



Grower Summary

HNS 198

Improving weed control in hardy
nursery stock

Annual 2016

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Project title: Improving weed control in hardy nursery stock

Project number: HNS 198

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Report: Annual report, December 2016

Previous report: N/A

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Date project commenced: 1 January 2016

Date project completed (or expected completion date): 31 December 2020

Grower Summary

Headline

- HDC H43 proved safe and effective when used post planting in a tank mix with Stomp Aqua + Flexidor 500 on rose rootstocks. A post budding application in a tank mix with Flexidor 500 was also tolerated.
- HDC H25 found to be safe and effective at planting on field-grown herbaceous crops.

Background

Recent changes in legislation have meant that the ornamentals industry has been left with fewer herbicides for the control of problematic weeds. The control of annual weeds in field-grown production has become more difficult following the loss of active ingredients (e.g. oxadiazon) and restrictions placed on some of the remaining actives (e.g. metazachlor).

A number of small seeded tree species are known to be susceptible to residual herbicides used in the seedbed and will only tolerate low rates of Goltix 70 SC (metamitron). The concept of applying differential residual herbicide treatments as inter-row or in-row treatments was successfully developed in sensitive seed raised vegetable crops in the first SCEPTRE project. The objective of the work on band spray treatments for seed grown trees (in this case *Betula*) was to test five herbicide treatments normally considered unsafe on *Betula* applied only in the inter-row with metamitron (Goltix 70 SC) as a low rate pre-emergence herbicide over the crop row. The aim being to deliver better weed control than with Goltix 70 SC applied overall.

The key recommended products previously used on field-grown roses (Ronstar Liquid, Skirmish and Artist) have been withdrawn or have lost appropriate approvals. There is, therefore, an urgent need to test replacement products for rose production. Novel products tested include; HDC H42, Logo (foramsulfuron, iodosulfuron-methylsodium + isoxadifen-ethyl), HDC H43 and Samson Extra 6% (nicosulfuron). The aim for the budded rose herbicide trial in 2016 was to test the efficacy and crop safety of novel herbicide, either alone or in combination with standard herbicides, in programmes for field rose production.

The field-grown herbaceous nursery stock sector is very dependent on the use of Flexidor 500 (isoxaben) and Venzar Flowable (lenacil) which increases the risk of resistant weed populations. There is also concern that Venzar Flowable, used currently under the LTAEU, may not be granted an EAMU going forward. The aims of the herbaceous trials carried out in 2016 were to test the efficacy and crop safety of novel herbicides for use as a single application

after planting on field-grown herbaceous nursery stock production and treatments applied as a follow-up.

Summary

Herbicide trials were carried out on *Betula pendula*, field-grown roses, and field-grown herbaceous HNS during 2016. **Table 1** lists the herbicides and rates used in each trial, along with the herbicides' approval status.

Table 1. Treatment list for hardy nursery stock trials carried out in 2016

Product	Active	Approval status	Rate kg/ha or L/ha				
			<i>Betula pendula</i>	Budded rose	Aster & Geranium	Iris	Veronica
Butisan S	500 g/L metazachlor	Label		1.5			
Butryflow	402 g/L bromoxynil	EAMU				1	
HDC H42		Not approved		1.5			
Flexidor 500	500 g/L isoxaben	Label ¹	0.5	0.5	0.25	0.25	
Gamit 36 CS	360 g/L clomazone	EAMU outdoor ³	0.25				
Goltix 70 SC	700 g/L metamitron	EAMU ²	1 2				
HDC H25	isoxaben 2.4% w/w + oryzalin 9.8% w/w	Not approved *			220	220	220
Logo	30% w/w foramsulfuron + 10% w/w iodosulfuron-methylsodium + 30% w/w isoxadifen-ethyl	EAMU outdoor		0.15			
Metobromuron	metobromuron 400 g/L	Not approved			3.75	3.75	3.75
Samson Extra 6%	60 g/L nicosulfuron	EAMU outdoor		0.75			

Product	Active	Approval status	Rate kg/ha or L/ha				
			<i>Betula pendula</i>	Budded rose	Aster & Geranium	Iris	Veronica
Sencorex Flow	600 g/L metribuzin	Not approved	1.15				
Springbok	200 g/L metazachlor + 200 g/L dimethenamid-p	EAMU outdoor	2.5	1.25		1.6	
Stomp Aqua	455 g/L pendimethalin	EAMU outdoor	2.9	2.9			
HDC H43		Not approved		2	2	2	2
Venzar Flowable	440 g/L lenacil	LTAEU Outdoor		3	1.5	1.5	1.5
Titus	25% w/w rimsulfuron	EAMU outdoor				0.05	0.05

¹Label only covers use on outdoor trees and shrubs but other ornamentals may be treated outdoors at grower's risk.

²Pre-emergence only

³Pre-emergence and early post-emergence only

*Product known in other markets as Winshot

Betula trial

The aim was to test the use of precision band sprayers for use in herbicide sensitive field-grown crops where seedlings are grown in spaced rows. The trial was set up as a fully randomised block design with seven treatments, including a commercial standard and an untreated control. Goltix 70 SC was used as a row treatment (except in untreated controls); the residual herbicide treatments were applied as inter-row treatments. The treatments were applied on 20 May 2016, as residual pre-emergence treatments four days after *Betula pendula* (UK 403 provenance) was drilled.

There were subtle differences in weed control between treatments at the first assessment, carried out 2 WAT (weeks after treatment). Untreated controls had 0.75% weed cover. The best inter-row treatments for weed control were Flexidor 500 + Springbok and Stomp Aqua +

Sencorex Flow, both of which had no weed cover. The next best inter-row treatments in terms of weed control with 0.13% weed cover was Stomp Aqua + Springbok + Gamit 36 CS.

All inter-row treatments other than the Growers standard, Goltix 70 SC resulted in unacceptable phytotoxicity, expressed as a reduction in growth and the number of seedlings germinating. It is thought that application of the inter-row herbicides over the grit dressed bed surface resulted in more lateral movement of the herbicides than would have occurred on bare soil. The least damaging inter-row treatment (apart from the Goltix 70 SC standard) was Flexidor 500 + Goltix 50 SC raising the possibility that *Betula pendula* might tolerate a low rate of Flexidor 500 over the row.

Budded rose trial

The budded rose herbicide trial was set up in a field at Whartons Nurseries Ltd. in Pulham St Mary, near Diss, on newly planted rootstocks. The trial consisted of 10 herbicide programmes (**Table 2**). Applications were made to the rootstocks on two occasions: at planting (7 April 2016), after budding (21 July 2016) and a further treatment will be made post heading back (this application will be carried out in February 2017). The trial was set up as a fully randomised block design and treatments were replicated four times.

Table 2. Treatment list and timings for the budded rose herbicide trial, Pulham St Mary 2016

Trt. no.	Planting treatment (07.04.16)	Rate (Kg/ha or L/ha)	Budding treatment (21.07.16)	Rate (Kg/ha or L/ha)	Heading back treatment	Rate (Kg/ha or L/ha)
1	Untreated	N/A	Untreated	N/A	Untreated	N/A
2	Stomp Aqua + Flexidor 500 + Venzar Flowable	2.9 + 0.5 + 3.0	Flexidor 500 + Butisan S	0.5 + 1.5	Stomp Aqua + Flexidor 500 + Springbok	2.0 + 0.5 + 1.25
3	Stomp Aqua + Flexidor 500 + Venzar Flowable	2.9 + 0.5 + 3.0	Logo + Mero (adjuvant)	0.075 + 2.0	Stomp Aqua + Flexidor 500 + Springbok	2.0 + 0.5 + 1.25
4	Stomp Aqua + Flexidor 500 + HDC H43	2.9 + 0.5 +	Flexidor 500 + HDC H43	0.5 + 2.0	Stomp Aqua + Flexidor 500 + HDC H43	2.0 + 0.5 +
5	Stomp Aqua + Flexidor 500 + HDC H42	2.9 + 0.5 +	Flexidor 500 + Butisan S	0.5 + 1.5	Stomp Aqua + Flexidor 500 + HDC H42	2.0 + 0.5 +
6	Samson Extra 6%	0.75	Flexidor 500 + Butisan S	0.5 + 1.5	Samson Extra 6%	0.75
7	Flexidor 500 + Samson Extra 6%	0.5 + 0.75	Flexidor 500 Butisan S	0.5 + 1.5	Flexidor 500 Samson Extra 6%	0.5 + 0.75
8	Flexidor 500 + Samson Extra 6% + HDC H42	0.5 + 0.75 +	Flexidor 500 + Butisan S	0.5 + 1.5	Flexidor 500 + Samson Extra 6% + HDC H42	0.5 + 0.75 +
9	Logo + Mero (adjuvant)	0.15 + 2.0	Flexidor 500 + Butisan S	0.5 + 1.5	Logo + Mero (adjuvant)	0.15 + 2.0
10	Flexidor 500 + Logo	0.5 + 0.15	Flexidor 500 + Butisan S 1.5	0.5 + 1.5	Flexidor 500 + Logo	0.5 + 0.15

Phytotoxicity and weed assessments were carried out approximately 2, 6 and 12 WAT. Phytotoxicity was scored on a scale of 0 to 9 with 0 being dead, 9 being healthy and 7 being considered commercially acceptable. Weed cover was assessed as an overall percentage of the plot.

Out of the treatments applied at planting, Stomp Aqua + Flexidor 500 + HDC H43, Flexidor 500 + Samson Extra 6% + HDC H42 and Flexidor 500 + Logo all provided the best weed control in the trial, however the combination of Flexidor 500 + Logo was too phytotoxic to the rootstocks (**Figure 1**). The above treatments performed well in terms of weed control up to the assessment carried out 6 WAT, however by the 12 WAT assessment their weed control was beginning to break down (**Figure 2**). Logo, when used with only an adjuvant, was much safer than the combination with Flexidor 500 however in this case the weed control was inferior.

All of the post-budding treatments appeared to be safe to use on the rose rootstocks, however roses that were treated with Flexidor 500 + Logo at planting remained very stunted at budding and were scored down for phytotoxicity following the subsequent application of Flexidor 500 + Butisan S. However, this damage was thought to be the result of the application of Flexidor 500 + Logo at planting and not the Flexidor 500 + Butisan that was applied post-budding. Flexidor 500 + Butisan S also proved to be the best post budding treatment for weed control (**Figure 3**).

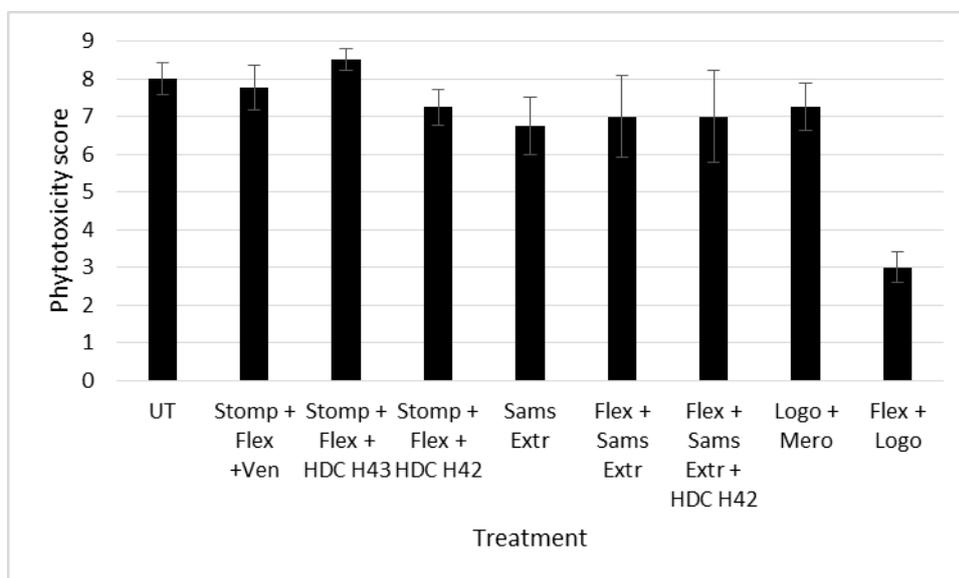


Figure 1. Phytotoxicity scores for budded rose trial 12 weeks after the treatments were applied at planting ($p < 0.001$, I.s.d. 0.987) – Pulham St Mary, 22 June 2016 (scale of 0 – 9 where 9 is healthy, 0 is dead and 7 is commercially acceptable)

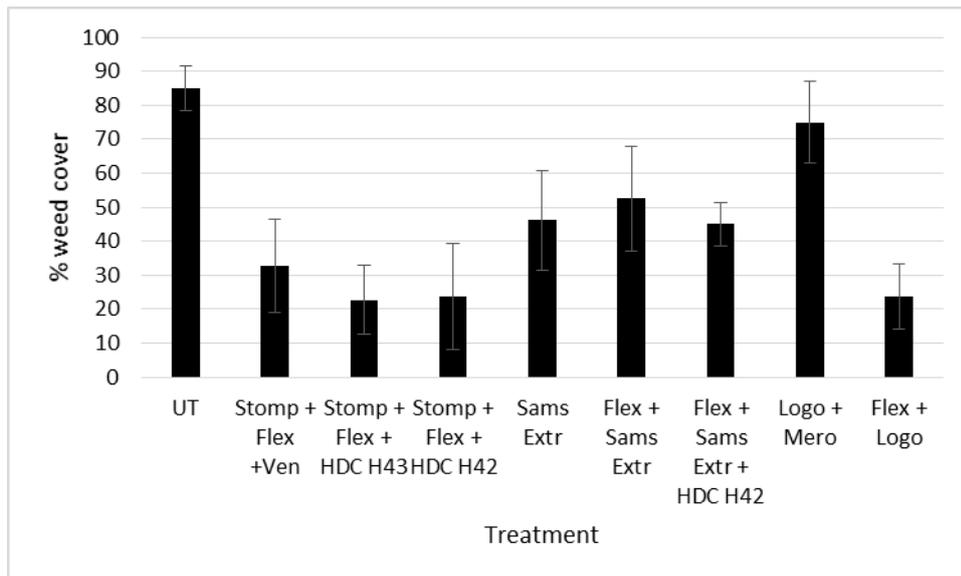


Figure 2. Percentage weed cover of budded rose plots 12 weeks after the planting treatments were applied ($p < 0.001$, l.s.d. 9.04) - Pulham St Mary, 22 June 2016

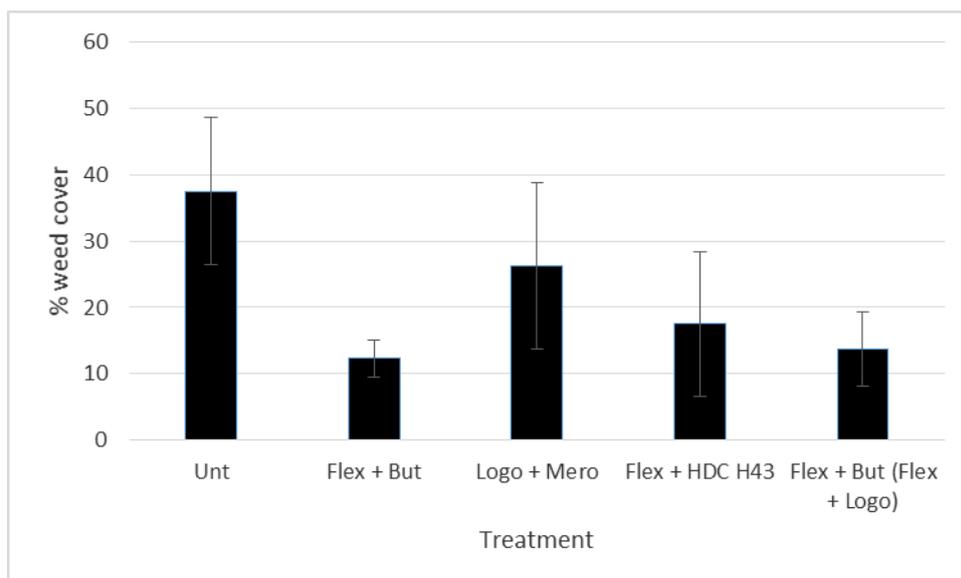


Figure 3. Percentage weed cover of budded rose trial 12 weeks after post-budding treatments were applied ($p < 0.001$, l.s.d. 9.06) – Pulham St Mary, 5 October 2016

Herbaceous trials

The aster, geranium, iris and veronica trials were set up in fields at Howard Nurseries Ltd. in Wortham, near Diss. The aster and geranium trials both had the same five treatments (**Table 3**). Treatments were applied on two occasions for both trials; the first application was made on 4 May 2016 (at planting) and the second application was made on 9 August 2016. The iris trial consisted of seven treatment programmes. Treatments were applied on two occasions; at planting (14 April 2016) and as a follow up treatment, 10 weeks after the planting application

(22 June 2016) (**Table 4**). The veronica trial tested six herbicide treatment programmes (**Table 5**). The veronica treatments were applied on the same dates as the aster and geranium trials. Treatments were replicated four times in each of the herbaceous trials. Phytotoxicity and weed assessment were carried out approximately 2, 6 and 10 weeks after each treatment application was made. The assessments used the same methods as were used in the rose trial above.

Table 3. Treatment list and timings for the aster and geranium trials, Wortham 2016

Trt. no.	Planting treatment (04.05.16)	Rate (Kg/ha or L/ha)	Follow up treatment (09.08.16)	Rate (Kg/ha or L/ha)
1.	Untreated	N/A	Untreated	N/A
2.	HDC H25	220.0	Untreated	N/A
3.	Flexidor 500 + Venzar Flowable	0.25 + 1.5	Flexidor 500 + Venzar Flowable	0.25 + 1.5
4.	Flexidor 500 + HDC H43	0.25 +	Flexidor 500 + HDC H43	0.25 +
5.	Flexidor 500 + Metobromuron	0.25 + 3.75	Flexidor 500 + Metobromuron	0.25 + 3.75

Table 4. Treatment list and timings for the field-grown iris herbicide trial, Wortham 2016

Trt. no.	Planting treatment	Rate (Kg/ha or L/ha)	Follow up treatment (22.06.16)	Rate (Kg/ha or L/ha)
1.	Untreated	N/A	Untreated	N/A
2.	HDC H25	220.0	Untreated	N/A
3.	Flexidor 500 + Venzar Flowable	0.25 + 1.5	Flexidor 500 + Springbok	0.25 + 1.6
4.	Flexidor 500 + Venzar Flowable	0.25 + 1.5	Butryflow	1.0
5.	Flexidor 500 Venzar Flowable	0.25 + 1.5	Titus	0.05
6.	Flexidor 500 + HDC H43	0.25 +	Flexidor 500 + HDC H43	0.25 +
7.	Flexidor 500 + Metobromuron	0.25 + 3.75	Flexidor 500 + Metobromuron	0.25 + 3.75

Table 5. Treatment list and timings for the veronica herbicide trial, Wortham 2016

Trt. no.	Planting treatment (04.05.16)	Rate (Kg/ha or L/ha)	Follow up treatment (09.08.16)	Rate (Kg/ha or L/ha)
1.	Untreated	N/A	Untreated	N/A
2.	HDC H25	220.0	Untreated	N/A
3.	Venzar Flowable	1.5	HDC H43	
4.	Venzar Flowable	1.5	Titus	0.05
5.	HDC H43		Venzar Flowable	1.5
6.	Metobromuron	3.75	Metobromuron	3.75

Aster

All of the treatments that were applied to the asters at planting proved to be safe on the plants with no obvious signs of phytotoxicity seen throughout the trial. HDC H25 was found to be the most effective herbicide at controlling weeds (**Figure 4**).

All of the follow-up treatments that were applied proved to be safe on the asters. The plots that had received the treatment HDC H25 at planting even though it received no further follow up treatment, had the lowest levels of weeds throughout the trial period (**Figure 5**).

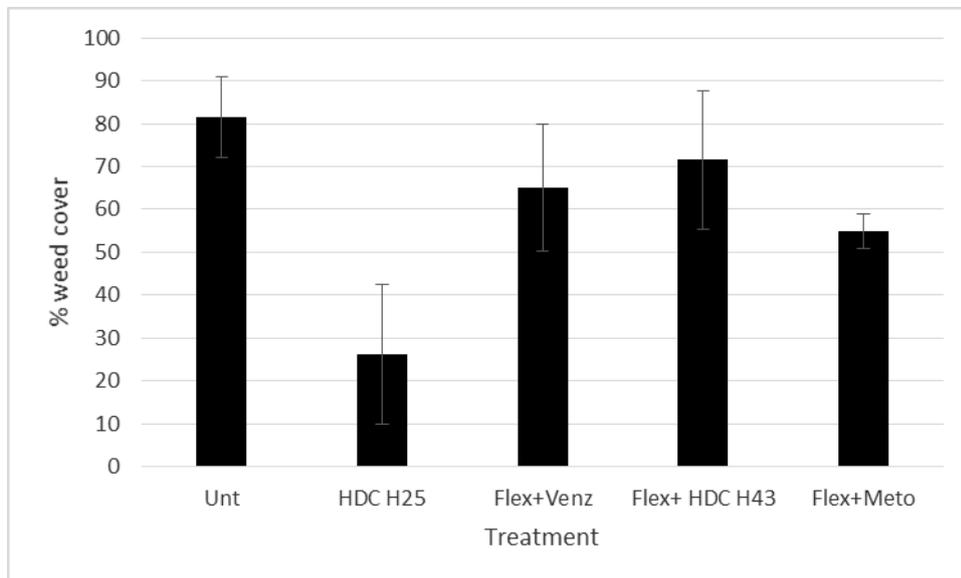


Figure 4. Percentage weed cover of plots 10 weeks after the planting treatments were applied to the aster trial ($p < 0.001$, l.s.d. 20.55) – Wortham, 4 August 2016

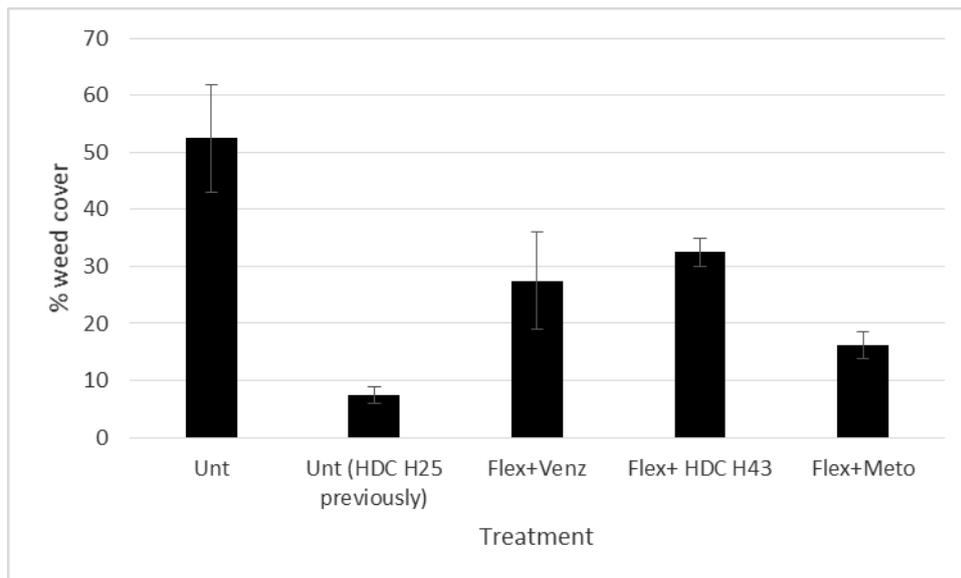


Figure 5. Percentage weed cover of plots 10 weeks after the second treatments were applied to the aster trial ($p=0.004$, I.s.d. 20.16) – Wortham, 26 October 2016

Geranium

None of the planting treatments used in the geranium trial caused any serious damage to the geraniums. At the 6 WAT assessment, all of the treatments applied at planting had the same percentage weed cover, including the untreated plots (**Figure 6**). Weed assessments were difficult to carry out throughout the trial due to the crop becoming very dense and so the next assessment was postponed until the final assessment after the follow-up treatments had been applied. At the final assessment carried out after the follow-up treatments had been applied, the geraniums had started to die back, making it easier to assess the weed level. Plots that were treated with HDC H25 had the lowest level of weeds and were closely followed by plots that had been treated with Flexidor 500 + metobromuron (**Figure 7**). All of the follow-up treatments applied were considered safe to the geraniums.

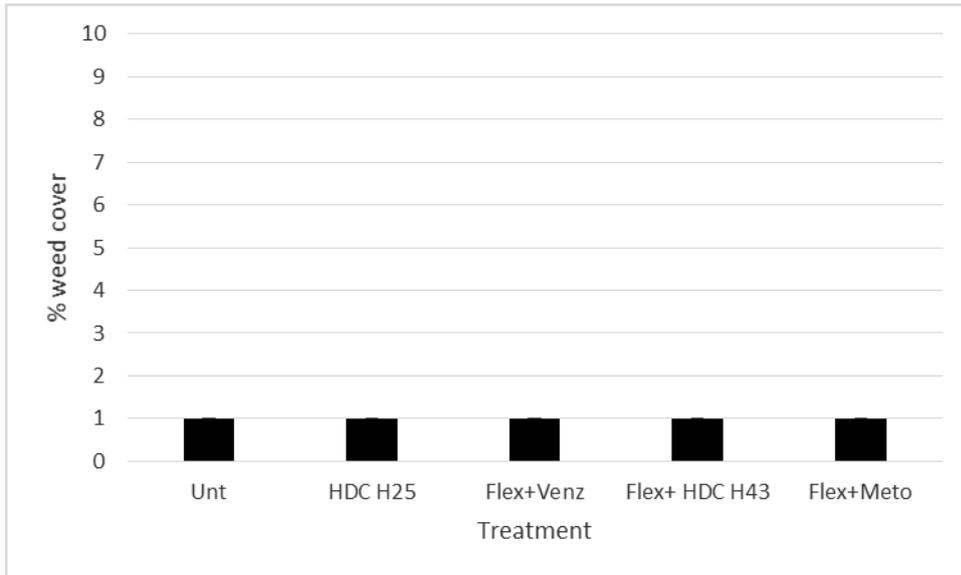


Figure 6. Percentage weed cover of plots 6 weeks after the planting treatments were applied to the geranium trial – Wortham, 16 June 2016

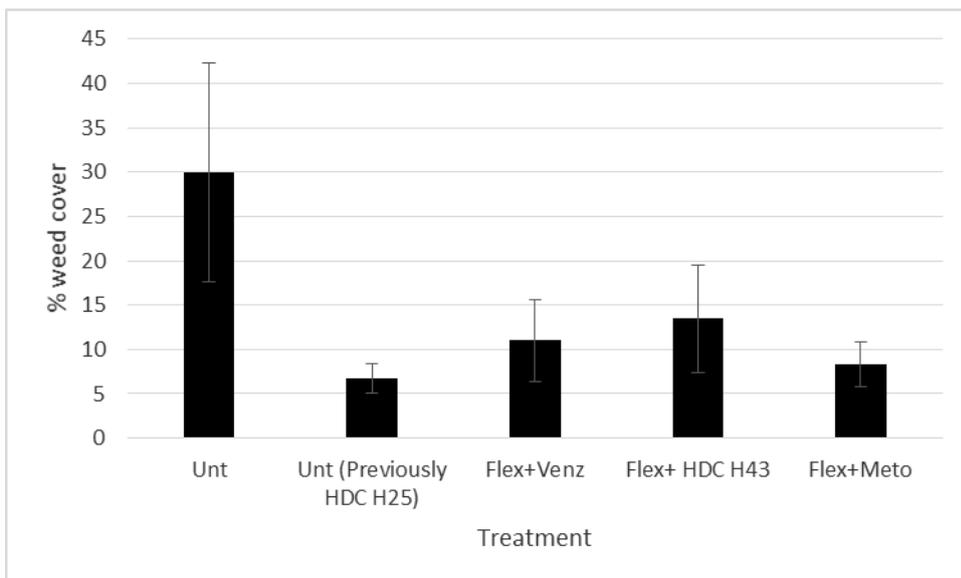


Figure 7. Percentage weed cover 10 weeks after the second treatments were applied to the geranium trial – Wortham, 26 October 2016

Iris

None of the treatments applied at planting in the iris trial caused any lasting herbicide damage to the crop. HDC H25 provided the best weed control and Flexidor 500 + HDC H43, Flexidor 500 + Venzar Flowable and Flexidor 500 + metobromuron all provided good weed control in the trial when applied at planting (**Figure 8**). No significant phytotoxicity was seen from any of the follow-up treatments that were applied to the iris trial. Out of the follow-up treatments, the

only plots where effective weed control was seen were the plots that had received an application of HDC H25 at planting and received no further follow-up treatment (**Figure 9**).

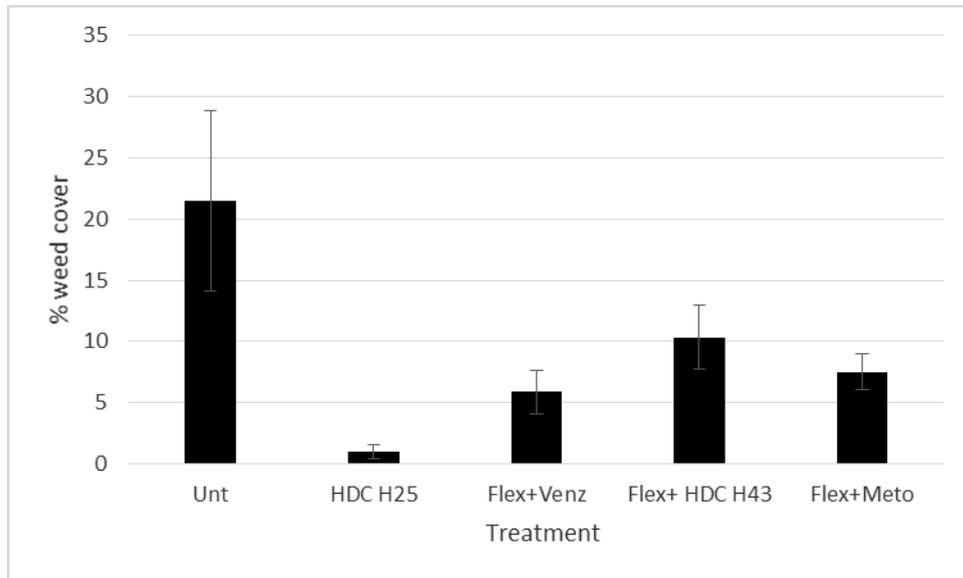


Figure 8. Percentage weed cover of plots 6 weeks after the first treatments were applied to the iris trial – Wortham, 26 May 2016

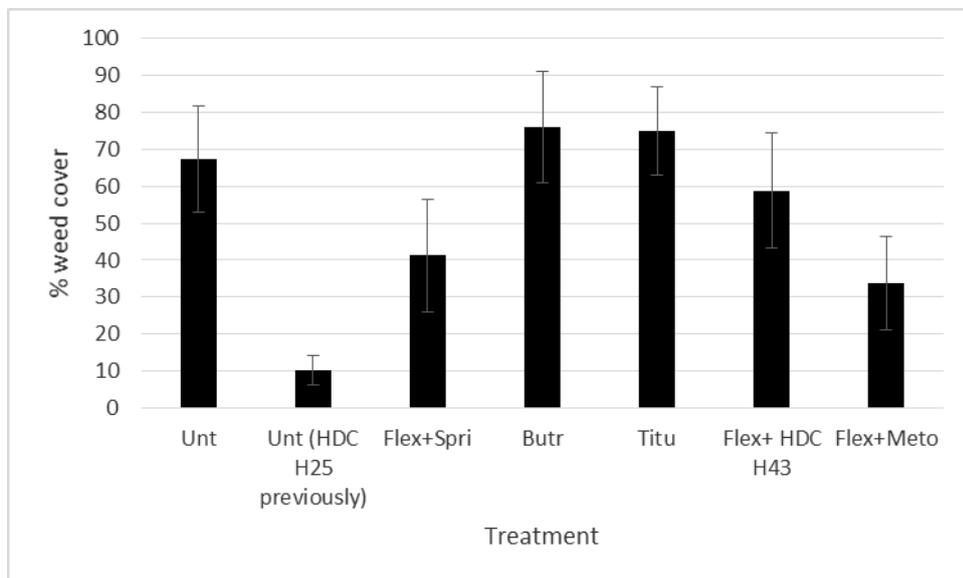


Figure 9. Percentage weed cover of plots 10 weeks after the second treatments were applied to the iris trial – Wortham, 2016

Veronica

The veronica were very slow to establish due to the dry conditions that were experienced at the time of planting. Despite the plants being slow to establish, no phytotoxic symptoms were seen in any of the different treated plots throughout the trial. HDC H25 performed the best in terms of weed control, however weed control with this treatment was not as good as was experienced from the other herbicide trials in this project where it was tested, even at the 6 WAT assessment (**Figure 10**). This was probably because the veronicas did not compete with the weeds as well as the species in the other trials did. None of the follow-up treatments applied to the veronica caused any phytotoxic damage. The plots with the lowest level of weeds after the follow-up treatments were applied were the HDC H25 treated plots 10 WAT, however weed levels in these plots were still high (**Figure 11**).

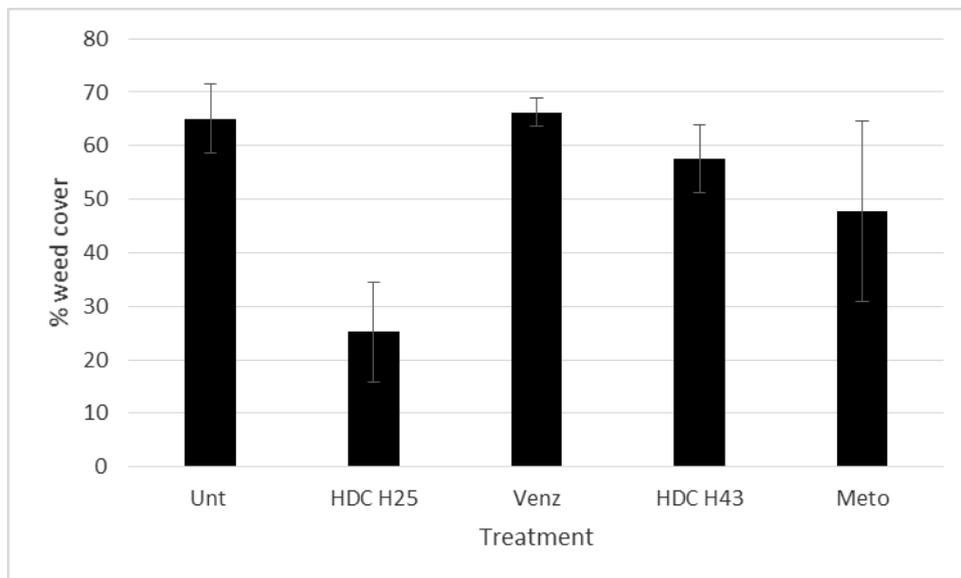


Figure 10. Percentage weed cover of plots 6 weeks after the planting treatments were applied to the veronica trial – Wortham, 16 June 2016

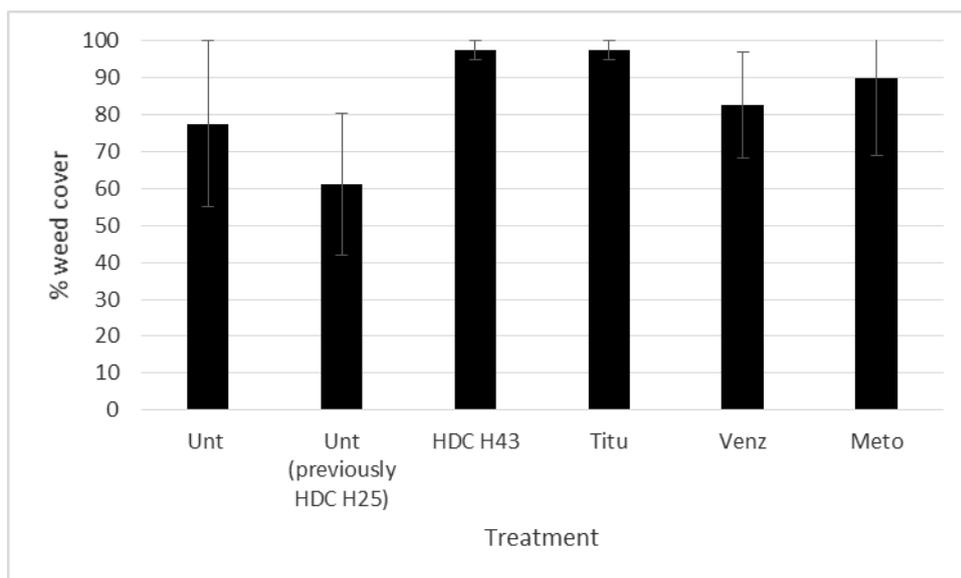


Figure 11. Percentage weed cover of plots 10 weeks after second treatments were applied to the veronica trial – Wortham, 26 October 2016

Review of herbicide authorisations for hardy nursery stock production in selected European countries

A review of herbicide authorisations was undertaken to identify treatments that are available in other European countries for nursery stock production but are not currently available in the UK or are available only with restrictions that do not apply elsewhere. In fact there are relatively few new active ingredients available in other European countries that would be useful for UK nursery stock production. Of particular interest are oxyfluorfen and oryzalin however we are unlikely to see availability in the UK for these actives. There are several products based on iodosulfuron-methyl-sodium either co-formulated with foramsulfuron or diflufenican. The former combination is already proposed for an EAMU in the UK.

Although there are few actives being used that are completely new to hardy nursery stock in the UK there are many examples of products available in other European countries but which in the UK have very much lower rates of use (e.g. flumioxazin, s-metolachlor), restrictions to pre-emergence use only (before crop emergence) (e.g. prosulfocarb, dimethenamid-p + pendimethalin, metribuzin, metamiltron) or other crop restrictions (e.g. propyzamide). It is proposed that improvements to the EAMUs for prosulfocarb and metribuzin be sought to allow use over dormant crops as is permitted in other European countries.

Financial Benefits

Hand weeding field-grown crops three times during the growing season is estimated to cost in the region of £30,000 per hectare. Any reduction in hand weeding or reduction in direct contact herbicide applications that can be achieved with residual herbicides will help to reduce this cost significantly, contributing to grower profitability. For example Veronica is not normally treated with herbicides but treatment HDC H25 was safe and reduced weed cover by more than 50% of the untreated for 5 months. Although some hand weed weeding would still be required the saving in labour cost could be in the region of £15,000 per hectare.

Action Points

- Flexidor 500 and Goltix 70SC showed the best potential as an inter-row treatment on *Betula* although further work is required with lower rates of both herbicides.
- New herbicide HDC H25 has good potential for use at planting for herbaceous nursery stock species grown in the soil and it has a very good weed control spectrum. It had been hoped that HDC H25 would be available as a commercial product with a label approval for outdoor ornamental plant production during 2017, but regulatory hurdles are currently preventing this from happening in the short term.
- HDC H43 is now authorised on Maize in the UK and could be a useful additional herbicide for growers of a range of field-grown nursery stock providing an EAMU can be obtained.
- Butryflow and Titus are already approved for ornamental plant production and could be safely used for selective post-emergence weed control in herbaceous nursery stock crops of Iris. Initial results suggest that Titus may also be safe for use in Veronica.

