



Grower summary

SF 91 and 91a

Strawberry: Evaluation of
herbicides for use in bed
systems

Final Report July 2010

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Headline

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A range of herbicide products were assessed for use in strawberry bed systems and successful treatments were identified for use in alleyways, over beds and for runner control.

Background and expected deliverables

The majority of strawberries produced in the UK are grown in plastic-mulched raised beds. The alleyways between beds can be difficult to keep weed-free, because of the lack of crop competition. Where the alleyway is treated rather than the crop, there is the potential for using less selective herbicides that would not be safe when used over the crop. This project evaluated the safety and efficacy of a range of herbicides for total weed control in the alleyway.

The increasingly common practices of both bed replanting and thinning of high density plantings results in gaps in the plastic-mulched beds and consequent weed control problems. The problems have been exacerbated by the loss of soil fumigants. The use of chemical weed control over plastic-mulched beds has the potential for significant cost saving compared with hand-weeding. This project evaluated the safety of existing approved strawberry herbicides and novel products when used over beds.

The recent loss of the contact herbicide paraquat from the UK market has reduced the options available for runner and weed control between strawberry beds. The introduction of the contact herbicide Shark (carfentrazone-ethyl) was thought to offer another alternative for contact weed and runner control. This project evaluated the efficacy of Shark for runner and weed control in strawberry bed alleyways compared with industry standards. An extension to the project (SF 91a, also reported here) evaluated the potential for using Shark as an overall dormant season treatment to selectively clean up existing weeds in plastic mulched beds and in traditional matted-row plantings.

The expected deliverables from this project are:

- Information on the relative efficacy and crop safety of selected herbicides when used as alleyway or over-bed treatments for weed control during the growing season in strawberries.
- Information about the level of chemical residues in fruit resulting from over-bed herbicide application to strawberries grown in plastic mulched beds.

- Information on the relative efficacy and crop safety of Shark when used as a runner control treatment in the alleyways and as an overall dormant season treatment.

Summary of the project and main conclusions

Alleyway treatments

A range of herbicides (Table 1) were applied in the spring to the alleyways between previously used plastic-mulched strawberry beds that were not currently planted, but were subsequently planted after the alleyway spray application. Two experiments were carried out, with different sites used in 2008 and 2009.

Table 1. Residual herbicide treatments applied to strawberry alleyways

Product	Active ingredient	Product rate	Approval status (strawberries)
Stomp 400SC + Flexidor 125	pendimethalin (400 g/L) + isoxaben (125 g/L)	3.3 L/ha + 2.0 L/ha	Label
Ally SX	metsulfuron methyl (20% w/w)	0.03 kg/ha	Not approved
Artist	flufenacet (24 % w/w)+ metribuzin (17.5 % w/w)	2.5 kg/ha	Not approved
Calaris	terbuthylazine (330 g/L) + mesotrione (70 g/L)	1.5 L/ha	Not approved
Chikara	flazasufuron (25% w/w)	0.15-0.2 kg/ha	Not approved
Diuron 80WP	diuron (80% w/w)	1.25 kg/ha	Not approved
Goal 2E	oxyfluorfen (2 g/L)	2.0 L/ha	Not approved
Ronstar Liquid	oxadiazon (250 g/L)	4.0 L/ha	Not approved
Sencorex WG	metribuzin (70% w/w)	0.7-1.0 kg/ha	Not approved
Skirmish	terbuthylazine (420 g/L) + isoxaben (75 g/L)	1.0 L/ha	Not approved
Springbok	dimethenamid-p (200 g/L) + metazachlor (200 g/L)	2.5 L/ha	Not approved
Sumimax	flumioxazine (300 g/L)	0.1 L/ha	Not approved

Goal 2E was only tested in 2008 and Diuron 80WP and Springbok were only tested in 2009. Where two rates are listed, the lower rate was used in 2009.

- Chikara and Sencorex WG gave the best control of the predominant weeds; annual meadow grass (*Poa annua*), groundsel (*Senecio vulgaris*), American willowherb (*Epilobium ciliatum*) and sow-thistle (*Sonchus oleraceus*) and had good persistence.
- Ally SX performed well where groundsel and annual meadow grass predominated, but in 2008 failed to control American willowherb.
- Ronstar Liquid and Springbok were initially very effective on groundsel and annual meadow grass but were less persistent than Chikara, Sencorex WG or Ally SX.
- Artist, Calaris, Skirmish and Sumimax give significant levels of weed control but showed some weakness in groundsel control.
- No damage was noted in the crop planted subsequently into the adjacent beds.

Bed treatments

A further range of herbicides was assessed for crop safety, chemical residues and weed control when applied to strawberries post-planting over the plastic-mulched beds. Two sets of experiments were carried out over two years (four experiments in total). Residual herbicides (Table 2) were applied shortly after planting in May to 60- day crops planted as cold stored runners in early leaf. Contact herbicides (Table 3) were applied to similar crops but just before flowering. The experiments were carried out on different sites using the cultivars Elsanta (2008) or Sonata (2009).

- Goltix Flowable appeared to give the best weed control from results in 2008. A few leaves showed slight yellowing in 2009 but vigour and yield was not affected. There was insufficient weed germination in 2009 to further test the efficacy of the residual treatments.
- No foliar phytotoxicity symptoms were seen in 2008 although HDC H5 slightly reduced yields, but in 2009 Springbok and HDC H5 caused unacceptable stunting.

Table 2. Residual herbicide treatments applied to strawberry beds

Product	Active ingredient	Product rate	Approval status (strawberries)
Devrinol ¹	napropamide (450 g/L)	5.0 L/ha	Label
Dual Gold	s-metolachlor (960 g/L)	1.4-1.6 L/ha	SOLA 1389/10 ³
Goltix Flowable	metamitron (700 g/L)	5.0 L/ha	Not approved pre-harvest
Springbok ²	dimethenamid-p (200 g/L) +	2.5 L/ha	Not approved

	metazachlor (200 g/L)		
HDC H5	confidential (500 g/L)	3.0 L/ha	Not approved

¹Devrinol was only tested in 2008

²Springbok was only tested in 2009.

³SOLA 1389/10 allows for 2 applications of Dual Gold at 0.7 L/ha to be made.

Table 3. Contact herbicide treatments applied to strawberry beds

Product	Active ingredient	Product rate	Approval status (strawberries)
Alpha phenmedipham 320	phenmedipham (320 g/L)	1.25 L/ha	Label
Beetup	phenmedipham (160 g/L)	2.5 L/ha	Label
Defy	prosulfocarb (800 g/L)	5.0 L/ha	Not approved
Dow Shield	clopyralid (200 g/L)	0.5 L/ha	Label but not for maidens
Goltix Flowable	metamitron (700 g/L)	3.0 L/ha	Not approved pre-harvest
Alpha phenmedipham 320 + Goltix Flowable	phenmedipham (320 g/L) + metamitron (700 g/L)	1.25 L/ha + 3.0 L/ha	Label Not approved pre-harvest

Beetup was replaced with Alpha phenmedipham 320 in 2009, Defy was only tested in 2008 and the tank mixture of Alpha phenmedipham 320 + Goltix Flowable was only tested in 2009.

- Defy caused unacceptable foliage and flower distortion and reduced yield. The plants did subsequently recover to some extent.
- The Alpha phenmedipham 320 + Goltix Flowable tank mix caused some foliar yellowing and stunting.
- None of the other treatments caused phytotoxicity or loss of yield.
- The only residues found were 0.02 mg/kg metamitron (below the MRL of 0.1 mg/kg) from Goltix Flowable applied at the higher 5 L/ha rate in 2008. No residues were found in 2009.
- There was insufficient weed germination to test the efficacy of the post emergence treatments.

Runner and alleyway treatments

In an assessment of runner and alleyway weed control, herbicide treatments (Tables 4 and 5) were applied to runner and weed growth adjacent to the beds in the autumn. Straight

treatments were tested in 2008 (Table 4) and tank mixtures were tested in 2009 (Table 5). The main weeds present in both years were annual meadow grass, American willowherb and hairy bittercress (*Cardamine hirsutum*)

- Reglone was only partially effective at controlling runners and weed growth.
- Shark was much less effective than Harvest at controlling runners and left some weeds uncontrolled, particularly annual meadow grass.
- Harvest was an effective treatment for runner control when used at the 5 L/ha rate. The addition of Shark improved weed and runner control compared with harvest alone but the difference was slight.
- Because no runner translocation damage resulted from any of the treatments, it is not possible to say if the addition of Shark could act as a safener for Harvest when used in the autumn on non-cut runners. However because of the relative lack of activity of Shark on strawberry runners this effect is unlikely
- For control of cleavers (*Galium aparine*) and small nettles (*Urtica urens*), Shark does have some advantages over Harvest although these weeds were not present in the experiments reported here.

Table 4. Contact herbicide treatments applied to the alleyway between strawberry beds 2008 experiment

Product	Active ingredient	Product rate	Approval status (strawberries)
Shark	carfentrazone-ethyl (60 g/L)	0.8 or 1.6 L/ha	Not approved
Harvest	glufosinate-ammonium (150 g/L)	5.0 L/ha	Label
Reglone	diquat	2.0 L/ha	Label

Table 5. Contact herbicide treatments applied to the alleyway between strawberry beds 2009 experiment

Product	Active ingredient	Product rate	Approval status (strawberries)
Shark	carfentrazone-ethyl (60 g/L)	1.6 L/ha	Not approved
Harvest	glufosinate-ammonium (150 g/L)	5.0 L/ha	Label
Harvest + Shark	glufosinate-ammonium (150 g/L) + carfentrazone-ethyl (60 g/L)	3.0 L/ha 1.6 L/ha	Label Not approved

Harvest	glufosinate-ammonium (150 g/L + 5.0 L/ha	Label
+ Shark	carfentrazone-ethyl 60 g/L) 1.6 L/ha	Not approved

Shark application over crop foliage

In an evaluation of dormant season overall application, Shark was applied at two rates (0.33 and 0.8 L/ha) and three application timings (1 December 2009, 28 January and 8 April 2010) to strawberries grown on plastic covered raised beds or traditional matted rows.

- The December and January applications did not result in any crop injury or loss of crowns.
- The April applications scorched the leaf that was present at the time of spraying but the plants re-grew strongly. There was no loss of crowns, flowers or reduction in berry numbers at the time of first pick although the overall crop canopy was slightly thinner at one site.
- American willowherb was controlled on the Shark treated plots and dandelions present at one site were scorched and effectively controlled. The lower rate was as effective as the higher rate.

Financial benefits

Some of the most effective treatments tested, Chikara (on soil pathways) and Shark, require SOLAs before they can be adopted by growers. Therefore there is no financial benefit from these treatments at present.

A SOLA would be required to permit the use of Chikara on pathways between strawberry crops. For these crops, the benefit in improved weed control could be around 100hr/ha or £600/ha. Chikara is relatively expensive at £300 / ha compared with a standard treatment such as Stomp 400SC 3.3 L/ha + Flexidor 2.0 L/ha (£130 / ha) but the treated pathway area is typically 50% of the field area. Sencorex WG was slightly less effective than Chikara but much cheaper at around £40/ha for 1kg/ha.

For over-bed treatments, some growers already use Dow Shield (clopyralid) or approved phenmedipham products similar to Beetup. It is reassuring that so far, no residues have been found in the fruit following these treatments. Goltix (metamitron) shows some potential for use as a bed treatment. At present the specific off-label approval (SOLA) only covers post-harvest use, but with the impending withdrawal of Ramrod (propachlor), Goltix could provide a partial replacement for groundsel control in particular. Dual Gold now has a SOLA for use in strawberries and could contribute to general weed control. For example studies in

Project HNS 139 showed that willowherb was effectively controlled and groundsel partially controlled.

It is estimated that hand weeding costs could be up to £1,200/ha per weeding session (i.e. 3p per plant/hole @ 40,000 plants /ha). Typically a crop may require one further weeding session at a quicker rate of £600/ha (i.e. 1.5p per plant/hole) per year. The total saving, by eliminating the need for hand weeding (£2,100/ha or 300 hr/ha @ £7 per hr including overheads) and allowing for spray application costs (£100/ha), could amount to £2000/ha.

Action points for growers

- Now available, Dual Gold appears to be safe for use over strawberry beds and, subject to conditions on the SOLA (1389/10) could provide useful residual control of a range of weeds.
- Goltix was safe applied over strawberry beds. It is currently approved for use post-harvest and could provide a useful alternative to Ramrod for short term residual control of groundsel. A low level of residue was detected in the fruit when tested at the higher rate pre-harvest – this use is not currently approved.
- Currently approved herbicides Dow Shield and Devrinol did not give rise to residues when applied post-planting, pre-flowering over the plastic-mulched strawberry beds. Similarly Beetup did not give rise to residues. Beetup is not currently approved on strawberries but similar formulations of phenmedipham are approved.
- Chikara was the most effective total herbicide for weed control between strawberry beds (Figs 1 and 2). It is approved for use on land not intended to bear vegetation. For strawberry crops, a SOLA would be required to allow use between plastic-mulched beds.
- Shark was not as effective as Harvest for the control of strawberry runners between beds, but it was more effective than Reglone. No damage was seen on the mother plants in early spring even though the runners were not cut when sprayed in the autumn.
- Shark has good potential for use as an overall dormant season clean-up treatment in both bed and matted row strawberries provided a SOLA can be obtained for this use.