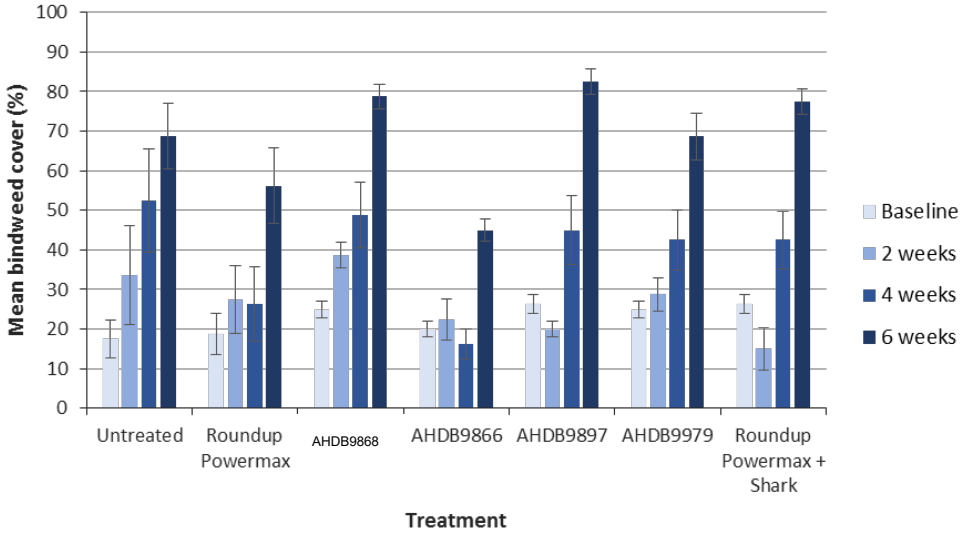


Figure 3. Mean percentage bindweed cover in plots. Bars represent ± one standard error

At four weeks after application the greatest reduction in bindweed cover was in plots treated with AHDB9866, where there was a 69.05 % reduction compared to the untreated control (Table 7). The grower standard (Roundup PowerMax) had maintained the bindweed cover at the two week assessment, however the Roundup PowerMax + Shark treatment had increased from the two week assessment. All other treatments had also seen an increase in the bindweed cover, but there was still a reduction in cover compared to the control in all treatments.

Table 7. Mean total plot percentage bindweed cover per treatment for each of the four assessment dates. Means analysed by ANOVA with Duncan's multiple range test, percentage reduction in bindweed calculated using Abbotts Formula

Treatment	15-May		29-May		11-Jun		28-Jun	
	Mean	Abbott's	Mean	Abbott's	Mean	Abbott's	Mean	Abbott's
Untreated	17.50		33.75		52.50		68.75	
Roundup PowerMax	18.75	-7.14	27.50	18.52	26.25	50.00	56.25	18.18
AHDB9868	25.00	-42.86	38.75	-14.81	48.75	7.14	78.75	-14.55
AHDB9866	20.00	-14.29	22.50	33.33	16.25	69.05	45.00	34.55
AHDB9897	26.25	-50.00	20.00	40.74	45.00	14.29	82.50	-20.00
AHDB9979	25.00	-42.86	28.75	14.81	42.50	19.05	68.75	0.00
Roundup PowerMax + Shark	26.25	-50.00	15.00	55.56	42.50	19.05	77.50	-12.73
P value	0.346		0.293		0.102		0.004	
d.f.	18		18		18		18	
s.e.d.	4.86		9.99		12.68		8.59	
l.s.d.	10.21		20.98		26.63		18.05	
	Not significantly different from untreated control (p>0.05)							
	Significantly different from untreated control (p<0.05)							
	Positive Abbott's formula percentage reduction							

By six weeks after application AHDB9866 had significantly lower bindweed cover than the untreated control and gave the best persistence in bindweed suppression. The only other treatment to show an Abbott's percentage reduction in bindweed cover at this point was the grower standard (Roundup PowerMax).

Discussion

The trial was sited in a 13 year old blackcurrant plantation which had a high bindweed burden, as well as challenging perennial weeds, such as creeping thistle. By the final assessment the total weed cover in the untreated control plots had reached 96.3 % and the bindweed cover 68.8 %. All of the contact herbicide treatments tested reduced the overall weed cover compared to the untreated control. Some of the treatments provided significantly better control than others and was particularly true in the bindweed control.

The Roundup PowerMax + Shark treatment showed a good initial knockdown of the bindweed in the plots, but the effect was not long lasting and by 4 weeks after treatment the bindweed levels were similar to the untreated control. The only other treatment to show an initial reduction in bindweed was AHDB9897.

AHDB9866 was the best performing treatment on bindweed over the whole trial period and outperformed the grower standard (Roundup PowerMax) at six weeks after treatment. There was a slight increase in bindweed cover at two weeks after treatment in these plots, but this was due to the active ingredient being a synthetic auxin (HRAC Group O), which causes excessive growth to plant death.

All herbicide treatments reduced the weed cover compared to the control, however, the best performing treatments were Roundup PowerMax (grower standard), Roundup PowerMax +

Shark, AHDB9866 and AHDB9897. The latter two treatments also had some effect on the creeping thistle in the trial plots, though this was not fully quantified.

Shark and AHDB9897 have the same mode of action (HRAC Group E), but have slightly different weed spectrums. Of particular note is the susceptibility of young black nightshade to AHDB9897, which is another weed of concern to blackcurrant growers. The berries of this weed species are very similar to blackcurrants in size and colour, but are toxic, presenting significant risk if contamination occurs during mechanical harvest.

Roundup PowerMax + Shark was trialled to assess whether the addition of Shark would increase efficacy of Roundup PowerMax when tank mixed. In the trial the treatment resulted in a good initial burn off of vegetation, however, after four weeks the weeds had regrown and by the end of the trial the weed cover was greater than in the Roundup PowerMax alone treatment. It is likely that the Shark desiccated the vegetation before the Roundup PowerMax could be taken up by the leaves, resulting in a sub-optimal treatment effect.

All of the herbicide treatments resulted in some phytotoxicity symptoms on the bushes. All of the symptoms appeared on leaves and branches that had been touched by the chemical. The most damaging treatment was Roundup PowerMax + Shark, followed by AHDB9979. All other treatments caused fewer initial symptoms and the damage was acceptable for growers. AHDB9866 caused some twisting to young leaves and shoots and AHDB9897 caused some leaf scorch, but affected bushes grew through these symptoms. As a result of the phytotoxicity seen none of the products tested would be recommended for use at the base of the bush during the growing season.

Two products (AHDB9866 and AHDB9897) tested during this work demonstrated good bindweed and general weed control in commercial blackcurrant plantations with minimal damage to the bushes. AHDB9866 performed as well or better than the grower standard in the trial and although AHDB9897 did not perform quite as well at the six week point, it had good efficacy up to four weeks and has a weed spectrum that would be useful to blackcurrant growers. These products are suggested to be put forward for EAMU, based on their efficacy and crop safety during the trial.

Conclusions

- Roundup PowerMax, Roundup PowerMax + Shark, AHDB9866 and AHDB9897 reduced total weed cover compared to the untreated control up to four weeks after application. AHDB9866 had the lowest weed cover at the end of the six week trial.
- AHDB9866 had the lowest bindweed cover at the end of the trial and was comparable to the grower standard in terms of efficacy.
- Roundup PowerMax + Shark performed worse than Roundup PowerMax alone, indicating that the addition of Shark desiccated the weed leaf before the Roundup PowerMax could be taken up by the weed.
- Phytotoxic effects were seen in all herbicide treatments including the grower standard, however the effect was generally minor and the bushes grew through any damage.
- AHDB9866 and AHDB9897 performed well both in efficacy and crop safety during the trial and would be suitable products to boost the limited contact herbicide options available to blackcurrant growers.

Acknowledgements

AHDB for funding the work, and also the crop protection companies for their financial contributions as well as providing samples for the trials. Thanks should also be given to the Harriet Prosser from Lucozade Ribena Suntory and grower Andy Youngman who provided the site and crops for the trials as well as technical input.

Appendix

a. Crop diary – events related to growing crop

Crop	Cultivar	Planting date	Row width (m)
Blackcurrant	Ben Dorain	31/01/2006	1.5

Active ingredients(s)/fertiliser(s) applied to trial area

Date	Product	Rate (kg/ha)
06/04/2018	13-13-29.5	308kg
22/05/2018	34.5% AN	123kg
26/03/2018	13-13-29.5	308kg
23/05/2018	34.5% AN	123kg

Pesticides applied to trial area

Date	Product	Rate (L/ha)
22/11/2017	Kerb Flo 400	3.0
23/03/2018	Stomp Aqua	2.9
	Artist	2.5
21/04/2018	Roundup PowerMax	3.5
15/06/2018	Shark	0.3
14/12/2018	Kerb Flo 400	3.0
01/03/2019	Stomp Aqua	2.9
	Artist	2.5
16/04/2019	Roundup PowerMax	3.5
	No further chemical applied as per request of lead researcher	-

b. Trial diary

Date	Event
15/05/2019	Trial marked out and temperature/relative humidity data logger set up in centre of trial. Weed levels assessed. Trial plots sprayed with herbicide treatments
29/05/2019	Weed levels and crop safety assessed.
11/06/2019	Weed levels and crop safety assessed.
28/06/2019	Weed levels and crop safety assessed before harvest.

c. Trial photographs

Phytotoxicity symptoms:


Roundup PowerMax + Shark (left) and AHDB9897 (right) 2 weeks after application (29/05/2019)


AHDB9866 (both photos) 2 weeks after application (29/05/2019)

Weed cover at two weeks after application:

Trial area two weeks after application (29/05/2019)

Untreated control (left) and AHDB9866 (right) 2 weeks after application (29/05/2019)

Grower standard (left) and AHDB9897 (right) four weeks after application (11/06/2019

Weed cover at four weeks after application:

Trial area four weeks after application (11/06/2019)

Untreated control (left) and AHDB9866 (right) four weeks after application (11/06/2019)

Grower standard (left) and AHDB9897 (right) four weeks after application (11/06/2019)

d. Climatological data during study period

Date	Temperature °C (maximum)	Temperature °C (minimum)	Rainfall (mm)
15/05/2019	14.8	4.1	0.00
16/05/2019	16.2	4.4	0.00
17/05/2019	15.2	5.6	0.00
18/05/2019	12.9	9.8	0.79
19/05/2019	16.6	8.4	0.00
20/05/2019	16.8	7.5	1.80
21/05/2019	17.2	9.2	0.61
22/05/2019	19.0	7.0	0.00
23/05/2019	19.4	6.1	0.00
24/05/2019	21.1	8.4	0.00
25/05/2019	21.3	9.3	0.00
26/05/2019	20.7	8.9	0.00
27/05/2019	21.4	10.8	0.99
28/05/2019	16.6	7.9	0.00
29/05/2019	13.2	6.9	6.81
30/05/2019	16.2	5.5	1.19
31/05/2019	22.9	13.2	0.00
01/06/2019	20.8	11.1	0.00
02/06/2019	21.5	11.1	0.00
03/06/2019	26.2	14.2	0.00
04/06/2019	20.1	10.8	0.00
05/06/2019	16.9	8.9	5.99
06/06/2019	18.0	10.4	4.60
07/06/2019	18.0	10.1	1.19
08/06/2019	16.2	9.5	5.41
09/06/2019	17.1	10.7	2.01
10/06/2019	17.9	8.0	0.00
11/06/2019	13.3	10.8	21.7
12/06/2019	18.3	11.2	0.20
13/06/2019	14.7	11.1	8.00
14/06/2019	16.3	11.0	1.19
15/06/2019	18.7	11.4	0.00
16/06/2019	18.7	11.3	0.00
17/06/2019	19.7	9.7	0.20
18/06/2019	21.2	11.9	0.00
19/06/2019	20.5	10.9	2.01
20/06/2019	17.9	12.4	11.00
21/06/2019	19.4	12.8	1.40
22/06/2019	19.7	9.7	0.00
23/06/2019	18.9	10.7	0.00
24/06/2019	22.8	10.2	0.00
25/06/2019	25.1	16.6	0.00
26/06/2019	23.8	15.6	9.60
27/06/2019	17.2	13.1	0.00
28/06/2019	17.7	12.1	0.00

e. Raw data from assessments

Total weed percentage cover data

Plot number	Block	Treatment	Total weed % cover			
			15/05/2019	28/05/2019	11/06/2019	28/06/2019
101	1	2	40	50	30	60
102	1	4	50	35	40	75
103	1	1	45	75	95	100
104	1	7	45	40	70	95
105	1	3	40	50	50	100
106	1	6	50	60	70	90
107	1	5	40	40	80	85
201	2	1	50	60	75	90
202	2	7	50	15	50	80
203	2	2	35	50	50	85
204	2	6	40	50	75	100
205	2	5	35	30	75	100
206	2	4	50	30	45	60
207	2	3	55	55	70	80
301	3	3	55	50	70	90
302	3	6	50	50	70	80
303	3	4	45	40	30	60
304	3	5	40	30	60	90
305	3	2	40	40	50	85
306	3	7	30	20	50	85
307	3	1	35	60	75	95
401	4	7	60	20	40	90
402	4	3	65	70	70	100
403	4	5	45	25	30	95
404	4	6	60	55	60	100
405	4	4	50	50	30	50
406	4	1	45	60	80	100
407	4	2	40	30	30	45

Bindweed percentage cover data

Plot number	Block	Treatment	Bindweed % cover			
			15/05/2019	28/05/2019	11/06/2019	28/06/2019
101	1	2	10	20	10	40
102	1	4	15	10	10	40
103	1	1	30	70	80	85
104	1	7	25	30	60	85
105	1	3	20	30	25	80
106	1	6	25	25	20	60
107	1	5	25	20	50	75
201	2	1	10	20	30	60

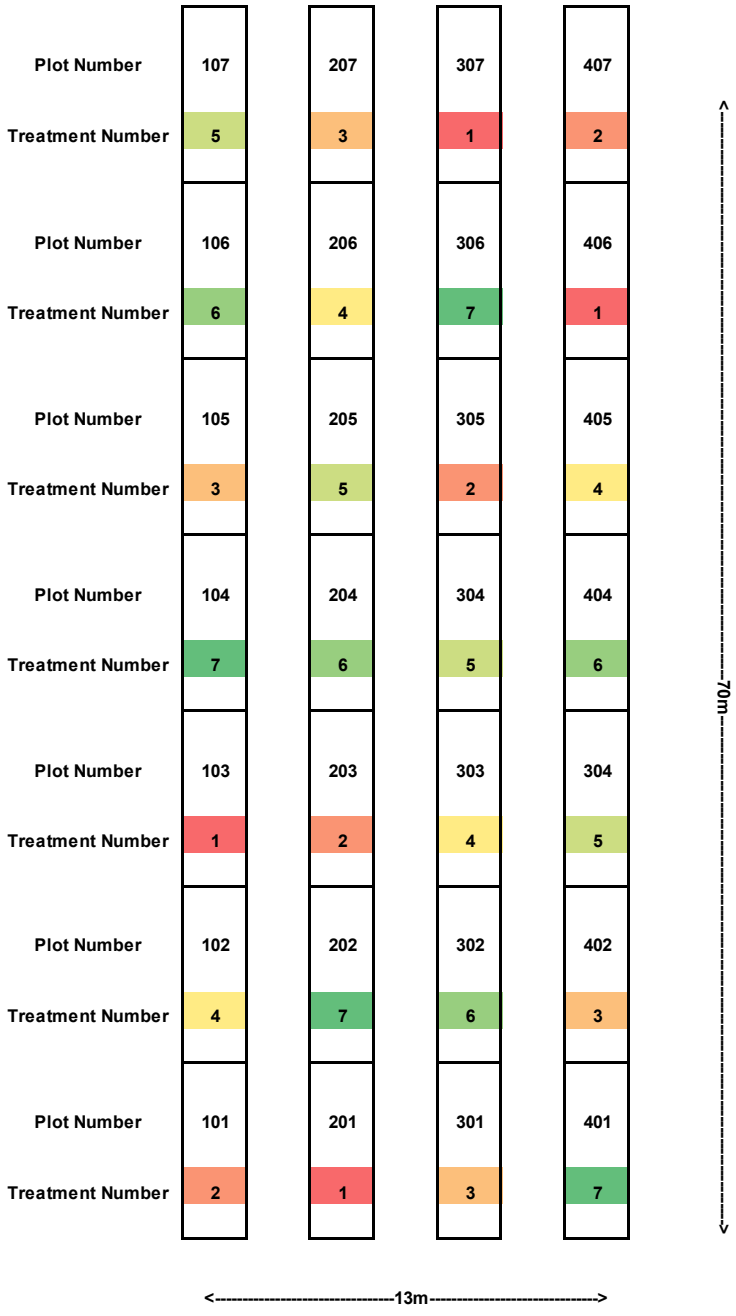
202	2	7	30	10	45	70
203	2	2	30	50	45	75
204	2	6	20	20	50	85
205	2	5	30	20	60	90
206	2	4	20	20	25	50
207	2	3	30	45	60	70
301	3	3	25	40	60	80
302	3	6	30	40	50	70
303	3	4	20	35	20	50
304	3	5	30	25	50	85
305	3	2	25	30	40	70
306	3	7	20	15	40	75
307	3	1	10	15	30	50
401	4	7	30	5	25	80
402	4	3	25	40	50	85
403	4	5	20	15	20	80
404	4	6	25	30	50	60
405	4	4	25	25	10	40
406	4	1	20	30	70	80
407	4	2	10	10	10	40

Phytotoxicity score data

Plot number	Block	Treatment	Phyto_2WA	Phyto_4WA	Phyto_6WA
101	1	2	1	1	0
102	1	4	2	1	0
103	1	1	0	0	0
104	1	7	4	2	0
105	1	3	2	1	0
106	1	6	2	2	0
107	1	5	2	1	0
201	2	1	0	0	0
202	2	7	2	1	0
203	2	2	1	1	0
204	2	6	4	2	0
205	2	5	1	1	0
206	2	4	2	1	0
207	2	3	1	1	0
301	3	3	1	1	0
302	3	6	3	2	0
303	3	4	2	1	0
304	3	5	1	1	0
305	3	2	1	1	0
306	3	7	4	2	0
307	3	1	0	0	0
401	4	7	3	2	0

402	4	3	1	1	0
403	4	5	1	1	0
404	4	6	2	1	0
405	4	4	2	1	0
406	4	1	0	0	0
407	4	2	3	1	0

f. Trial design



Treatment No.	Treatment
1	Untreated
2	Roundup Powermax
3	AHDB9868
4	AHDB9866
5	AHDB9897
6	AHDB9979
7	Roundup Powermax + Shark

g. ORETO certificate.

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

This certifies that

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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
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HSE
Chemicals Regulation Division

Department of Agriculture and Rural Development