



Agriculture & Horticulture  
DEVELOPMENT BOARD



# **Grower Summary**

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## **FV 372**

Evaluation of potential  
alternatives for weed control in  
asparagus following the loss of  
herbicides

Final Report 2011

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Read the label before use: use pesticides safely.

## **Further information**

If you would like a copy of the full report, please email the HDC office ([hdc@hdc.ahdb.org.uk](mailto:hdc@hdc.ahdb.org.uk)), quoting your HDC number, alternatively contact the HDC at the address below.

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## Headline

New herbicide solutions exist for weed control in asparagus offering the potential for SOLAs in the following uses:

- Applied pre-emergence of spears:  
Callisto, Sumimax, BUK 9900H and Goltix 90 controlled groundsel. Black nightshade was controlled by Callisto and BUK 9900H.
- Applied post-harvest:  
Callisto performed well on a range of weeds and Sumimax was effective on black nightshade. However, where fern was present, Callisto caused severe damage and Sumimax was also damaging.

## Background and expected deliverables

Weeds in asparagus crops reduce the yield and quality of spears and delay crop maturity. Nettles and thistles also deter pickers. Some herbicides can cause damage and also affect quality. Effective herbicides simazine, terbacil and diuron have been lost as a result of the Pesticide Review 91/414/EEC and can no longer be used (although diuron may eventually become available again). There may be further losses under the new Regulation EC 1107/2009 where registration criteria will be hazard-based. In addition, herbicide dose rates may be reduced at product re-registration stage which may reduce their efficacy. Crop protection companies cannot justify the cost of the development and approval process for herbicides for minor, high value crops such as asparagus. There are nine selective herbicides remaining for asparagus, all of which are SOLAs. None of these herbicides are, or are likely to be, authorised for use during the harvest period.

Asparagus is a perennial crop which is grown for up to 10 years. Frequent use of the limited range of herbicides has led to a build-up of weed species that may escape control, and problems also occur where weed seeds are exposed when pickers disturb the soil. A survey of growers by the Asparagus Growers Association in 2004 reported that thistles, nettles, field bindweed and fat-hen were frequently occurring weeds with black nightshade, groundsel and cleavers being the most serious problems. Since then, SOLAs for clopyralid (for thistles), metamitron (for groundsel) and clomazone (cleavers and groundsel), may have reduced the

problem. Metamitron is authorised for pre-emergence and post-harvest use on newly planted asparagus, but only post-harvest use on established crops,. Growers suggest that control of black-nightshade and groundsel is still difficult.

The objectives of this project were to:

- identify alternative herbicides with the potential for SOLA applications to replace those lost in the EC Review for weed control in asparagus.
- evaluate herbicides applied pre-emergence of spears or post-harvest in a screening trial and to identify effective herbicides that are free of phytotoxic effects.
- select the most promising candidates with the aim of obtaining residues data so that HDC can submit applications for SOLAs.

This could provide a wider range of herbicides so that a weed control strategy using different herbicides at different timings would prevent the build up of certain species, and avoid weed resistance.

## Summary of the project and main conclusions

Herbicide screening trials in 2010 were as follows:

Site 1 in newly planted crowns (Spalding) on light silt soil;

Site 2 a 6-year established commercial crop (Salford Priors) on a sandy clay loam.

### ***Herbicide Treatments*** (applied in 200l/ha water volume)

Site 1 newly planted crowns

<i>Herbicide Product</i>	<i>Active Ingredient</i>	<i>Dose product l/ha</i>
1. untreated	-	
<i>Pre-emergence</i>		
2. Callisto	mesotrione	1.5 L
3. Sumimax	flumioxazin	0.1 L
4. BUK 9900H	confidential	4.0 l
5. Stomp Aqua + Goltix 90 + HDCH1	pendimethalin + metamitron + confidential	3.3 l + 2.2 kg + 2.0 L
<i>Post-harvest (fern and spears not removed)</i>		
6. Callisto	mesotrione	1.5 L
7. Sumimax	flumioxazin	0.1 L
8. BUK 9900H	confidential	4.0 l
9. Stomp Aqua + Goltix 90 + HDCH1	pendimethalin + metamitron + confidential	3.3 l + 2.2 kg + 2.0 L
<i>Full fern</i>		
10. Goltix 90 +oil	metamitron + oil	2.2 kg + 0.2 L

Site 2 established 6-year crop

<i>Herbicide Product</i>	<i>Active Ingredient</i>	<i>Dose product l/ha</i>
1. untreated	-	
1a. Roundup Biactive	glyphosate	4.0 L
<i>Pre-emergence</i>		
2. Callisto	mesotrione	1.5 L
3. Sumimax	flumioxazin	0.1 L
4. BUK 9900H	confidential	4.0 l
5. Stomp Aqua + Goltix 90 + HDCH1	pendimethalin + metamiltron + confidential	3.3 l + 2.2 kg + 2.0 L
11. Dual Gold	s-metolachlor	1.4 L
12. Goltix 90	metamiltron	2.2 kg
13. Flexidor + Sencorex	isoxaben + metribuzin	1.75 l + 0.9 kg
14. HDC H1	confidential	2.0 L
<i>Post-harvest most fern and spears removed</i>		
6. Callisto	mesotrione	1.5 L
6a. Callisto + Roundup Biactive	mesotrione + glyphosate	1.5 l + 4.0 L
7. Sumimax	flumioxazin	0.1 L
7a. Sumimax + Roundup Biactive	flumioxazin+ glyphosate	0.1 L+ 4.0 L
8. BUK 9900H	confidential	4.0 l
8a. BUK 9900H + Roundup Biactive	confidential+ glyphosate	4.0 l + 4.0 L
9. Stomp Aqua + Goltix 90 + HDCH1	pendimethalin + metamiltron + confidential	3.3 l + 2.2 kg + 2.0 L
9a. Stomp Aqua + Goltix 90 + HDCH1 + Roundup Biactive	pendimethalin + metamiltron + confidential+ glyphosate	3.3 l + 2.2 kg + 2.0 L+ 4.0 L
<i>Full fern</i>		
10. Goltix 90 + oil	metamiltron + oil	2.2 kg + 0.2 L

## **Crop safety**

### *Herbicides pre-emergence of spears*

All herbicides tested were safe to newly planted crowns of asparagus at Site 1 – no herbicide effect was observed on spear emergence or damage to emerged spears. Counts in mid-July (10 asparagus plants per plot) showed that numbers of new spears and live buds just below ground were not reduced by any of the herbicide treatments - numbers were related to herbicide efficacy and percentage (%) weed cover and demonstrated the detrimental effect of weeds on the crop. The highest numbers of buds were for tank-mix treatment 6, where plots remained virtually weed-free.

The herbicides were all safe to the 6-year established crop at Site 2.

### *Post-harvest herbicides*

At Site 1, the safety of herbicides on spears and fern was evaluated to see whether removal would be necessary. Callisto 1.5 l/ha caused severe damage, bleaching of fern with several primary shoots dying. Only a very few buds (below soil level) survived. Sumimax was slower to act and was also too damaging to fern and reduced bud numbers.

The following treatments appear to be safe to spray when fern is present: BUK 9900H and the tank-mix Stomp Aqua + Goltix 90 + HDC H1 had very little effect on the asparagus fern although a slight kink in the stems of occasional asparagus stems developed, possibly caused by pendimethalin. Goltix 90 + oil had no effect on the asparagus fern.

At Site 2, post-harvest plots were split so that treatments were applied with or without Roundup Biactive 4.0 l/ha. In a commercial situation in a weedy crop, glyphosate would be added to a tank-mix of residual herbicide(s). The fern and most spears were cut back, but a small number, 2-6 cm high, remained when post-harvest treatments were applied. Remaining spears suffered slight temporary effects: bleaching from Callisto; stunting from Sumimax and slight distortion from BUK 9900. These effects soon grew out. If fern and most spears are removed it appears to be safe to use any of these herbicides, but **caution is advised particularly with Callisto on newly planted crops**. Treatment with Goltix + oil, applied later to fern, was also safe.

## **Weed control**

### *Herbicides pre-emergence of spears*

There were 11 weed species at Site 1, mainly *Chenopodium* spp., knotgrass, red dead-nettle, small nettle and a late flush of annual meadow-grass. All herbicides gave excellent control of fat-hen, fig-leaved goosefoot, red dead-nettle, small nettle, shepherds purse and chickweed. The knotgrass that escaped control with Callisto 1.5 l/ha and Sumimax 100 ml/ha over-ran plots and neither herbicide controlled a late flush of annual meadow-grass. BUK 9900H 4.0 l/ha was more effective on these weeds but did not control mustard. The best control was with the tank-mix Stomp Aqua + Goltix 90 + HDC H1. Seven weeks after application a few weeds began to emerge on treated plots, so even in the absence of soil disturbance during harvesting in this first year crop, herbicides may not persist until a post-harvest treatment can be applied.

At site 2 there were high populations of the target species black nightshade (260 plants/m<sup>2</sup>) and groundsel (41 plants/m<sup>2</sup>) in the established crop. Callisto 1.5 l/ha (treatment 2) and BUK 9900H 4.0 l/ha (treatment 4) performed best on these two weeds. Here control of groundsel was 100% with Callisto (mesotrione) 1.5 l/ha; 84% Sumimax 100ml; 92% BUK 9900H at 4.0 l/ha; and 89% with Goltix 90 2.2 kg/ha. Sumimax and Goltix pre-emergence were not effective on black nightshade. Efficacy of HDC H1 2 l/ha on both weeds was poor. The components of the tank-mix (treatment 5): Goltix 90 2.2 kg was mainly responsible for the 89% control of groundsel; Stomp Aqua 3.3 l/ha for 81% black nightshade control. Dual Gold 1.4 l/ha (treatment 11) and the tank-mix of Flexidor (1.75 l/ha) + Sencorex (0.9 kg/ha) (treatment 13) were effective on black nightshade in this trial, but inadequate on groundsel. The poor control of groundsel supports observations that groundsel may have become resistant to Sencorex (metribuzin) at this site and currently there is no other active that is effective on groundsel approved for use pre-spear-emergence in an established crop. All treatments gave excellent control of populations of fat-hen (46 plants/m<sup>2</sup>) with the exception of Dual Gold, which was inadequate.

### *Post-harvest herbicides*

At Site 1, no herbicides were applied pre-emergence to these plots and weeds were very large at the post-harvest timing. Callisto 1.5 l/ha was the most effective treatment leaving only 10% of the plot covered by weeds - a reduction from the total cover of 86% before



treatment. Most species were killed: fat-hen, small nettle, red dead-nettle, shepherd's purse, groundsel, and chickweed. Knotgrass, annual meadow-grass and speedwells were less well controlled. The weeds were too large for control with Sumimax – although it caused severe damage to fat-hen, this re-grew. Sumimax had little effect on knotgrass (present in low numbers) or annual meadow-grass. The tank-mix Stomp Aqua (3.3 l/ha) + Goltix 90 (2.2 kg/ha) + HDC H1 2.0 l/ha gave good weed control and caused scorch and stunting of fat-hen and fig-leaved goosefoot, but their stems remained green and plants did not die. Red dead-nettle, small nettle, chickweed and shepherd's purse suffered severe scorch and died as did the low numbers of annual meadow-grass. BUK 9900H had little contact activity and control of emerged weeds was poor. Weeds were too advanced for control with Goltix 2.2 kg/ha + oil.

At Site 2, a pre-emergence herbicide was applied overall to these plots. However, before post-harvest experimental treatments were applied, groundsel plants were 15-25 cm tall, with flower buds, black nightshade at 2-5 true leaf stage. Roundup Biactive alone and in tank-mixes (6a - 9a), controlled the large groundsel and black nightshade that were present at the time of application. Herbicides Callisto and Sumimax had good contact as well as residual activity; the quickest effect was with Callisto on groundsel, but with Sumimax on black nightshade. Control of black nightshade was excellent 42 days after treatment with Callisto or Sumimax, good for BUK 9900 and just acceptable for the tank-mix treatment 9.

*New Herbicides: Current Approval Status (December 2010)*

<i>Herbicide</i>	<i>Product and formulation</i>	<i>Company</i>	<i>Dose product/ha</i>	<i>Authorised UK or other Status</i>
mesotrione	Callisto 100 g/l SC	Syngenta	1.5 l	Annex 1, maize UK, linseed (asparagus in USA)
flumioxazin	Sumimax etc. 300 g/l SC	InterFarm	0.1 l	Annex 1, wheat UK; SOLA UK onions, peas, carrots (asparagus in USA)
Confidential	BUK 9900H	confidential	4.0 l	No UK authorization yet for any crop. (residues data for asparagus in Germany)
pendimethalin	Stomp Aqua 455g/l CS	BASF	2.9 l	SOLA UK asparagus Stomp Aqua and others pre-spear-emergence and post-harvest.
metamitron	Goltix 90 WG 90% w/w	Makhteshim	2.2 kg	SOLA Goltix 12 wks after planting asparagus
s-metolachlor	Dual Gold 960 g/l SC	Syngenta	1.4 l	Annex 1, maize UK
isoxaben	Flexidor 125 125 g/l SC	Landseer	1.75 l	Voluntarily withdrawn use until 31 Dec 2012, SOLA UK asparagus
metribuzin	Sencorex WG 70% w/w WG	Bayer CropScience	0.9 kg	SOLA UK asparagus
confidential	HDC H1	confidential	2.0 l	HDC H1 no EU authorization yet
glyphosate	Roundup Biactive 360g/l SL	Monsanto	4.0 l	Approved UK pre-emergence of spears and post-harvest

## **Financial benefits**

Without suitable herbicides, asparagus production costs could be prohibitive. Safe and effective alternatives to herbicides lost as a result of the EC Review have been found and these can benefit the industry in the following ways:

- Labour savings, and the high cost of hand-weeding would be avoided.
- New actives could provide growers with alternatives for weed control.
- A wider range of herbicides for this perennial crop will enable a weed control strategy using different herbicides at different timings and years to avoid build-up of certain species and also avoid herbicide resistance.

Residues data and SOLAs will need to be sought and this may involve additional costs, although it may be possible to obtain residues data for asparagus from other countries.

## **Action points for growers**

Asparagus is a perennial crop which is grown for up to 10 years. Frequent use of a limited range of herbicides has led to a build-up of weed species that may escape control. Weed seeds are also exposed where pickers disturb soil. A wider range of herbicides will enable a weed control strategy using different herbicides at different timings and this could avoid build up of certain weed species. Groundsel may have already developed resistance to products containing metribuzin as a result of repeated use - currently, no other active is approved for groundsel control pre-spear-emergence in an established crop. In glasshouse tests on groundsel samples collected from four commercial crops, Stephen Moss of Rothamsted Research has recently confirmed very high resistance to simazine (included as a standard) and partial resistance of groundsel to both metribuzin and metamitron, with many plants damaged but surviving field rates of both herbicides. In contrast, all plants of a susceptible standard were killed by all four rates used (0.5, 1, 2, 4 x field rate). He says this pattern is consistent with classic triazine resistance, which usually confers partial cross-resistance to triazinone herbicides.

There are herbicides that appear to be safe when applied to asparagus crops:

- Applied pre-emergence of spears:

Groundsel controlled by Callisto, Sumimax, BUK 9900H and Goltix 90.  
Black nightshade controlled by Callisto and BUK 9900H.

- Applied post-harvest:

Callisto performed well on a range of weeds and Sumimax was effective on black nightshade. Where fern was present Callisto caused severe damage and Sumimax was also damaging.

These herbicides are not available for asparagus yet because residues data for SOLAs will be required. Products containing mesotrione and flumioxazin are authorised for use pre-spear-emergence and post-harvest in asparagus in the USA. There are also residues data for BUK 9900H from the EU, a foliar-acting herbicide would be needed in tank-mix (and fern removed) for post-harvest use. BUK 9900H has no UK registration yet for any crop (December 2010). A SOLA for Goltix applied pre-spear-emergence for groundsel control could also be helpful. HDC has applied for a SOLA for Callisto, but **caution is advised particularly with Callisto on newly planted crops.**

Label and weed susceptibility trials information from other countries is available in appendix 2 of the full report but growers are advised to treat this information with caution. Growers can get a copy of the full report by contacting the HDC: [hdc@hdc.ahdb.org.uk](mailto:hdc@hdc.ahdb.org.uk)