Grower Summary

SF 161

Strawberry: Investigating rates and application timing of carfentrazone-ethyl (Shark)

Final 2015

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AHDB Horticulture,
AHDB
Stoneleigh Park
Kenilworth
Warwickshire
CV8 2TL

Tel – 0247 669 2051

AHDB Horticulture is a Division of the Agriculture and Horticulture Development Board.

Project title:	Strawberry: Investigating rates and application timing of carfentrazone-ethyl (Shark)
Project number:	SF 151
Project leader:	Janet Allen, ADAS UK Ltd (Originally H. Roberts, ADAS UK Ltd)
Report:	Final report, December 2015
Previous report:	Annual report, December 2014
Key staff:	Janet Allen Emma Worrall Steven Darlington
Location of project:	Sunclose Farm, Cambridgeshire H&H Duncalfe, Wisbech
Industry Representative:	Richard Stanley Rectory Farm, Stanton St John Oxford OX33 1HF
Date project commenced:	1st February 2014
Date project completed	31st September 2015

GROWER SUMMARY

Headline

- Carfentrazone-ethyl (Shark) has potential as an overall treatment in established strawberries for selective post-emergence control of weeds in the planting holes.

Background and expected deliverables

Growers have very few options for the post-emergence control of broad leaved weeds found in soil and substrate grown strawberries. Diquat or glufosinate-ammonium based products can be used as spot treatments or shielded applications when applied to weeds growing in alleyways between crop beds but only clopyralid, phenmedipham and metamitron can be applied over a crop of strawberries. The range of weeds sensitive to clopyralid is limited and its use is more or less exclusively for the control of composite weeds e.g. groundsel, sowthistle (*Sonchus oleraceus*) and creeping thistle (*Cirsium arvense*). Use of clopyralid is also restricted to application between 1 March and 31 August (EAMU). The range of products containing phenmedipham with on label approval for use on strawberry is limited. Use of phenmedipham is restricted to pre-flowering and post-harvest and more or less exclusively post-planting during the establishment period of crops. Phenmedipham can provide control of quite a range of annual broad leaved weed species e.g. black-bindweed (*Fallopia convolvulus*), fat hen (*Chenopodium album*) and groundsel (*Senecio vulgaris*) but only at the small seedling stage. The use of metamitron is permitted by several EAMUs on the established strawberry crop, applied post-harvest, between September and November. Like phenmedipham, metamitron can provide post-emergence control of seedling weeds.

Currently, other than laborious and costly hand weeding, there are relatively few options for the control of annual broad-leaved weeds up to or beyond the two to four leaf stage, for soil and substrate grown strawberry crops. In addition, the herbicides with approval for use on strawberry either provide limited or no post-emergence control of cleavers (*Galium aparine*), hairy bitter cress (*Cardamine hirsuta*), American willowherbs (*Epilobium ciliatum*), black nightshade (*Solanum nigrum*), knotgrass (*Polygonum aviculare*), redshank (*Persicaria maculosa)* and speedwells (*Veronica*). It is estimated that to weed strawberries by hand could cost £1,200/ha. With several sessions of hand weeding required during the life of a strawberry crop, hand weeding is a very expensive method for growers to employ.

In projects SF 91 and 91a, Shark was evaluated initially as a directed spray for the control of strawberry runners (for which it proved ineffective), then as an over the crop dormant season spray. The results of these projects indicated that Shark caused very little lasting damage to

the strawberry plants when applied in the dormant season, to the extent that it could be considered for use as an overall application for this crop.

The aim of this project was to refine rates of Shark and to further confirm crop safety and efficacy against problematic weeds (e.g. American willowherbs, cleavers, redshank and knotgrass) when applied both as a post-harvest and dormant season application.

This information could then be used to increase confidence in the use of Shark as a selective herbicide in strawberries and support an application for an EAMU to permit treatment over the crop both in the dormant season and also post-harvest, for the control of over wintering weeds around plants in soil and substrate grown crops.

Summary of the project and main conclusions

This project included three trials that tested different application timings of Shark; 1) dormant season, 2) post-harvest and 3) post-harvest followed by dormant season.

Trial one – Dormant season application of Shark

The dormant season trial was carried out on a protected (Spanish tunnel) June bearer strawberry crop (cv. Elegance), on a commercial farm in Cambridge. The crop was grown in coir filled bags, set on poly-mulch covered raised beds, and was entering its second (i.e. main season) cropping year. The crop contained a varied but uniform weed population typical of this method of crop production.

There were four treatments in this trial (**Table 1**). Each plot was three metres long and one row of coir filled bags wide, comprising approximately 30 plants. The treatments were applied on one occasion, 19 February 2014, using an air assisted knapsack Oxford Precision Sprayer (OPS) and lance.

Table 1. Treatment list for trial one (dormant season application)

Treatment no.	Treatment	Rate (L/ha)	Timing
1	Untreated	N/A	N/A
2	Hand-weeded	N/A	19 February 2014
3	Shark	0.33	19 February 2014
4	Shark	0.8	19 February 2014

The plots were assessed for any signs of damage or effects to strawberry plant growth some two, four and eight weeks after the treatments were applied and then again at harvest. Weed assessments were carried out prior to trial set up and also at two, four and eight weeks after treatments had been applied.

The fruit produced from the individual plots was harvested by farm staff over a three week period. Yield and number of berries of class one, class two and waste fruit was recorded.

Despite some initial scorching of overwintered green leaves (**Figure 1**), the use of Shark as an over the crop dormant season spray appeared to have no lasting phytotoxic effects on strawberry plants, yield or quality of fruit produced by treated plants (**Table 2**)**.** No statistically significant effects were seen as regards to weed control achieved from the use of either 0.33 or 0.8 L of Shark but this was due to the trial site's light weed population. Both rates of Shark displayed promising efficacy against American willowherbs, chickweed (*Stellaria media*) and both rates had some effect on groundsel. No residues of carfentrazone-ethyl were detected in fruit collected and submitted for analysis during the first harvest of the treated plants.

Figure 1. Scorching to plants treated with Shark (0.8 L/ha) was seen two weeks after treatment in the dormant season trial

Table 2. Results of dormant season applications on crop safety, weed control and marketable yield.

Treatment	Phytotoxicity 2 weeks after treatment	Phytotoxicity 8 weeks after treatment	% weed cover in alleyway 2 weeks after treatment	Average marketable yield g/plant
Untreated	9.0	9.0	20.0	700.31
Hand weeded	9.0	9.0	0.5	802.03
Shark 0.33 L/ha	8.0	9.0	14.5	774.96
Shark 0.8 L/ha	6.5	9.0	12.5	807.84
P value	<0.001	NS	0.017	NS
l.s.d. (d.f. 9)	0.884	NS	10.89	164.5

Phytotoxicity scored on a 0-9 scale where 0 is plant death and 9 is no effect

Trial two – Post-harvest application of Shark

The post-harvest trial was located on the same farm as the dormant season trial but this time the June bearer cv. Elsanta was used. The crop was planted in April 2014 as ex-cold stored A+ (13-19mm) runners that were sourced from the Netherlands. The crop was grown under a Spanish tunnel, which was clad from planting until harvest was completed (mid-July 2014) and then again from 7 April 2015 until September.

The post-harvest trial compared two rates of Shark (**Table 3**). Each plot was three metres long and one row of coir filled bags wide, comprising approximately 30 plants. The treatments were applied on one occasion, 22 July 2014, using an air assisted OPS knapsack sprayer and lance.

Table 3. Treatment list for trial two (post-harvest application)

Treatment no.	Treatment	Rate (L/ha)	Timing
1	Untreated	N/A	N/A
2	Hand-weeded	N/A	22 July 2014
3	Shark	0.33	22 July 2014
4	Shark	0.8	22 July 2014

For the post-harvest trial the strawberry plants were assessed for any damage two and four weeks after treatment application, the following March as growth commenced, at flowering and again prior to harvest in 2015. Weed populations were assessed at two and four weeks after treatment.

The fruit produced from the individual plots of both trials was harvested by farm staff over a three week period. The yield and number of berries of class one and waste fruit were recorded.

The post-harvest application of Shark also produced some initial scorching of the older leaves of treated strawberry plants (**Figure 2**). However, newly emerging leaves were unaffected and no signs of toxicity to crop foliage was observed when the next plant assessments were made in March 2015 (**Table 4**). At two weeks after application, both rates of Shark significantly reduced the number of weeds in planting holes, although no significant effect was seen with the number of weeds growing in the alleyways, between the treated crop rows. Assessments were carried out two and four weeks after Shark application to determine if Shark had any effect upon the incidence of powdery mildew. The number of live crowns per plant were also recorded. No significant effects were seen with powdery mildew incidence or number of live crowns per plant. There were no yield reductions in 2015 resulting from the previous season's application of Shark at 0.33 L/ha but where Shark was applied at 0.8 L/ha the plants produced a significantly lower yield of class one fruit.

Figure 2. Scorching to plants treated with Shark (0.8 L/ha) two weeks after treatment in the post-harvest trial

Table 4. Results of post-harvest season applications on crop safety, weed number and yield of class one strawberries.

Treatment	Phytotoxicity 2 weeks after treatment	Phytotoxicity as growth commences	No. weeds in planting holes 2 weeks after treatment	Class 1 yield g/plant
Untreated	9.0	9.0	4.0	391.97
Hand weeded	9.0	9.0	1.0	443.13
Shark 0.33 L/ha	7.5	8.9	0.8	435.49
Shark 0.8 L/ha	5.5	9.0	0.8	280.64
P value	<0.001	NS	0.032	0.005
l.s.d. (d.f. 9)	0.653	0.199	1.622	81.200

Phytotoxicity scored on a 0-9 scale where 0 is plant death and 9 in no effect

Trial three – Post-harvest and dormant season application of Shark

The final trial was located on two commercial farms; one near Cambridge where the treated cultivar was Elsanta, the other was set up at Wisbech where the cultivar used was Sonata. On both sites, the trial comprised two treated 20 m long rows of strawberries and two untreated 20 m long rows of strawberries. Shark was applied over the crop at 0.4 L/ha on two occasions to give a total dose of 0.8 L/ha (**Table 5**). Shark was applied to each site post-harvest, on 22 August 2014, and again in the dormant season, 6 March 2015.

Table 5. Treatment list for trial three (post-harvest and dormant season applications)

Treatment no.	Treatment	Rate (L/ha)	Timing
1	Untreated	N/A	N/A
2	Shark	0.4	22 July 2014 and 6 March 2015

No formal assessments were made for these trials, although samples of fruit were picked at harvest and submitted for Good Laboratory Practice (GLP) residue analysis to support an application for an Extension of Authorisation for Minor Use (EAMU) for the use of Shark on strawberry, as an over the crop treatment, post-harvest and in the dormant season.

No residues were detected in the berry samples submitted for these trials.

Financial benefits

At present, the use of chemical herbicides in the crop row and planting holes of strawberry crops from late winter to early spring and immediately post-harvest, is more or less impossible, whether the weeds are present as seedlings or established plants.

Considerable hand weeding of plants is therefore carried out in crops post-winter, prior to the onset of growth, and again as soon as the final fruits have been harvested. Growers have no options available for the post-emergence control of weeds such as American willowherbs, mallows, knotgrass, hairy bitter cress and small nettle; all of which often overwinter within strawberry crops. Similarly, soil grown crops often become contaminated with carfentrazone-ethyl susceptible weed species (redshank, pale persicaria, knotgrass and black nightshade) during harvest, which again can only be cleared by hand weeding.

It is estimated that the removal of weeds by hand could cost up to £1,200/ha per session. Typically, a strawberry plantation in a single growing season may require hand weeding on several occasions. Increasing the options available to commercial strawberry growers for post-emergence weed control could save growers in excess of £2,000/ha. The ability to use Shark on strawberry would therefore be very beneficial for growers.

Action points for growers

- For growers to benefit from this project, an EAMU would be required for carfentrazone-ethyl.
- A post-harvest application of Shark at the higher (0.8 L/ha) rate appears to carry the risk of yield reduction the following year.