

# Innovative Farmers Project Report

## Herbicidal weed control in *Solanum* trap crops 2021

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Report Reviewed by: Louise Wright

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## 1. SUMMARY

*Solanum sisymbriifolium* and *Solanum scabrum* are used as trap crops to reduce populations of potato cyst nematodes. No herbicides currently have approval in these crops. The Agriculture and Horticulture Development Board (AHDB) want to identify herbicides which are safe and effective, with a view to applying for Extensions of Authorisation for Minor Uses (EAMUs).

## 2. INTRODUCTION

Trap crops in this context are those which produce root exudates to stimulate hatch of potato cyst nematode (PCN), the larval forms of which are then unable to complete their lifecycle and die, leaving a much reduced number of viable cysts in the soil after cropping. Trap crops are particularly valuable in PCN control in situations where its not possible to grow resistant varieties. One of the most important reasons for failure of trap crops is weed competition, which can even be so severe as to prevent establishment. Currently, the only approved herbicide for trap crops is use of glyphosate pre-cropping. This gap is reducing the potential for wider use of trap crops, a non-chemical form of pest control.

The common name for *S. sisymbriifolium* is sticky nightshade and for *S. scabrum* is African nightshade or garden huckleberry. In Britain they are also commonly known as sisym and scabrum (or broadleaf).

## 3. MATERIALS AND METHODS

### *Trial site and Trial design*

Flatt nook, situated at an altitude of 70 m, latitude of 52.774711 and a Longitude of -2.4199958, near Harper Adams University, Newport, Shropshire, TF10 8NB. (Sandy soil)



Figure 1. The trial site at Flat Nook near Harper Adams University marked by a red cross.

### *Experimental Design*

Randomised complete block with 4 replicates.

### *Equipment*

Drill: Model SD1370 Trials Equipment UK with 150 mm spacing.

### Plot size and layout

Each plot was 1.8 m wide and 10 m long. The plots were drilled with *Solanum sisymbriifolium* or *Solanum scabrum* as per the trial layout. Discards were also drilled at either side of the trial (Figure 2).

SPECIES	scabrum	sisymbriif	scabrum	scabrum	scabrum	sisymbriif	scabrum			sisymbriif	sisymbriif	scabrum	scabrum	sisymbriif	sisymbriif	scabrum		
REP	DISCARD	4	4	4	4	4	4			4	4	4	4	4	4	4		DISCARD
TREATME	DISCARD	4	1	5	4	5	4			3	2	6	3	6	1			DISCARD
PLOT	DISCARD	37	38	39	40	41	42			43	44	45	46	47	48			DISCARD
SPECIES	sisymbriif	sisymbriif	scabrum	sisymbriif	scabrum	scabrum	scabrum			scabrum	sisymbriif	sisymbriif	scabrum	sisymbriif	sisymbriif	sisymbriif		
REP	DISCARD	3	3	3	3	3	3			3	3	3	3	3	3			DISCARD
TREATME	DISCARD	5	6	3	1	3	5			4	2	4	2	6	1			DISCARD
PLOT	DISCARD	25	26	27	28	29	30			31	32	33	34	35	36			DISCARD
SPECIES	scabrum	scabrum	sisymbriif	scabrum	scabrum	sisymbriif	sisymbriif			sisymbriif	scabrum	sisymbriif	sisymbriif	scabrum	scabrum	sisymbriif		
REP	DISCARD	2	2	2	2	2	2			2	2	2	2	2	2			DISCARD
TREATME	DISCARD	3	5	2	5	4	6			1	6	3	2	4	1			DISCARD
PLOT	DISCARD	13	14	15	16	17	18			19	20	21	22	23	24			DISCARD
SPECIES	sisymbriif	sisymbriif	sisymbriif	scabrum	scabrum	scabrum	sisymbriif			sisymbriif	scabrum	sisymbriif	sisymbriif	scabrum	scabrum	scabrum		
REP	DISCARD	1	1	1	1	1	1			1	1	1	1	1	1			DISCARD
TREATME	DISCARD	4	3	5	1	3	1			2	6	5	6	4	2			DISCARD
PLOT	DISCARD	1	2	3	4	5	6			7	8	9	10	11	12			DISCARD

Irrigator tram

Figure 2. The trial layout for the site.

### Drilling dates

The site was drilled 21/06/2021

### Seed

Seed was supplied by Produce Solutions, Sutton Farm, Market Drayton, Shropshire, TF9 2HZ and applied at a rate of 54 g per plot. The seeds were mixed with inert lentils to aid drilling. It was drilled to a depth of 1.5 cm.

### Preparation of the trial site

The trial site was subsoiled to loosen the soil using the McOnal Shakerator. It was then ploughed using the Dow deswell Delta Furr plough and sprayed with the herbicide Azural (glyphosate) at 4 l ha<sup>-1</sup> to remove and control any established weeds that were already present on the site. Finally, it was power harrowed prior to drilling using Dow Deswell Power Harrow with a width of 3 m (Table 1)

### Study chronology

Table 1. Trial diary

Date	Action	Team member
19/04/2021	Site subsoiled to loosen the soil using McOnal Shaker Racker	GW
26/04/2021	Site ploughed	GW
26/05/2021	The trial site was sprayed with the herbicide Azural at 4 lh-1	SC
14/06/2021	Site power harrowed	GW
21/06/2021	All plots drilled according to the plan.	SC, GW
24/06/2021	Treatments 3,4,5 applies according to the protocol	SC, SW
30/07/2021	Treatments 2 and 6 applied according to the protocol.	SC, GW
04/08/2021	Assessments carried out	SC, HV
04/08/2021	Assessments carried out	SC, HV
	NEXT ONE DUE 24TH	
	BROUGHT FORWARD TO THE 14TH SEPTEMBER.	SC, AC
14/09/2021	Assessments carried out	

## Treatment details

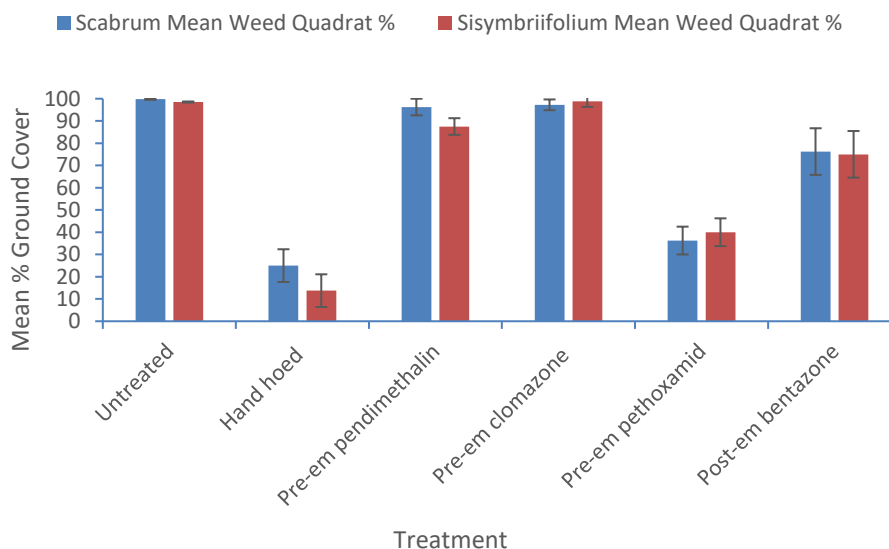
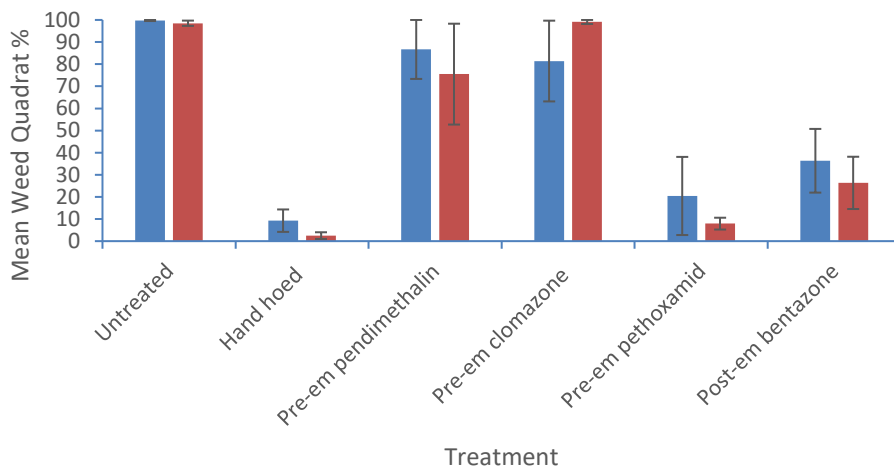
Treatments 3,4,5,6 (Table 2) were applied by hand using the Lunch Box plot sprayer fitted with F110-03 nozzles with a pressure of 2 bar at 6 km<sup>-1</sup>. Treatment 1 was drilled as per the plan and received no treatments. Treatments 2 were all hand hoed. All treatments were made on the advice of the client (AHDB)

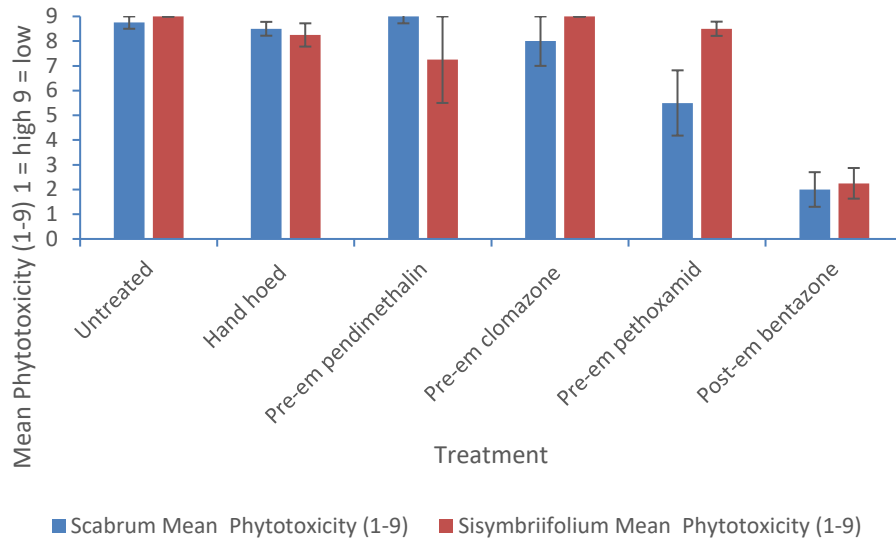
Table 2. Trial treatments and dates of application

Treatment number	Treatment	Rate of application l/ha	Date of application
1	Untreated control	NA	21/06/2021
2	Hand hoed to simulate inter-row cultivation	NA	30/07/2021
3	Pre-em, pendimethalin (Stomp Aqua)	2	24/06/2021
4	Pre-em, clomazone (Clomate)	0.15	24/06/2021
5	Pre-em, pethoxamid (Successor)	1	24/06/2021
6	Post-em, bentazone (Benta)	3	30/07/2021

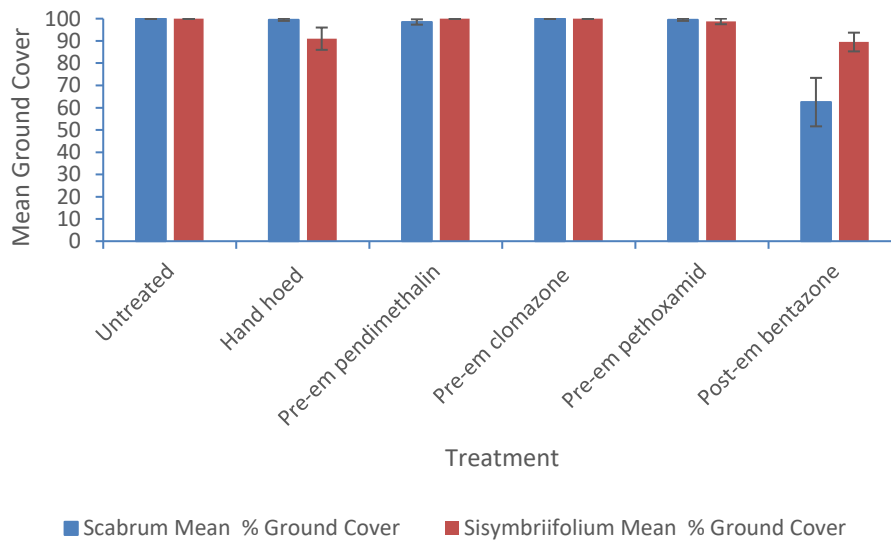
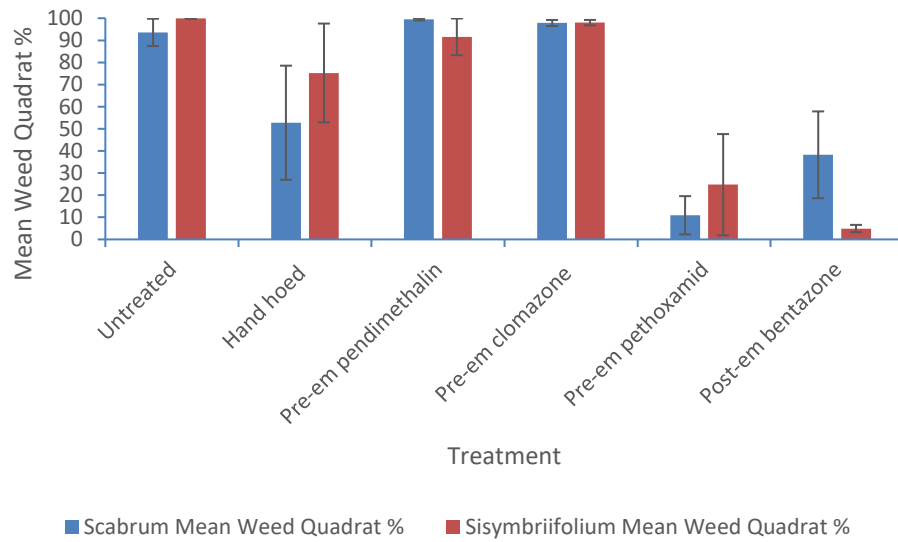
## 4. RESULTS

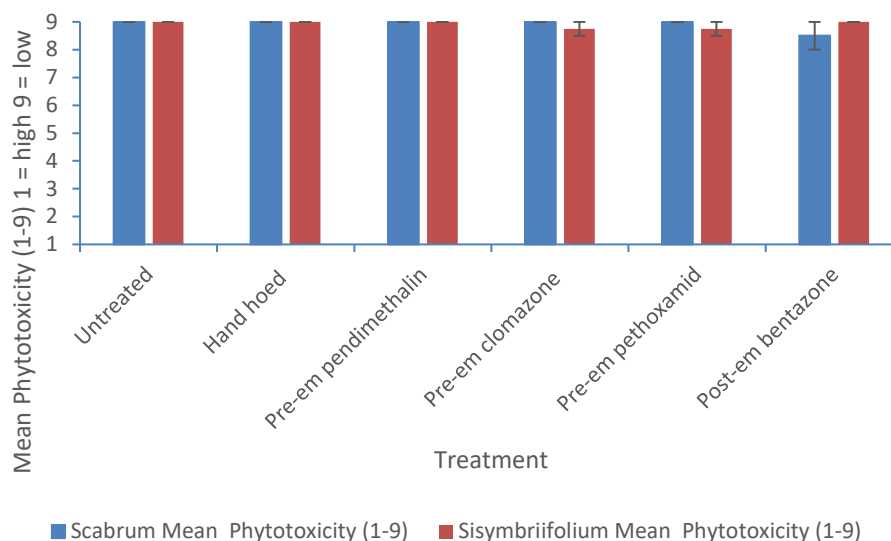
### Assessment 20/08/2021





**Assessment 14/09/2021**





### Summary of results for assessment 20/08/2021

The main weeds on the site were groundsel (*Senecio vulgaris*) mayweed (*Tripleurospermum inodorum*), fat hen (*Chenopodium album*) and small nettle (*Urtica urens*). At eight weeks post drilling the treatment hand hoeing achieved the lowest number of weeds across both species of *Solanum*. However, *Solanum scabrum* had slightly higher number of weeds at 10% than *Solanum sisymbriifolium* which had below 10%. This was closely followed by the pre-em pethoxamid achieving approximately 20% weeds for *Solanum scabrum* and less than 10% for *Solanum sisymbriifolium*. The post-em bentazone showed slightly more weeds at 40% for *Solanum scabrum* and 30% for *S. sisymbriifolium*. The untreated, pre-em pendimethalin and clomazone ranged from 70% to 100% weed coverage. Of note, the post-em treatment bentazone and hand hoeing were carried out on the 30 July 2021. Weeds that were removed by hand were left on the top of the soil. In contrast, the post-em application of bentazone, the weeds were left in the ground to senesce.

The percentage ground cover had a similar pattern to the mean weed quadrat percent, with the untreated, pre-em pendimethalin and pre-em clomazone having high levels of weed that were relatively equally in both the species of *Solanum* crops between 85% to 100% coverage. This is in contrast to the plots that were hand hoed, pre-em pethoxamid and post-em bentazone. Here, the lower percent ground cover reflects less weed and the *Solanum* species becoming established.

The post-em bentazone showed relatively equal amount of phytotoxicity in both the *Solanum* species at approximately level 2 phytotoxicity and was the highest level out of all the treatments and this stage. The pre-em pethoxamid had a greater phytotoxicity effect on *Solanum scabrum* at level 5 whilst its effect on *Solanum sisymbriifolium* appeared no different to the Untreated, hand hoed and the pre-em pendimethalin and clomazone treatments at over level 8.

### Summary of results for assessment 214/09/2021

At thirteen weeks post drilling the treatment post-em bentazone showed the fewest number of weeds present at 10% in the *Solanum sisymbriifolium* plots. However, *Solanum scabrum*, had up to 40% weed cover. In contrast, the pre-em pethoxamid had only 10% weed cover for the *Solanum scabrum* plots and 30% for the *Solanum sisymbriifolium* plots. Hand hoeing at this stage was less effective than at eight weeks post drilling with *Solanum scabrum* at 50% weed coverage and *Solanum sisymbriifolium* at 80%. All other treatments were above 80% weed coverage.

All plots showed high levels of ground cover percentage as the crop or weeds matured. The treatment post-em bentazone had greater number of *Solanum* crops to weeds with *Solanum sisymbriifolium* achieving 90% ground cover with less than 10% weed cover and 60% ground cover with 40% weeds for *Solanum scabrum*. The treatment pre-em pethoxamid also had good numbers of *Solanum* crop cover at 90% with weed percentage for *Solanum sisymbriifolium* at 30% and 10% for *Solanum scabrum*. Hand hoeing produced over 90% ground coverage for *Solanum scabrum* with a 50% weed coverage and 90% coverage and 70% weed for *Solanum sisymbriifolium*. Phytotoxicity at this stage was similar across all treatments with all treatments scoring 8 or 9.

## 5. CONCLUSIONS AND PRACTICAL RECOMMENDATIONS

- Hand hoeing appears to be the most effective form of weed control eight weeks after drilling, closely followed by pre-em and post-em application of pethoxamid and bentazone respectively.
- Pre-em pethoxamid and post-em bentazone were the most effective form of weed control long term.
- The treatments pre-em pendimethlin and clomazone appeared to be the least effective in weed control and were very similar to the control.
- Phytotoxicity was highest in the post-em bentazone treatment at eight weeks with it affecting *Solanum scabrum* with a score of 2 as opposed to a score of 3 for *Solanum sisymbriifolium*.
- *Solanum scabrum* was more sensitive to damage from pethoxamid than *Solanum sisymbriifolium*.
- By the end of the trial the plants damaged by pethoxamid and bentazone were no longer showing visible symptoms, but total ground cover and root growth may have been reduced by the early phytotoxicity.