SCEPTREPLUS

Final Trial Report

Trial code:	SP17 - 2017
Title:	AHDB SCEPTREplus rhubarb herbicide post-harvest Callisto screen
Crop	Group: field vegetable – Polygonaceae (rhubarb)
Target	General broadleaf weeds and grasses, 3WEEDT EPPO1/89(3) Weeds in leafy and brassica vegetables
Lead researcher:	Angela Huckle
Organisation:	RSK ADAS
Period:	1st July 2017 – 31st March 2018
Report date:	3rd January 2019
Report author:	Angela Huckle Emily Lawrence
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

7th January 2019 

Date Authors signature

Trial Summary

Introduction

The limited range of herbicides currently available leaves gaps in the weed control spectrum, and rhubarb growers experience problems with a wide range of weeds. Himalayan balsam (*Impatiens glandulifera*), and perennials such as docks (*Rumex* spp.) and thistles (*Cirsium arvense*) are particularly problematic for growers. As well as competing with the crop for nutrients and water, these weeds also hinder pickers, reducing harvest efficiency.

In recent years, rhubarb crown size and yield has decreased in both forced and green pull crops. Growers believe that this is a consequence of increased competition from weeds, amongst other influencing factors.

As a perennial crop, rhubarb presents a challenge for weed control as there is only a short window where the crop is fully dormant where non-selective herbicides can be applied safely. If any leaf is present – even if senescent– crop safety of any herbicide applied over the crop needs to be considered. For example, glyphosate is an effective option for weed control over winter, with an EAMU approval for Roundup Biactive in rhubarb, but the short dormant season of the crop provides only a limited window for treatment. The crop must be completely dormant with no leaf, otherwise glyphosate will kill the sets. Therefore, the main option currently used immediately post-harvest is diquat, which has gaps in the weed control spectrum and only offers temporary suppression.

Mesotrione (Callisto) was approved in 2016 for use at both pre- and post-harvest timings, and has been shown in previous work to give wide-spectrum weed control, including species such as Himalayan balsam. However, growers are concerned about its use over an actively growing crop at a post-harvest timing due to its volatility and persistence.

This trial aimed to give growers guidance in the use of Callisto, testing rates and timings of application post-harvest, as well as in tank-mixes with other herbicides approved for use on outdoor rhubarb.

Method

A trial site was located at a commercial rhubarb grower in Yorkshire. Treatments were applied alone or in combinations, either over the recently topped crop, or as an inter-row spray. The rhubarb sets (var. Timperley Early) were planted in 2016. The first treatments (Timing A) were applied over the recently topped crop on 12th July 2017, and the Timing B treatments were applied on 25th July to the actively growing crop. The treatments were applied with a 1.5m boom, or a single nozzle hooded lance under the crop canopy as appropriate, with an Oxford Precision Sprayer knapsack at 200 L/ha water volume.

A randomised block design was used with four replicates of eighteen treatments, including two untreated controls, totalling seventy-two plots. Plots were 1.7m wide by 6m long. Plots were assessed for weed control on four occasions, with the percentage of weed ground cover recorded. Crop damage was also assessed; recorded first at two weeks after the first treatment application, and on three subsequent occasions (four, six and nine weeks after treatment).

Results

While many treatments scored below the commercially acceptable level for crop quality/effects (phytotoxicity score averaged 7.18 across treatments at final assessment), they were still comparable to the untreated control, which scored 7.25 in the final assessment (Table 1). The untreated control was scored as such because there were marks on the leaves of the rhubarb which meant crop appearance for quality was marked lower. Therefore, while all treatments showed some level of damage, this is often comparable in relation to the ‘lower’ quality score of the untreated control.

Only one treatment scored significantly lower than the untreated control in terms of crop quality by the final assessment; which was Callisto + Gamit 36 CS when applied two weeks after topping. The crop in those plots showed phytotoxic effects which remained at the end of the nine week assessment period or harvest.

There were no significant differences in efficacy between treatments, and the weed distribution across the trial remained uneven throughout the nine week assessment period. Levels of weed cover in the untreated plots varied from 17% to 70% at nine weeks after the first application date, therefore while there were trends for less weed in some treatments, any differences in weed levels could not be confidently attributed to treatment effects due to this variability.

Table 1. Summary of crop damage and percentage weed cover (back-transformed) (13th September 2018, 9 weeks post treatment).

Timing A	Timing B	Crop damage/quality (0-10)	Weed cover (%)
Untreated	Untreated	7.25	36.61
Diquat*	-	7.00	38.56
Callisto 0.5 L/ha	-	7.25	33.07
Callisto 0.75 L/ha	-	8.25	28.80
Callisto 1.5 L/ha	-	7.75	21.48
Callisto 0.75 L/ha+ Stomp Aqua 3.3 L/ha	-	8.25	18.18
Callisto 0.75 L/ha + Gamit 36 CS 0.25 L/ha	-	7.25	26.45
Callisto 0.75 L/ha+ Diquat*	-	8.00	42.33
-	Diquat*	7.75	39.30
-	Callisto 0.5 L/ha	7.00	19.96
-	Callisto 0.75 L/ha	6.25	28.91
-	Callisto 1.5 L/ha	6.00	33.43
-	Callisto 0.75 L/ha+ Stomp Aqua 3.3 L/ha	6.50	27.65
-	Callisto 0.75 L/ha + Gamit 36 CS 0.25 L/ha	5.75	41.53
-	Callisto 0.75 L/ha+ Diquat*	8.00	37.12
AHDB9972*	-	7.50	40.76
AHDB9972	-	6.25	48.26
* Applied inter-row	**F prob. value**	<0.001	0.345
	d.f.	52	52
	S.E.D.	0.717	6.17
	L.S.D.	1.438	14.31

Conclusion

.

- Callisto appears crop safe by harvest when applied immediately post-topping.
- A tank-mix of Callisto + Gamit 36 CS caused a greater level of damage when applied over crop foliage compared to other treatments. It causes less effects on the crop if applied sooner after topping.
- Applying Callisto at two weeks after topping, once the crop had started to regrow gave more crop damage and the crop suppression also allowed weeds to take advantage of the lack of competition increasing weed levels.

Take home message

For less crop damage it is advantageous to apply Callisto, or any mixes containing Callisto as soon as possible after topping the crop, or before new regrowth is present if possible.

Objectives

1. To compare the newly approved product Callisto at two post-emergence timings, at three rates and in tank-mixes with commercial standards for selectivity (crop safety) and efficacy in rhubarb
2. To compare performance against the current approved commercial standard (inter-row diquat)
3. To monitor the treated crop for phytotoxicity

Trial conduct

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

Relevant EPPO guideline(s)		**Variation from EPPO**
EPPO PP1/135(4)	Phytotoxicity assessment	None
EPPO PP1/152(4)	Guideline on design and analysis of efficacy evaluation trials	None
EPPO PP1/225 (2)	Minimum effective dose	None
EPPO PP1/181 (4)	Conduct and reporting of efficacy evaluation trials including good experimental practice	None
EPPO PP 1/214(3)	Principles of acceptable efficacy	None
EPPO PP 1/224(2)	Principles of efficacy evaluation for minor uses	None

Deviations from EPPO guidance: None

Test site

Item	**Details**
Location address	Field: Jaw Bones E Oldroyd & Sons Rothwell, Leeds LS26 0ZL Yorkshire Grid reference: SE 32809 29009
Crop	Rhubarb
Cultivar	Timperley Early
Soil or substrate type	Freely draining lime-rich loamy soils
Agronomic practice	See Appendix A
Prior history of site	See Appendix A

Trial design

Item	**Details**
Trial design:	Fully randomised block
Number of replicates:	4
Row spacing:	0.85m (2 rows per plot)
Plot size: (w x l)	1.7m x 6m
Plot size: (m^2)	10.2m^2
Number of plants per plot:	Approx. 10
Leaf Wall Area calculations	N/A

Treatment details

AHDB Code	Active substance	Product name	Formulation batch number	Content of active substance in product (g/L)	Formulation type
N/A	diquat	Reglone	N/K	200	Soluble Concentrate
N/A	mesotrione	Callisto	SAV5D15030	100	Suspension Concentrate
N/A	pendimethalin	Stomp Aqua	ST10630416	455	Capsule Suspension
N/A	clomazone	Gamit 36 CS	160344	360	Capsule Suspension
AHDB9972	N/A	N/A	N/A	N/A	N/A
AHDB9978	N/A	N/A	N/A	N/A	N/A

Application schedule

Treatment number	Treatment: product name or AHDB code	Rate of active substance (ml/ha)	Rate of product (L/ha)	Application timing code
1	Untreated	-	-	-
2	Untreated	-	-	-
3	Diquat* **	400	2.0	A
4	Callisto 0.5 L/ha	50	0.5	A
5	Callisto 0.75 L/ha	75	0.75	A
6	Callisto 1.5 L/ha	150	1.5	A
7	Callisto 0.75 L/ha+ Stomp Aqua 3.3 L/ha	75 1501.5	0.75 3.3	A
8	Callisto 0.75 L/ha + Gamit 36 CS 0.25 L/ha	75 90	0.75 0.25	A
9	Callisto 0.75 L/ha+ AHDB9978**	75 400	0.75 2.0	A
10	AHDB9978**	400	2.0	B
11	Callisto 0.5 L/ha	50	0.5	B
12	Callisto 0.75 L/ha	75	0.75	B
13	Callisto 1.5 L/ha	150	1.5	B
14	Callisto 0.75 L/ha+ Stomp Aqua 3.3 L/ha	75 1501.5	0.75 3.3	B
15	Callisto 0.75 L/ha + Gamit 36 CS 0.25 L/ha	75 90	0.75 0.25	B
16	Callisto 0.75 L/ha+ AHDB9978**	75 400	0.75 2.0	B
17	AHDB9972**	480	2.0	A
18	AHDB9972	240	1.0	A

* Grower standard
** Inter-row application, guarded spray under canopy

Application details

	Timing A	Timing B
Application date	12/07/2017	25/07/2017
Time of day	13:00	10:45
Crop growth stage (Max, min average BBCH)	(topped)	20-21
Crop height (cm)	N/A	50
Crop coverage (%)	N/A	60
Application Method	spray	spray
Application Placement	foliar	foliar
Application equipment	Oxford Precision Sprayer (knapsack)	Oxford Precision Sprayer (knapsack)
Nozzle pressure	2.4 bar	2.4 bar
Nozzle type	Flat fan	Flat fan
Nozzle size	02F110	02F110
Application water volume/ha	200	200
Temperature of air - shade (°C)	18.5	16.0
Relative humidity (%)	58.5	76.3
Wind speed range (mph)	2.8 – 4.8	2.0 -3.8
Dew presence (Y/N)	N	N
Temperature of soil - 10cm (°C)	20.0	15.0
Wetness of soil - 2-5 cm	Wet	Wet
Cloud cover (%)	60	100

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

Common name	**Scientific Name**	**EPPO Code**	**Infection level at start of assessment period** (2 weeks)	**Infection level mid-assessment period** (4 weeks)	**Infection level at end of assessment period** (9 weeks)
Broad leaved weeds and grasses	*N/A*	3WEEDT	13.04% *(untreated average)*	21.66% *(untreated average)*	36.61% *(untreated average)*

Assessment details

Evaluation date	**Evaluation Timing (DA)***	**Crop Growth Stage (BBCH)**	**Evaluation type (efficacy, phytotox)**	**What was assessed and how (e.g. dead or live pest; disease incidence and severity; yield, marketable quality)**
12/07/2017	0	(topped)	baseline	Weed species presence
25/07/2017	0	20-21	efficacy, phytotox	Phytotox (scale 0-10, 0 = Dead) Percentage of weed cover, whole plot score; weed species presence
09/08/2017	15	31 – 32	efficacy, phytotox	Phytotox (scale 0-10, 0 = Dead) Percentage of weed cover, whole plot score; weed species presence
25/08/2017	31	45	efficacy, phytotox	Phytotox (scale 0-10, 0 = Dead)

				Percentage of weed cover, whole plot score
13/09/2017	50	49	efficacy, phytotox	Phytotox (scale 0-10, 0 = Dead) Percentage of weed cover, whole plot score

* DA – days after application

Statistical analysis

The trial design was a randomised block design, with four replicates of eighteen treatments, including two untreated controls and a commercial standard (inter-row diquat).

As the distribution of weeds was uneven across the trial – which is not unexpected in field situations – there was a need to transform these variables prior to analysis. An angular transformation was used.

All data were analysed by ANOVA using Genstat 18.4 by Chris Dyer at RSK ADAS. For the % efficacy data, calculated by Abbotts formula, an angular transformation was carried out and then back transformed means presented, from which Abbotts formula was used to calculate the % reduction in weeds.

Results

Phytotoxicity

The results of phytotoxicity assessments from four dates are presented in Table 2 and Figure 1. These were scored on a scale from 0 to 10, with 0 being 'dead', and 10 being 'no effect'. Plots deemed to have a commercially acceptable level of damage were scored 8 or above.

Phytotoxicity was recorded using the following scale:

Crop tolerance score	Equivalent to crop damage (% phytotoxicity)
0	complete crop kill 100%
1	80-95% damage
2	70-80%
3	60-70%
4	50-60%
5	40-50%
6	25-40%
7	15-25%
8*	10-15%
9	5-10%
10	no damage

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

While many treatments scored below the commercially acceptable level for crop quality (phytotoxicity score averaged 7.18 across treatments at final assessment), they were still comparable to the untreated control, which scored 7.25 in the final assessment. Therefore, while all treatments showed some level of damage, this can generally be discounted in relation to the 'low' quality score of the untreated control.

Timing B treatments caused greater phytotoxicity than the same treatments applied at the earlier timing, though by the final assessment, most treatments did not differ significantly from the untreated in terms of crop safety. However, crop treated with Callisto + Gamit 36 CS at the second application timing did have a significantly lower crop quality score, showing phytotoxic effects which the crop did not grow through in the nine week assessment period (Table 2**Table 2**; *also, see Appendix section e*).

AHDB 9972 applied as an inter-row spray appeared to cause less crop damage than the same treatment applied over the newly topped crop, though by nine weeks after treatment, neither treatment showed a significant difference in phytotoxicity to the untreated.

Table 2. Mean phytotoxicity scores at four dates throughout the trial period (0 to 10; 0 = complete crop death, 10 = no damage). Scores significantly lower than that of the untreated are highlighted in red.

Timing A	Timing B	Mean crop damage scores			
		25th Jul	9th Aug	25th Aug	13th Sep
Untreated	Untreated	*N/A*	8.00	7.13	7.25
AHDB 9978*	-	8.50	6.75	7.25	7.00
Callisto 0.5 L/ha	-	7.88	6.50	6.75	7.25
Callisto 0.75 L/ha	-	7.50	7.00	7.00	8.25
Callisto 1.5 L/ha	-	7.13	7.25	7.00	7.75
Callisto 0.75 L/ha+ Stomp Aqua 3.3 L/ha	-	7.50	8.00	7.25	8.25
Callisto 0.75 L/ha + Gamit 36 CS 0.25 L/ha	-	7.13	6.75	6.75	7.25
Callisto 0.75 L/ha+ AHDB 9978*	-	8.50	8.75	8.50	8.00
-	AHDB 9978*	*N/A*	7.75	8.00	7.75
-	Callisto 0.5 L/ha	*N/A*	**6.25**	6.25	7.00
-	Callisto 0.75 L/ha	*N/A*	**5.50**	6.00	6.25
-	Callisto 1.5 L/ha	*N/A*	**5.25**	**5.50**	6.00
-	Callisto 0.75 L/ha+ Stomp Aqua 3.3 L/ha	*N/A*	**5.25**	**5.50**	6.50
-	Callisto 0.75 L/ha + Gamit 36 CS 0.25 L/ha	*N/A*	**5.25**	**5.50**	**5.75**
-	Callisto 0.75 L/ha+ AHDB 9978*	*N/A*	8.00	8.50	8.00
AHDB 9972*	-	9.00	8.00	7.75	7.50
AHDB 9972	-	8.67	**6.25**	6.00	6.25
* inter-row	**F pr. value**	<0.001	<0.001	<0.001	<0.001
	d.f.	23	52	52	52
	S.E.D.	0.2714	0.805	0.738	0.717
	L.S.D.	0.5615	1.615	1.481	1.438

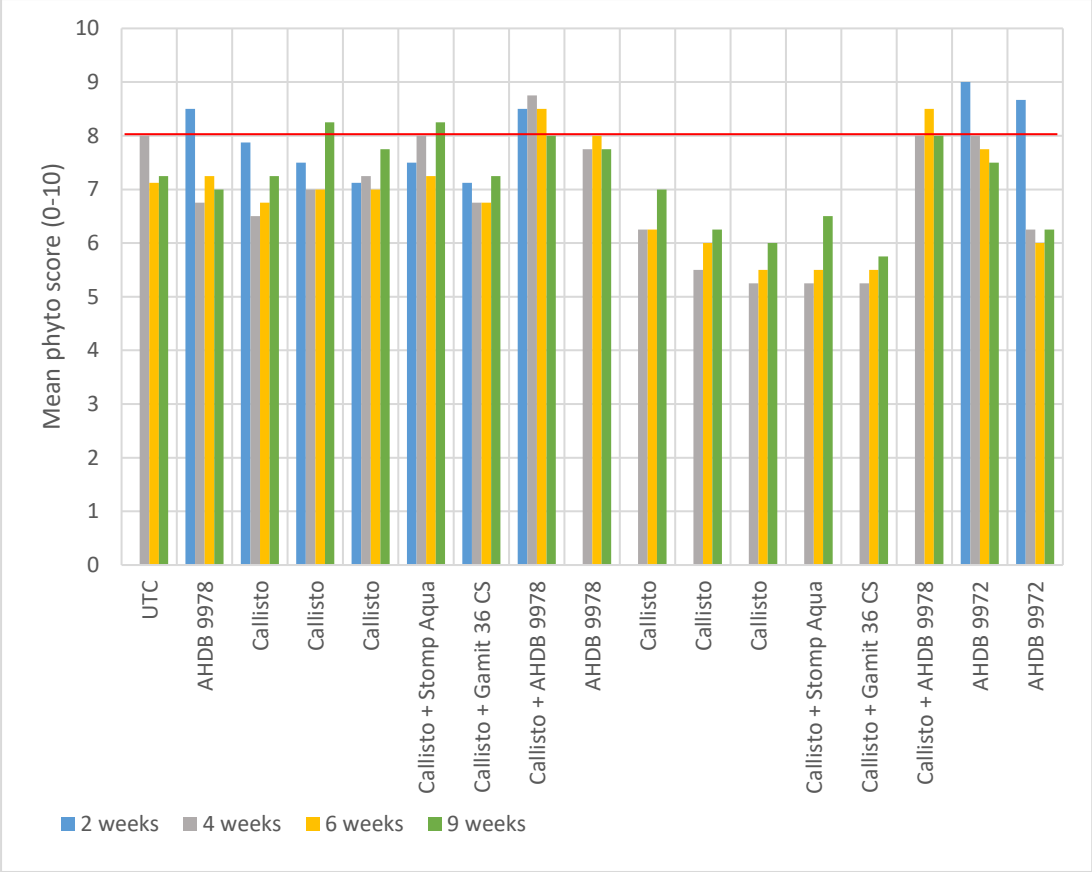


Figure 1. Mean phytotoxicity scores at 2, 4, 6 and 9 weeks after Timing A treatment application. Scores of 8 or above deemed acceptable damage (as indicated by red line).

Weed control – mean percentage weed cover

The results for the mean percentage weed cover per treatment are presented in Table 3 and Figure 2**Error! Reference source not found.**. The percent reduction in weed cover compared to the untreated control was calculated from these figures (using Abbotts formula), and results for each treatment are listed in Table 4.

Table 3. Mean percentage weed cover values (back-transformed) at 2, 4, 6 and 9 weeks after Timing A treatment application.

Trt. No.	Mean weed cover							
	25th July (2 weeks)		9th August (4 weeks)		25th August (6 weeks)		13th September (9 weeks)	
	Ang	Back-trans	Ang	Back-trans	Ang	Back-trans	Ang	Back-trans
UTC*	21.17	13.04	27.74	21.66	35.70	34.11	37.20	36.61
3	23.50	15.90	28.05	22.11	36.90	36.03	38.40	38.56
4	19.84	11.52	24.45	17.13	29.20	23.77	35.10	33.07
5	19.84	11.52	23.59	16.01	25.00	17.85	32.50	28.80
6	18.14	9.70	20.23	11.96	23.50	15.89	27.60	21.48
7	17.37	8.91	23.10	15.39	25.90	19.11	25.20	18.18
8	19.84	11.52	21.17	13.05	22.00	14.01	31.00	26.45
9	25.53	18.58	33.93	31.15	35.10	33.04	40.60	42.33

Trt. No.	Mean weed cover							
	25th July (2 weeks)		9th August (4 weeks)		25th August (6 weeks)		13th September (9 weeks)	
	Ang	Back-trans	Ang	Back-trans	Ang	Back-trans	Ang	Back-trans
10	19.69	11.36	27.42	21.20	35.20	33.27	38.80	39.30
11	21.73	13.70	22.81	15.04	23.90	16.45	26.50	19.96
12	20.78	12.59	22.65	14.83	26.80	20.31	32.50	28.91
13	20.47	12.23	24.59	17.32	27.80	21.78	35.30	33.43
14	21.04	12.88	21.95	13.97	29.50	24.23	31.70	27.65
15	21.70	13.67	22.64	14.82	29.30	24.00	40.10	41.53
16	25.25	18.20	31.31	27.00	28.80	23.19	37.50	37.12
17	22.81	15.04	30.23	25.35	39.60	40.61	39.70	40.76
18	20.01	11.71	25.15	18.07	29.80	24.64	44.00	48.26
F pr. value		0.427		0.025		0.226		0.345
d.f.		52		52		52		52
S.E.D.		3.041		3.823		6.63		6.17
L.S.D.		6.101		7.671		13.31		14.31

* Untreated control; treatments 1 and 2

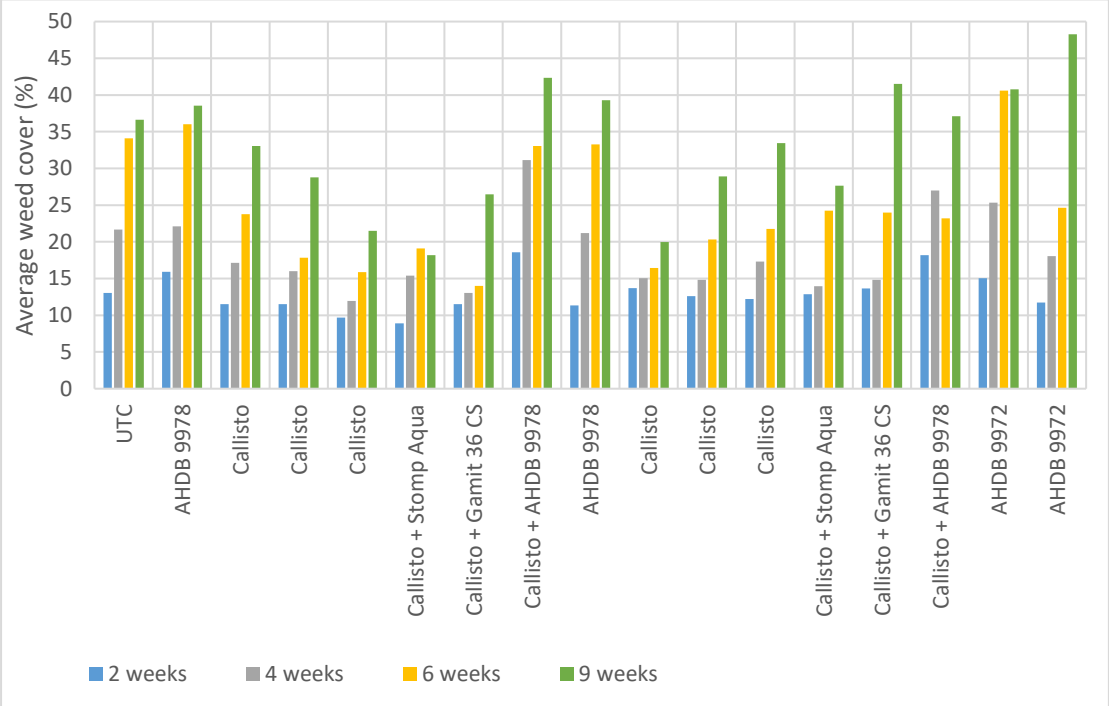


Figure 2. Mean weed cover (%) at 2, 4, 6 and 9 weeks after Timing A treatment application (back-transformed values).

Table 4. Percentage reduction in weed cover at 2, 4, 6 and 9 weeks after Timing A treatment application (calculated using Abbotts formula) – highlighted values show an increase in weed cover.

Timing A	Timing B	Weed cover reduction (%)			
		25th July (2 weeks)	9th Aug (4 weeks)	25th Aug (6 weeks)	13th Sep (9 weeks)
AHDB9978*	-	-21.93	-2.08	-5.63	-13.05
Callisto 0.5 L/ha	-	11.66	20.91	30.31	3.05
Callisto 0.75 L/ha	-	11.66	26.08	47.67	15.57
Callisto 1.5 L/ha	-	25.61	44.78	53.42	37.03
Callisto 0.75 L/ha+ Stomp Aqua 3.3 L/ha	-	31.67	28.95	43.98	46.70
Callisto 0.75 L/ha + Gamit 36 CS 0.25 L/ha	-	11.66	39.75	58.93	22.46
Callisto 0.75 L/ha+ AHDB9978*	-	-42.48	-43.81	3.14	-24.10
-	AHDB9978*	12.88	2.12	2.46	-15.22
-	Callisto 0.5 L/ha	-5.06	30.56	51.77	41.48
-	Callisto 0.75 L/ha	3.45	31.53	40.46	15.24
-	Callisto 1.5 L/ha	6.21	20.04	36.15	1.99
-	Callisto 0.75 L/ha+ Stomp Aqua 3.3 L/ha	1.23	35.50	28.97	18.94
-	Callisto 0.75 L/ha + Gamit 36 CS 0.25 L/ha	-4.83	31.58	29.64	-21.75
-	Callisto 0.75 L/ha+ AHDB9978*	-39.57	-24.65	32.01	-8.82
AHDB9972*	-	-15.34	-17.04	-19.06	-19.50
AHDB9972	-	10.20	16.57	27.76	-14.48

The mean of the initial weed burden in the trial field was 13.4% and was variable across the field, ranging from a minimum of 5% to a maximum of 30%. The change in weed cover from the baseline assessment to the final assessment, 9 weeks after the first treatment application, was assessed.

There were no significant differences in efficacy between treatments, and the weed distribution across the trial remained uneven. Levels of % weed cover in the untreated plots varied from 17% to 70% at nine weeks after the first application, so any differences in weed levels could not be attributed to treatment effects due to this variability.

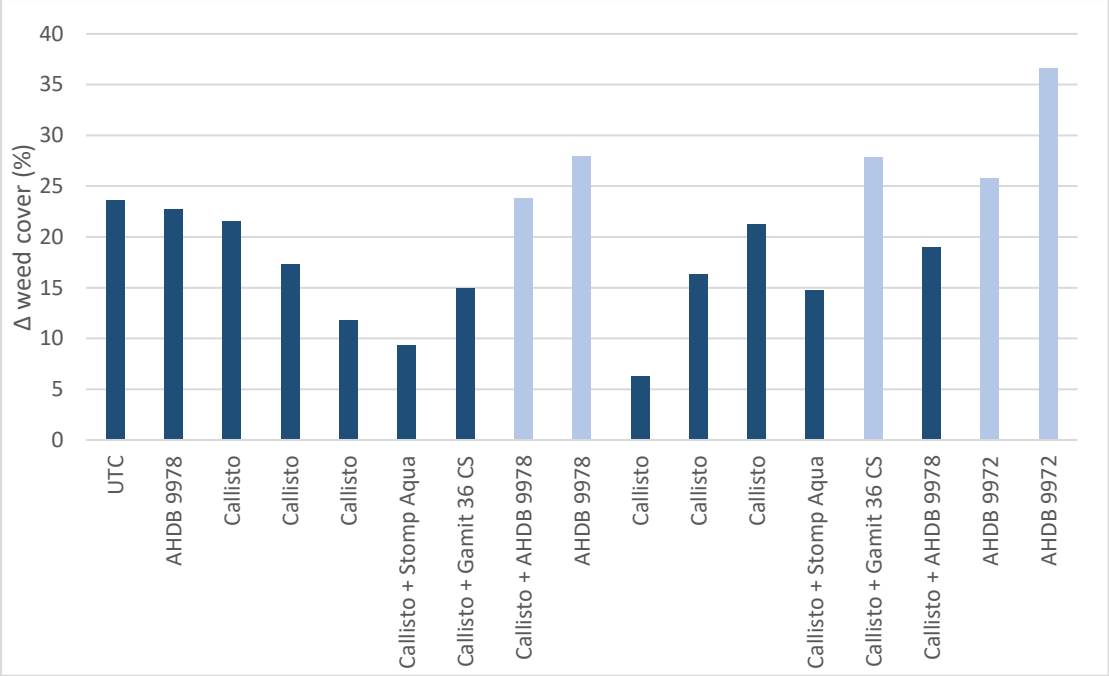


Figure 3. Percentage change in weed cover over 9 week assessment period. Light blue bars indicate treatments where weed cover increase was greater than that of untreated control *(+ve change = weed cover increase, -ve change = weed cover decrease)*.

Discussion

While many treatments scored below the commercially acceptable level for crop quality/effects (phytotoxicity score averaged 7.18 across treatments at final assessment), they were still comparable to the untreated control, which scored 7.25 in the final assessment (Table 1). The untreated was scored as such because there were marks on the leaves of the rhubarb which meant crop appearance for quality was marked lower. Therefore, while all treatments showed some level of damage, this is often comparable in relation to the 'lower' quality score of the untreated control.

Only one treatment scored significantly lower than the untreated control in terms of crop quality by the final assessment; which was Callisto + Gamit 36 CS when applied two weeks after topping. The crop in those plots showed phytotoxic effects which remained at the end of the nine week assessment period.

There were no significant differences in efficacy between treatments, and the weed distribution across the trial remained uneven throughout the nine week assessment period. Levels of weed cover in the untreated plots varied from 17% to 70% at nine weeks after the first application date, therefore while there were trends for less weed in some treatments, any differences in weed levels could not be confidently attributed to treatment effects due to this variability.

Conclusions

- Callisto appears crop safe by harvest when applied immediately post-topping
- A tank-mix of Callisto + Gamit 36 CS caused a greater level of damage when applied over crop foliage compared to other treatments. It causes less effects on the crop if applied sooner after topping.
- Applying Callisto at two weeks after topping, once the crop had started to regrow gave more crop damage and the crop suppression also allowed weeds to take advantage of the lack of competition increasing weed levels.

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 those who provided sites and crops for the trials as well as technical input, particularly Lindsay Hulme, of E. Oldroyd and Sons.

Appendix

a. Crop diary – events related to growing crop

Crop	Cultivar	Planting date	Row width (m)
Rhubarb	Timperley Early	29/01/2016	0.75

Previous cropping

Year	Crop
2014	Winter wheat
2015	Winter barley

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

Date	Product	Rate	Unit
21/02/2016	Nitram	85	kg/ha
19/06/2016	Nitram	60	kg/ha
01/03/2017	Nitram	80	kg/ha

Pesticides applied to trial area

Date	Product	Rate (L/ha)
14/02/16	Gamit 36 CS	0.25
	Stomp Aqua	3.00
05/11/16	Roundup Flex	2.00
15/02/17	Gamit 36 CS	0.25
	Stomp Aqua	3.00

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

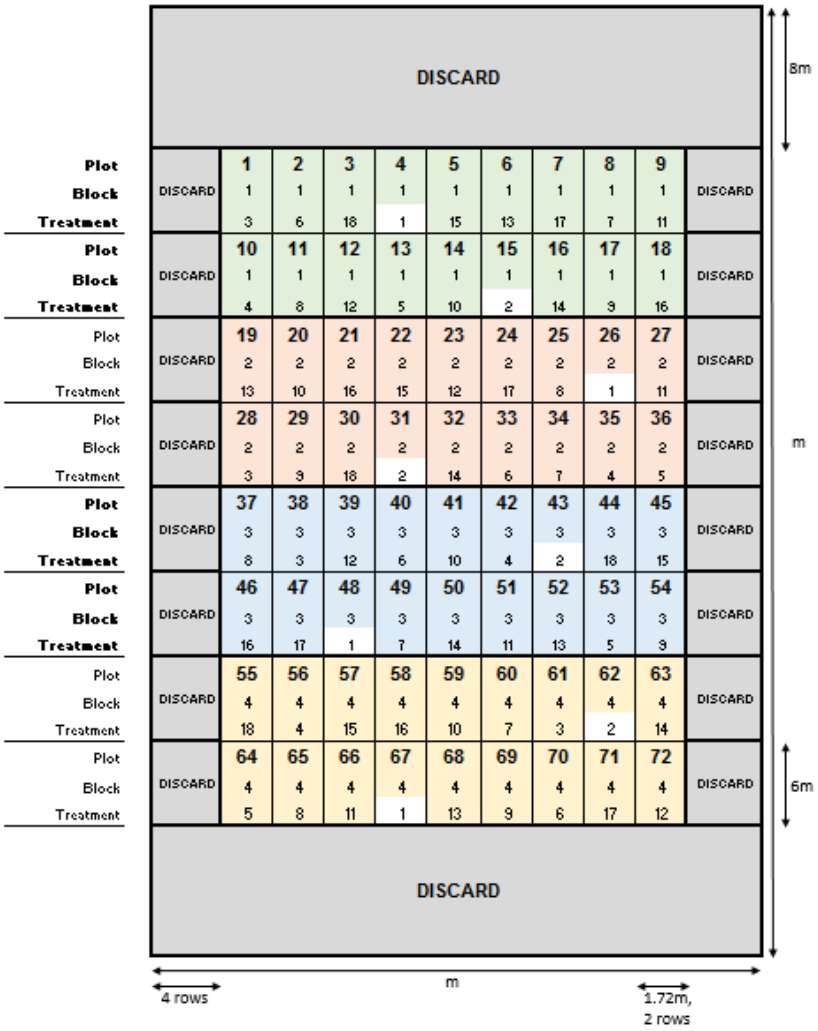
Date	Event
12/07/2017	Baseline assessment (weed presence)
12/07/2017	Timing 1 treatment application
25/07/2017	2 week assessment (weeds, phyto)
25/07/2017	Timing 2 treatment application
09/08/2017	4 week assessment (weeds, phyto)
25/08/2017	6 week assessment (weeds, phyto)
13/09/2017	9 week assessment (weeds, phyto)

c. Climatological data during study period

Date	Temperature °C (minimum)	Temperature °C (maximum)	Rainfall (mm)
12/07/2017	11.1	21.3	0.2
13/07/2017	12.3	23.3	0.2
14/07/2017	12.9	19.3	0.0
15/07/2017	13.9	21.4	0.8
16/07/2017	13.5	22.3	0.0
17/07/2017	12.2	25.2	0.0
18/07/2017	12.9	25.0	0.0
19/07/2017	14.9	25.4	3.2
20/07/2017	13.3	18.2	3.8
21/07/2017	13.1	20.7	0.2
22/07/2017	12.3	21.4	15.2
23/07/2017	11.8	20.8	6.0
24/07/2017	12.2	18.0	2.7
25/07/2017	11.9	22.6	1.1
26/07/2017	11.7	23.3	1.9
27/07/2017	11.7	19.1	2.2
28/07/2017	13.2	21.3	2.2
29/07/2017	13.2	20.4	1.9
30/07/2017	12.6	21.1	1.7
31/07/2017	12.8	20.9	2.3
01/08/2017	12.6	20.7	4.2
02/08/2017	13.7	20.3	2.4
03/08/2017	15.1	20.9	0.2
04/08/2017	13.4	20.0	0.0
05/08/2017	10.6	19.8	0.0
06/08/2017	11.6	19.7	12.4
07/08/2017	12.4	20.7	2.4
08/08/2017	11.7	13.9	12.6
09/08/2017	11.1	18.4	2.4
10/08/2017	9.4	21.9	0.0
11/08/2017	10.8	19.3	0.0
12/08/2017	12.4	21.3	0.0
13/08/2017	9.6	21.2	0.0
14/08/2017	13.6	21.1	1.2
15/08/2017	12.8	21.1	0.2
16/08/2017	11.3	21.6	2.4
17/08/2017	14.1	24.1	9.0
18/08/2017	11.7	18.1	0.8
19/08/2017	11.7	18.4	0.0
20/08/2017	11.9	19.8	0.0
21/08/2017	11.1	19.6	1.0
22/08/2017	16.2	22.7	0.2
23/08/2017	14.1	21.7	13.4
24/08/2017	12.4	19.9	0.0
25/08/2017	13.2	20.4	0.2
26/08/2017	12.3	22.2	0.2
27/08/2017	11.5	24.0	0.0
28/08/2017	15.8	23.7	0.0

Date	Temperature °C (minimum)	Temperature °C (maximum)	Rainfall (mm)
29/08/2017	12.3	19.3	0.6
30/08/2017	10.8	18.3	0.0
31/08/2017	9.8	19.8	0.2
01/09/2017	9.2	19.9	2.2
02/09/2017	8.8	20.8	0.0
03/09/2017	10.8	17.3	0.2
04/09/2017	12.7	21.8	0.8
05/09/2017	12.7	19.7	8.4
06/09/2017	11.4	17.1	1.4
07/09/2017	12.3	16.8	1.2
08/09/2017	11.8	18.2	9.0
09/09/2017	10.1	17.3	2.8
10/09/2017	9.6	17.1	4.4
11/09/2017	10.6	18.3	4.6
12/09/2017	10.9	17.2	6.4
13/09/2017	8.8	16.4	0.2

d. Trial design



e. Example of phytotoxic effects:

Yellowing from Callisto 0.75 L/ha + Gamit 36 CS 0.25 L/ha, applied to foliage of actively growing rhubarb plants (crop pictured 15 days after treatment, 09/08/2017).

f. 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