

## Grower Summary

### **HNS 198**

Improving weed control in  
hardy nursery stock

Annual Report 2018

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<b>Date project commenced:</b>	1 January 2016
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## **Grower Summary**

### **Headlines**

- Sencorex Flow and HDC H43 proved safe and effective in a tank mix with Stomp Aqua + Flexidor 500 when used post-planting and post-heading back on rose rootstocks.
- HDC H43 proved safe and effective when used as a post-budding application in a tank mix with Flexidor 500 on roses.
- HDC H42 provided particularly effective weed control when applied with standard products Stomp Aqua and Flexidor 500, post-heading back on roses.
- Sencorex Flow at 1 L/ha proved safe, applied as a post planting treatment to four tree rootstock species.
- Sunfire and Centurion Max were tolerated by ten hardy nursery stock species when applied after potting. A few species showed short term phytotoxicity symptoms but plants grew away from the damage by six weeks.
- Sunfire and Defy applied as dormant season treatments appear crop safe.
- Flexidor at 0.5 L/ha (the maximum rate) proved safe (by 13 weeks after treatment) on the majority of species tested.

### **Background**

A decreasing number of herbicides are available to the Hardy Nursery Stock (HNS) sector for efficient plant production and as a result effective weed control has become an urgent problem for the industry to solve.

Since the last herbicide trial on roses in the UK was completed in 2008 (HNS 132), the key recommended products Ronstar Liquid (oxadiazon), Skirmish (terbuthylazine + isoxaben) and Artist (flufenacet + metribuzin) have become unavailable for use. There is pressing need to test replacement products for rose production. The herbicides selected for inclusion are those for which appropriate Extension of Authorisation for Minor Use (EAMUs) have recently been granted, e.g. Logo (foramsulfuron + iodosulfuron-methyl-sodium), Sencorex Flow (metribuzin) and Springbok (metazachlor + dimethenamid-p). In 2016, this project looked at the efficacy and crop safety of two season herbicide programmes, including these new products for field rose production. The aim of the current trial was to build on the knowledge gained from the project's 2016 trials, and to include newly approved products such as Sencorex Flow.

The final use of Ronstar 2G (oxadiazon) in 2015 and restrictions on the use of Butisan S (metazachlor) have left gaps in the herbicides available to growers of container HNS. Flexidor 500 (isoxaben) – previously Flexidor 125 – has become the mainstay of weed control programmes in container HNS production, but it does not offer control of annual meadow grass, groundsel, willowherb, moss or liverwort, and now only one application is permitted per year. Research in the EMT/AHDB Horticulture/HTA Fellowship project CP 86 *'Weed control in ornamentals, fruit and vegetable crops – maintaining capability to devise suitable weed control strategies'* (Atwood, 2015) and HNS/PO 192 & 192a *'Herbicides screening for ornamental plant production (nursery stock, cut flowers and wallflowers)'* (Atwood 2015, 2016) have investigated promising new actives in screening trials, and reviewed cultural controls. As a result, Dual Gold (s-metolachlor) and Springbok were developed as container HNS treatments (though with limitations). Currently, relatively few new residual herbicides show potential for container HNS testing, but two were selected for 2017-18 trials; Sunfire (flufenacet) and Defy (prosulfocarb), both promising for efficacy on key weeds and safety on indicative nursery stock species. Two new herbicide actives (both coded products) were also selected for inclusion in 2018 trials; HDC H44 and HDC H46. The withdrawal of Aramo (tepraloxydim), a selective contact herbicide for grass control, has had an impact across both field and container grown HNS. It was used as a post-emergence control of a range of annual grasses, in particular annual meadow grass. A safe and effective replacement is urgently required. Centurion Max (clethodim) was selected as the most promising candidate and included phytotoxicity screening on indicative nursery stock species.

HDC H46 is an active that could be new to the UK; it is approved in other countries and is used in HNS production, and therefore was included in the 2018 container screening tests. The UK formulation is likely to be different to the formulation used in HNS production in other countries. It gives pre-emergence residual control of a range of annual grasses and broad leaved weeds including the following weed species: Hairy bittercress, Common chickweed, Mouse eared chickweed, Groundsel, Annual meadow Grass, Clovers and Italian Ryegrass. Due to the delays in converting the Long Term Arrangements for Extensions of Use (LTAEU) to EAMUs a number of products are still available under the LTAEU. Some of which are included as this gives growers crop safety information as EAMUs are issued.

## Summary

Over 2017-18, two herbicide trials were carried out on field-grown roses whilst one herbicide trial was carried out on field grown trees. Phytotoxicity testing on 10 container-grown HNS subjects was done in two separate trials. **Table 1** lists the herbicides and rates used in each trial, along with the herbicides' approval status.

Table 1. **Herbicides, approval status and rates used in hardy nursery stock trials carried out in 2017/2018.**

Product	Active	Approval status	Budded rose (L/ha)	Budded rose – post heading back trial (L/ha)	Field Tree trial (L/ha)	HNS screen (L/ha)	Container trial 2018 (L/ha)
<b>Betanal maxxPro</b>	47 g/L desmedipham + 75 g/L ethofumesate + 27 g/L lenacil + 60 g/L phenmedipham	LTAEU	1.5				
<b>Butisan S</b>	500 g/L metazachlor	Label	1.5				
<b>Centurion Max</b>	120 g/L clethodim	LTAEU				2.0	2.0
<b>Defy<sup>2</sup></b>	800 g/L prosulfocarb	EAMU <sup>2</sup>				5.0	
<b>Flexidor 500</b>	500 g/L isoxaben	Label	0.5	0.5	0.5	0.25	0.5
<b>HDC H42</b>	Confidential	Not authorised		1.5			
<b>HDC H43</b>	600 g/L pethoxamid	Not authorised	2.0	2.0			2.0
<b>HDC H44*</b>	Confidential	Not authorised			2.0		2.0
<b>HDC H45</b>	Confidential	Not authorised			1.5 2.5		
<b>HDC H46</b>	Confidential	Not authorised					Confidential
<b>HDC H47</b>	Confidential	Not authorised		3.75	3.75		
<b>Logo<sup>3</sup></b>	30% w/w foramsulfuron + 10% w/w iodosulfuron-methyl-sodium	EAMU	0.075 kg/ha				
<b>HDC H43</b>	pethoxamid	Not authorised		2.0			2.0
<b>Sencorex Flow</b>	600 g/L metribuzin	EAMU	0.73 <sup>5</sup>	0.44 <sup>4</sup>	0.875 1.0		
<b>Springbok</b>	200 g/L metazachlor + 200 g/L dimethenamid-p	EAMU		1.25			1.6
<b>Stomp Aqua</b>	455 g/L pendimethalin	EAMU	2.9	2.0	2.9		
<b>Sunfire</b>	500 g/L flufenacet	EAMU		0.48			0.48
<b>Venzar Flowable<sup>1</sup></b>	440 g/L lenacil	LTAEU <sup>1</sup>	3.0				
<b>Venzar 500 SC</b>	500 g/L lenacil	LTAEU			0.4		0.4

<sup>1</sup> Approval now expired, <sup>2</sup> Pre-emergence only, <sup>3</sup> Mero adjuvant was added at 2 L/ha, <sup>4</sup> Post heading back rate, <sup>5</sup> Post planting rate.

\*HDC H44 has been evaluated on wide range of horticultural crops in the SCEPTRE plus project. A submission for use in potatoes has been submitted with potential for EAMUs and label extensions for other crops.

### ***Budded rose trial***

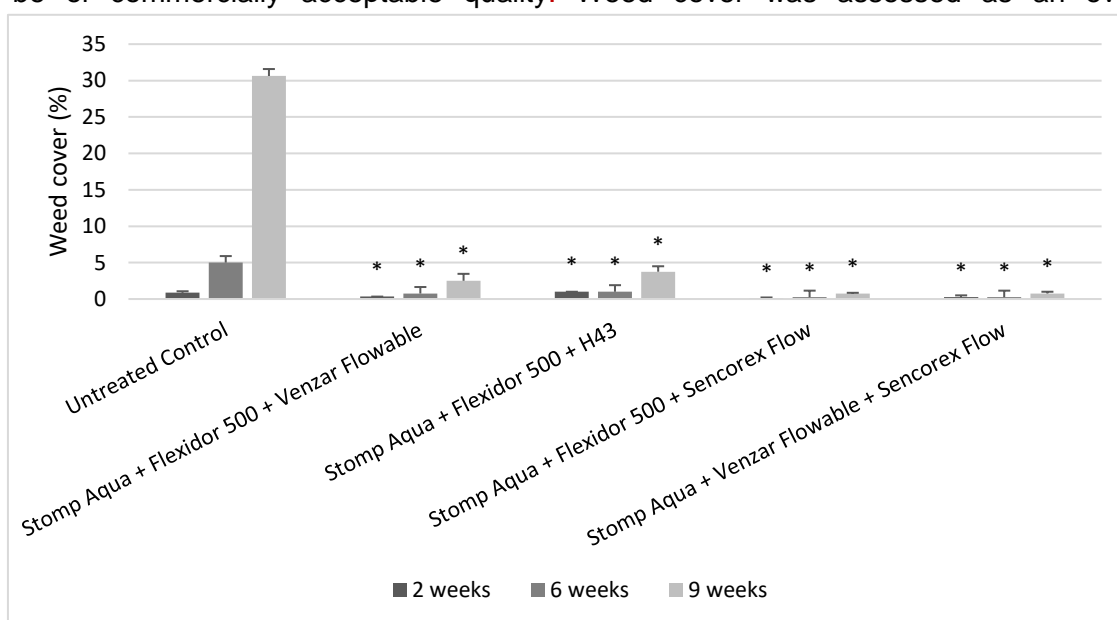
The budded rose herbicide trial was set up at Whartons Nurseries Ltd. in Pulham St Mary, on newly planted field-grown rootstocks. The trial consisted of nine herbicide programmes

(Table 2). Applications were made to the rootstocks on four occasions; at planting (15/03/17), a follow-up (18/05/17) and after budding (30/06/17). 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, 2017.

Trt. No.	Planting 15/03/2017	Follow up 18/05/2017	Budding 30/06/2017
1	Untreated	Untreated	Untreated
2	Stomp Aqua 2.9 L/ha + Flexidor 500 0.5 L/ha + Venzar Flowable 3.0 L/ha		Flexidor 500 0.5 L/ha + Butisan S 1.5 L/ha
3	Stomp Aqua 2.9 L/ha + Flexidor 500 0.5 L/ha + HDC H43 2.0 L/ha		Flexidor 500 0.5 L/ha + HDC H43 2.0 L/ha
4			Flexidor 500 0.5 L/ha + Butisan S 1.5 L/ha
5	Stomp Aqua 2.9 L/ha + Flexidor 500 0.5 L/ha + Sencorex Flow 0.73 L/ha		Flexidor 500 0.5 L/ha + Butisan S 1.5 L/ha
6	Stomp Aqua 2.9 L/ha + Flexidor 500 0.5 L/ha + Sencorex Flow 0.73 L/ha	Logo 0.075 kg/ha + Mero (adjuvant) 2.0 L/ha	Flexidor 500 0.5 L/ha + Butisan S 1.5 L/ha
7	Stomp Aqua 2.9 L/ha + Flexidor 500 0.5 L/ha + Sencorex Flow 0.73 L/ha	Logo 0.075 kg/ha + Mero (adjuvant) 2.0 L/ha + Betanal maxxPro 1.5 L/ha	Flexidor 500 0.5 L/ha + Butisan S 1.5 L/ha
8	Stomp Aqua 2.9 L/ha + Flexidor 500 0.5 L/ha + Sencorex Flow 0.73 L/ha	Betanal maxxPro 1.5 L/ha	Flexidor 500 0.5 L/ha + Butisan S 1.5 L/ha
9	Stomp Aqua 2.9 L/ha + Venzar Flowable 3.0 L/ha + Sencorex Flow 0.73 L/ha		Flexidor 500 0.5 L/ha + Butisan S 1.5 L/ha

Phytotoxicity and weed assessments were carried out at approximately two, six and ten weeks after treatment (WAT). Phytotoxicity was scored on a scale of 0-9; plants scoring 0 were considered dead, and 9 considered healthy, with plants scoring 7 or more considered to be of commercially acceptable quality. Weed cover was assessed as an overall



percentage of the plot. The same assessment criteria was used for all trials done in 2018. Of the post-planting treatments, the tank mixes which included Sencorex Flow appeared to offer the most effective weed control; the average weed cover in these treatments' plots was still <1% when assessed nine weeks after application (

**Figure 1).** The rose rootstocks showed no obvious symptoms of phytotoxicity after the application of these treatments.

Figure 1. **Weed cover (%) of budded rose plots two, six and nine weeks after planting treatment**

\* indicates significance at p value <0.001.

\*Statistically significant

The follow-up treatments all offered good weed control, with weeds in untreated plots averaging 37% cover after two weeks, compared to an average of  $\leq 0.5\%$  weed cover in those treated with Logo and/or Betanal maxxPro. However, Logo appeared to cause yellowing and stunting to the rose stocks, whether applied alone or in combination with Betanal maxxPro. Betanal maxxPro alone had very little effect on the rose stocks. Post-budding, Butisan S and HDC H43 (pethoxamid) appear similarly effective as tank mix partners for Flexidor 500, both showing a significant improvement in weed control compared to the untreated plots (

**Figure 2)**, and with no significant phytotoxic effects.

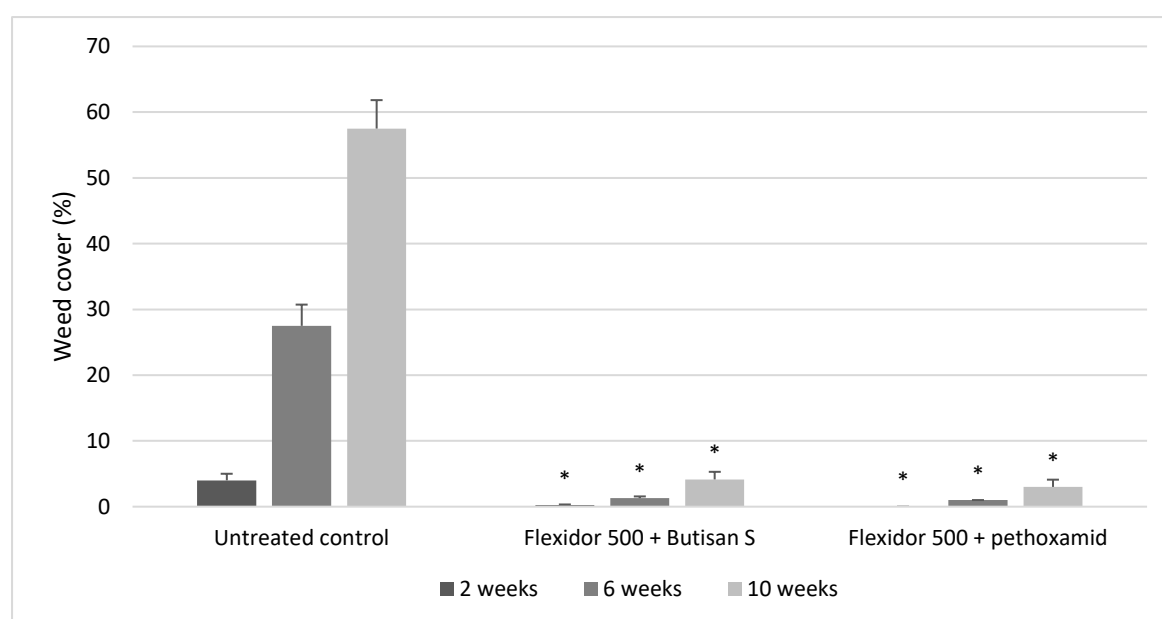


Figure 2. **Weed cover (%) of budded rose plots two, six and ten weeks after budding treatment. Results for plots which had received the same post-budding treatment were combined. \* indicates significance at p value <0.001.**

### ***Budded rose trial – post heading back trial***

The budded rose herbicide trial was set up at Whartons Nurseries Ltd. in Pulham St Mary, on recently headed back (rootstocks cut back to just above the bud that was budded the previous season) field-grown rootstocks, which were budded the previous year. The trial consisted of six herbicide treatments (**Table 23**). Residual herbicides were applied to the



rootstocks post-heading back (06/03/18). The trial was set up as a fully randomised block design and treatments were replicated four times.

Table 3. Treatment list for the post heading back rose herbicide trial, Pulham St Mary, 2018.

Treatment Number	Heading back 06/03/2018
1	Untreated
2	Stomp Aqua 2.0 L/ha + Flexidor 500 0.5 L/ha + Springbok 1.25 L/ha
3	Stomp Aqua 2.0 L/ha + Flexidor 500 0.5 L/ha + HDC H43 2.0 L/ha
4	Stomp Aqua 2.0 L/ha + Flexidor 500 0.5 L/ha + HDC H42 1.5 L/ha
5	Stomp Aqua 2.0 L/ha + Flexidor 500 0.5 L/ha + Sencorex Flow 0.44 L/ha
6	Stomp Aqua 2.0 L/ha + HDC H47 3.75 L/ha + Sencorex Flow 0.44 L/ha
7	Stomp Aqua 2.0 L/ha + HDC H47 3.75 L/ha + Sencorex Flow 0.44 L/ha + Sunfire 0.48 L/ha

The post heading back treatments applied to the roses were all effective and safe; Stomp Aqua + Flexidor 500 + HDC H42 as a tank mix offered particularly good weed control.

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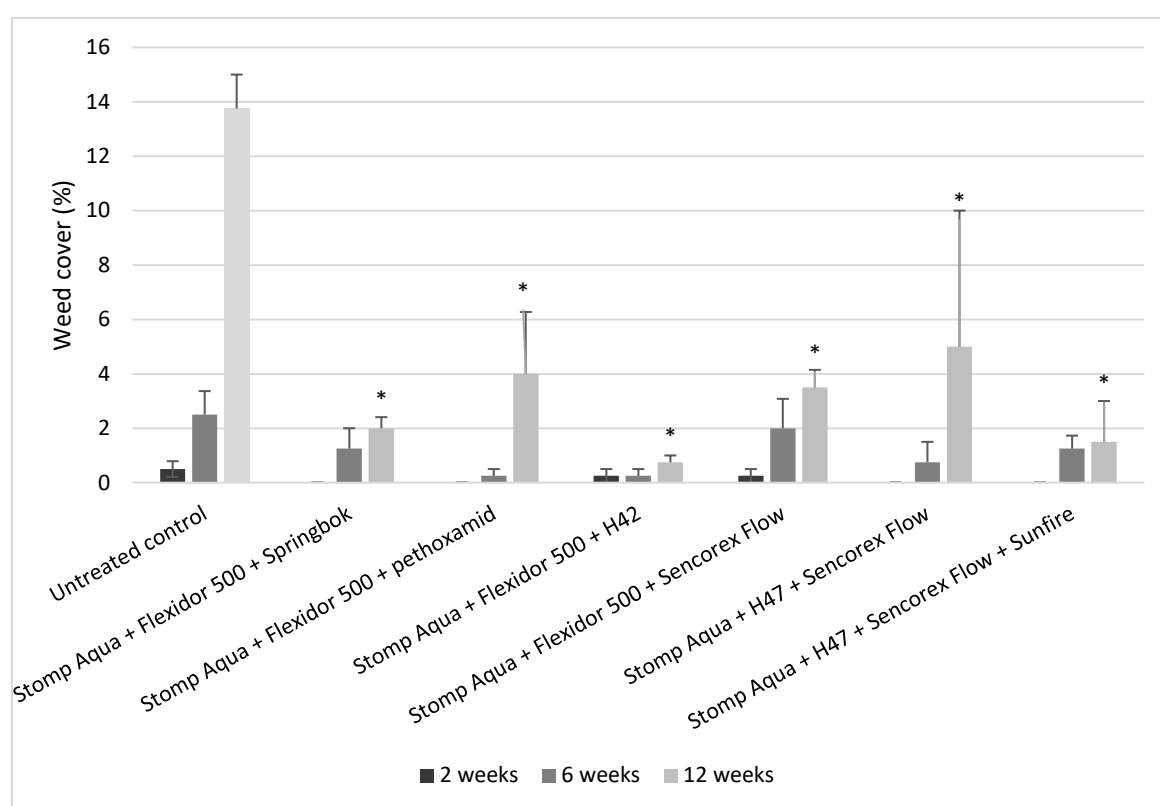


Figure 3. Weed cover (%) of budded rose plots at two, six and twelve weeks after post heading-back treatment (application made 06/03/18). \* indicates significance at p value at 0.010.

### 2018 Field Tree Trial

The 2018 field tree trial was set up on newly planted rootstocks at Frank P Matthews, Worcestershire. The aim of this study was to test the crop safety of a number of residual herbicides as alternatives to Flexidor, post-planting. Recent losses of key herbicides and restrictions on remaining residual herbicides has resulted in an increased reliance on Flexidor, however the new label only permits one application per crop, so growers need alternative residual options.

The trial was set up as a fully randomised block design with each plot containing four tree species (e.g. *Malus*, *Prunus*, *Quince* and *Sorbus*) and four replicate blocks. The trial consisted of seven herbicide treatments which were applied on 14/05/18 as residual pre-emergence treatments post planting of rootstocks. Phytotoxicity and weed assessments were carried out at two, six and twelve weeks after treatment (WAT). Phytotoxicity was scored on a scale of 0-9; plants scoring 0 were considered dead, and 9 considered healthy, with plants scoring 7 or more considered to be of commercially acceptable quality. Weed cover was assessed as an overall percentage of the plot (**Figure 4**).

Sencorex was tested at higher rates than previously used on the test species and proved to be crop safe at these higher rates; experimental treatments also proved crop safe. Stomp Aqua was included for comparison as an industry standard treatment, it was also known to be crop safe so rootstocks would not be affected prior to the application of additional experimental treatments in 2019 post heading back (rootstocks cut back to just above the bud that was budded the previous season).

**Table 4.** Treatment list and timings

Trt. No.	Planting 14/05/2018	Clean up contacts prior to post budding residuals 13/09/18	Post Budding 24/09/18
1	Untreated	Untreated	Untreated
2	HDC H44 2.0 L/ha	Diquat 2 L/ha + Shark 0.8 L/ha	<b>Flexidor 500 0.5 L/ha + Venzar 500 SC 0.4 L/ha</b>
3	HDC H45 1.5 kg/ha	Diquat 2 L/ha + Shark 0.8 L/ha	<b>Flexidor 500 0.5 L/ha + Venzar 500 SC 0.4 L/ha</b>
4	HDC H45 2.5 kg/ha	Diquat 2 L/ha + Shark 0.8 L/ha	<b>Flexidor 500 0.5 L/ha + Venzar 500 SC 0.4 L/ha</b>
5	HDC H47 3.75 L/ha	Diquat 2 L/ha + Shark 0.8 L/ha	<b>Flexidor 500 0.5 L/ha + Venzar 500 SC 0.4 L/ha</b>
6	Sencorex Flow 0.875 L/ha	Diquat 2 L/ha + Shark 0.8 L/ha	<b>Flexidor 500 0.5 L/ha + Venzar 500 SC 0.4 L/ha</b>
7	Sencorex Flow 1 L/ha	Diquat 2 L/ha + Shark 0.8 L/ha	<b>Flexidor 500 0.5 L/ha + Venzar 500 SC 0.4 L/ha</b>
8 to 10	Stomp Aqua 2.9 L/ha	Diquat 2 L/ha + Shark 0.8 L/ha	<b>Flexidor 500 0.5 L/ha + Venzar 500 SC 0.4 L/ha</b>

There were subtle differences in weed control between treatments at the first assessment, carried out 2 weeks after treatment (WAT). Untreated controls had 5% weed cover. The best treatment for weed control was HDC H44 with 1.2% weed cover followed by HDC H45 at the high rate with 1.25%. By the 6 WAT assessment Sencorex at the higher rate maintained the best weed control at 2% weed cover, followed by Sencorex at the lower rate with 2.5% weed cover. These two treatments continued to maintain the best weed control until the 12 WAT assessment. Both HDC H44 and HDC H45 at the low rate lacked persistence with weeds increasing between 6 and 12 WAT. Stomp Aqua did not control the weed spectrum present when applied alone without complimentary tank mix partners.

The only treatment that resulted in phytotoxic damage at the 2 WAT assessment (all four species in the trial were affected) was HDC H44. By 12 WAT, however, all genera had grown away from damage and were considered commercially acceptable although *Prunus*

treated with HDC H44 and the high rate of Sencorex Flow were significantly different to untreated; p value at >.001 (27 df) L.S.D. 0.3746. Any large weeds were removed by hand after the 12 WAT assessment in line with grower practice prior to budding. Post budding any weeds were controlled with diquat and Shark to clean them up prior to the top up application of residual herbicides (Flexidor 0.5 L/ha and Venzar 500 SC 0.4 L/ha). The post-heading back treatments were crop safe and effective (mean weed cover in untreated plots was 19.5% compared to 2.89% in treated plots, see **Table 21.**).

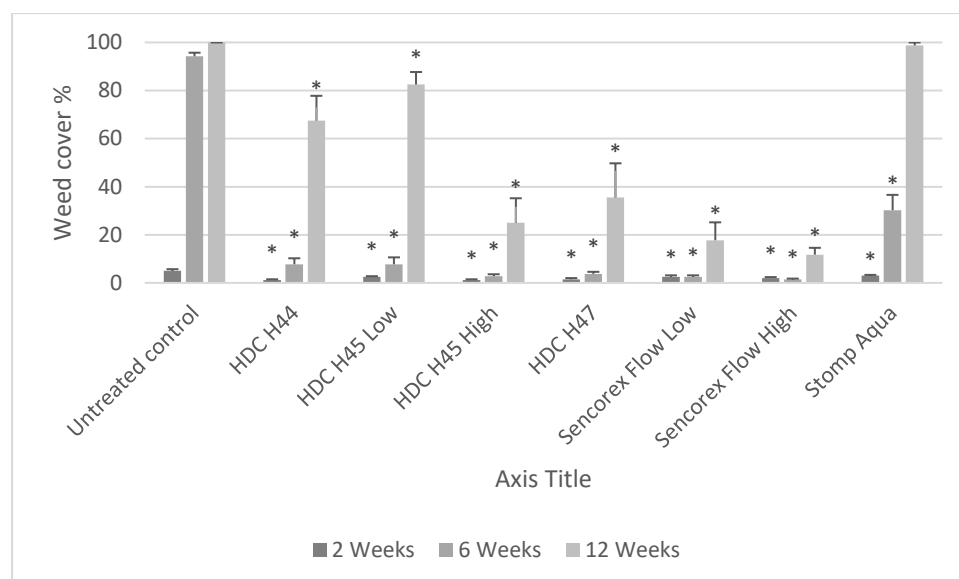


Figure 4: Weed cover (%) two, six and twelve weeks after planting treatment. Results for plots which had received the same post planting treatment were combined, \* indicates significance at p value <.001.

### **Hardy nursery stock trial**

The hardy nursery stock (HNS) trial was carried out at ADAS Boxworth on ten species of container grown plants (**Table 5**). The trial was set up as a fully randomised block design, with 5 plants per treatment and treatments replicated three times. The trial consisted of seven herbicide programmes, applied either post-potting or later, when the plants were dormant (**Table 5**). Applications of the post-potting treatments were made on 06/06/17, and dormant treatments were applied on 05/12/17.

Table 5. **Species and cultivars included in hardy nursery stock trial.**

Species	Cultivar
<i>Azalea japonica</i>	'Johanna'
<i>Buddleja davidii</i>	'Empire Blue'
<i>Euonymus fortune</i>	'Blondy R'
<i>Hydrangea macrophylla</i>	'Forever (R)'
<i>Hypericum x moserianum</i>	N/A
<i>Lavandula stoechas</i>	'Helmsdale'
<i>Spiraea japonica</i>	'Firelight'
<i>Viburnum tinus</i>	'Gwenllian'
<i>Weigela florida</i>	'Wine and Roses (R)'
<i>Coreopsis verticillata</i>	'Golden Gain'

Table 6. Treatment list and timings for the hardy nursery stock herbicide trial.

Treatment	Active ingredient	Rate (L/ha)	Timing
1	Untreated	-	-
2	Flexidor 500	isoxaben 500 g/L	June (post-potting)
3	Sunfire	flufenacet 500 g/L	
4	Centurion Max	clethodim 120 g/L	
5	Flexidor 500	isoxaben 500 g/L	December (over dormant crop)
6	Sunfire	flufenacet 500 g/L	
7	Defy	prosulfocarb 800 g/L	

None of the treatments applied after potting appeared to cause long-term phytotoxic effects (Table 7). Growers should note however, that Flexidor 500 may cause short-term scorch on *Hydrangea* and *Weigela*, and Sunfire could have a similar effect on *Buddleja*, *Hydrangea* and *Weigela*, as may Centurion Max on *Hydrangea* and *Spiraea*.

Table 7. Average phytotoxicity scores for hardy nursery species, thirteen weeks after June treatment application (assessed 04/09/17). (NS = no significant differences)

Species	UTC	Flexidor 500	Sunfire	Centurion Max
<i>Azalea japonica</i>	9.0	9.0	9.0	9.0
<i>Buddleja davidii</i>	9.0	9.0	9.0	9.0
<i>Euonymus fortune</i>	9.0	9.0	9.0	9.0
<i>Hydrangea macrophylla</i>	9.0	9.0	8.3	9.0
<i>Hypericum x moserianum</i>	9.0	9.0	8.7	9.0
<i>Lavandula stoechas</i>	9.0	9.0	9.0	9.0
<i>Spiraea japonica</i>	9.0	9.0	8.7	8.7
<i>Viburnum tinus</i>	9.0	8.7	9.0	9.0
<i>Weigela florida</i>	9.0	9.0	9.0	9.0
<i>Coreopsis verticillata</i>	9.0	9.0	9.0	9.0

Similarly, no significant phytotoxic effects were seen in hardy nursery stock plants treated while dormant – all treatments appeared crop safe on all species trialled (Table 7).

Table 8. Average phytotoxicity scores for hardy nursery species, nineteen weeks (due to prolonged dormancy as a result of a late spring) after December treatment application (assessed 17/04/18). (NS = no significant differences)

Species	UTC	Flexidor 500	Sunfire	Centurion Max
<i>Azalea japonica</i>	9.0	9.0	9.0	9.0
<i>Buddleja davidii</i>	9.0	8.7	9.0	9.0
<i>Euonymus fortune</i>	9.0	9.0	8.7	9.0
<i>Hydrangea macrophylla</i>	9.0	8.3	8.3	8.7
<i>Hypericum x moserianum</i>	9.0	9.0	9.0	9.0
<i>Lavandula stoechas</i>	9.0	9.0	9.0	9.0
<i>Spiraea japonica</i>	9.0	8.3	8.3	8.7
<i>Viburnum tinus</i>	9.0	8.7	8.7	8.7
<i>Weigela florida</i>	9.0	9.0	9.0	9.0
<i>Coreopsis verticillata</i>	9.0	9.0	9.0	9.0

### **HNS container trial 2018**

The 2018 HNS container trial was carried out at Wyevalle nurseries, Hereford, on ten species of container-grown plants (**Table 9**). The trial was set up as a fully randomised block design, with 5 plants per treatment, treatments were replicated three times. The trial consisted of six herbicide programmes, applied post-potting or as a top up treatment (**Table 10**). Applications of the post-potting treatments were made on 04/06/18,

Phytotoxicity was assessed at two, seven, and thirteen (June treatments) and again at three, six and twelve (October treatments) weeks after the herbicide treatments were applied on 16/10/18. Phytotoxicity was assessed by examining plants for any signs of herbicide damage (e.g. twisting, scorching, stunting), comparing treated plots to untreated, and scoring quality on a scale of 0-9; plants scoring 0 were considered dead, and 9 considered healthy, with plants scoring 7 or more considered to be of commercially acceptable quality

Flexidor was applied at the higher rate of 0.5 L/ha (equivalent to 2 L/ha of the old Flexidor 125 formulation) to test crop safety at the maximum rate, as only one application can now be applied per crop.

Table 9. **Species and cultivars included in hardy nursery stock container trial 2018.**

<b>Species</b>	<b>Cultivar</b>
<i>Buxus sempervirens</i>	
<i>Ceanothus thyrsiflorus</i>	'Skylark'
<i>Cistus x purpureus</i>	
<i>Cornus Alba</i>	'Red Selection'
<i>Euonymus japonicus</i>	'Green Rocket'
<i>Hydrangea paniculata</i>	'Limelight'
<i>Ilex aquifolium</i>	
<i>Olearia x haastii</i>	
<i>Perovskia atriplicifolia</i>	'Blue Spire'
<i>Sambucus nigra</i>	'Black Lace'

Table 10. **Treatment list and timings for the hardy nursery stock herbicide trial.**

<b>Treatment</b>		<b>Active ingredient</b>	<b>Rate (L/ha)</b>	<b>Timing</b>
1	Untreated	-	-	-
2	Sinclair pot topper	Physical mulch	3cm depth	June (post-potting)
3	HDC H46	Confidential	0.1	
4	HDC H44	Confidential	1.5	
5	Flexidor	isoxaben 500 g/L	0.5	
6	Flexidor +	isoxaben 500 g/L +	0.5 + 2.0	

	Centurion Max	clethodim 120 g/L		
7	Flexidor + HDC H43	isoxaben 500 g/L + pethoxamid	0.5+ 2.0	
8	Flexidor + Sunfire	isoxaben 500 g/L flufenacet 500 g/L	0.5 + 0.48	
1	Untreated	-	-	-
2	Untreated	-	-	-
3	Springbok + HDC H43	dimethanid-p + metazachlor + pethoxamid	1.6 + 2	
4	Springbok + HDC H43	dimethanid-p + metazachlor + pethoxamid	1.6 + 2	
5	Springbok	dimethanid-p + metazachlor	1.6	October top up
6	HDC H43	Pethoxamid	2	
7	Venzar 500 SC	Lenacil	0.4	
8	Springbok + H43 + Venzar 500 SC	dimethanid-p + metazachlor + pethoxamid + lenacil	1.6 + 2 + 0.4	

Following the June treatments, phytotoxicity assessments were carried out as before.

HDC H44 caused phytotoxic yellowing on a number of species (eight of the ten species treated) commercially unacceptable damage persisted to 13 WAT on five of the species tested (**Table 11**).

The new herbicide HDC H46 resulted in initial damage on a number of species however all species largely grew away from the damage with only slight damage by 13 WAT. Damage on four species was slightly more (scores between 6 and 6.3) than is considered commercially acceptable (a score of 7).

Flexidor at the 0.5 L rate damaged *Cornus* and *Perovskia* however *Cornus* grew away from the damage and plants were considered commercially acceptable by 13 WAT. *Perovskia* plants were not considered commercially acceptable by 13 WAT.

A tank mix of Flexidor and Centurion Max was slightly more damaging than Flexidor alone, however all species apart from *Perovskia* were considered commercially acceptable by 13 WAT. A tank mix of Flexidor and HDC H43 was also slightly more damaging than Flexidor alone however by 13 WAT only *Perovskia* and *Sambucus* were not considered commercially

acceptable. Flexidor + Sunfire was also more damaging than Flexidor alone and *Ceanothus*, *Hydrangea*, *Perovskia* and *Sambucus* were not considered commercially acceptable by 13 WAT.

Table 11. Average phytotoxicity scores for hardy nursery species, thirteen weeks after June treatment application (assessed 04/09/18). (NS = no significant differences)

Species	UTC	Sinclair pot topper	HDC H46	HDC H44	Flexidor	Flexidor + Centurion Max	Flexidor + HDC H43	Flexidor + Sunfire	p value	L.S.D.
<i>Buxus sempervirens</i>	9	9	9	9	9	9	9	9	(NS)	
<i>Ceanothus thyrsiflorus</i>	9	9	6	4	7.3	8	7	6.3	(NS)	
<i>Cistus</i> x <i>purpureus</i>	9	9	9	6	9	9	9	9	(NS)	
<i>Cornus alba</i>	9	9	9	9	9	9	9	9	(NS)	
<i>Euonymus japonicus</i>	9	9	9	7	9	9	9	9	(NS)	
<i>Hydrangea paniculata</i>	9	9	6	7	8	8	8	6	(NS)	
<i>Ilex aquifolium</i>	9	9	9	6.3	9	9	9	9	(NS)	
<i>Olearia</i> x <i>haastii</i>	9	9	9	4	8	9	8	9	(NS)	
<i>Perovskia atriplicifolia</i>	9	9	6.3	6	6	6.3	6	5.3	(NS)	
<i>Sambucus nigra</i>	9	9	6	9	9	7	6	4.6	(NS)	

No significant phytotoxic effects were seen in hardy nursery stock top up treatments – all treatments appeared crop safe on all species trialled (Tables 12 and 13).

Table 12. Average phytotoxicity scores for hardy nursery stock species, six weeks after October treatment application (assessed 20/11/18). (NS = no significant differences)

Species	UTC	Sinclair pot topper	Springbok + HDC H43	Springbok + HDC H43	Springbok	HDC H43	Venzar 500 SC	Springbok + HDC H43 + Venzar 500 SC	p value	L.S.D.
<i>Buxus sempervirens</i>	9	9	9	9	9	9	9	9	(NS)	-
<i>Ceanothus thyrsiflorus</i>	9	9	9	9	9	9	9	9	(NS)	-
<i>Cistus</i> x <i>purpureus</i>	9	9	9	9	9	9	9	9	(NS)	-

<i>Cornus alba</i>	9	9	9	9	9	9	9	9	(NS)	-
<i>Euonymus japonicus</i>	9	9	9	9	9	9	9	9	(NS)	-
<i>Hydrangea paniculata</i>	9	9	9	9	9	9	9	9	(NS)	-
<i>Ilex aquifolium</i>	9	9	9	8.3	9	9	9	8.6	(NS)	-
<i>Olearia</i> x <i>haastii</i>	9	9	8	8	8	8	9	8	(NS)	-
<i>Perovskia atriplicifolia</i>	9	9	9	9	9	9	9	9	(NS)	-
<i>Sambucus nigra</i>	9	9	9	9	9	9	9	9	(NS)	-

Table 13. Average phytotoxicity scores for hardy nursery stock species, twelve weeks after October treatment application (assessed 08/01/19). (NS = no significant differences)

Species	UTC	Sinclair pot topper	Springbok + HDC H43	Springbok + HDC H43	Springbok	HDC H43	Venzar 500 SC	Springbok + HDC H43 + Venzar 500 SC	p value	L.S.D.
<i>Buxus</i>	9	9	9	9	9	9	9	9	(NS)	-
<i>Ceanothus thyrsiflorus</i>	9	9	9	9	9	9	9	9	(NS)	-
<i>Cistus</i> x <i>purpureus</i>	9	9	9	9	9	9	9	9	(NS)	-
<i>Cornus alba</i>	9	9	9	9	9	9	9	9	(NS)	-
<i>Euonymus japonicus</i>	9	9	9	9	9	9	9	9	(NS)	-
<i>Hydrangea paniculata</i>	9	9	9	9	9	9	9	9	(NS)	-
<i>Ilex aquifolium</i>	9	9	9	9	9	9	9	9	(NS)	-
<i>Olearia</i> x <i>haastii</i>	9	9	8	8	8	8	9	8	(NS)	-
<i>Perovskia atriplicifolia</i>	9	9	9	9	9	9	9	9	(NS)	-
<i>Sambucus nigra</i>	9	9	9	9	9	9	9	9	(NS)	-

## Discussion

Appearing safe and effective, a combination of Stomp Aqua + Flexidor 500 + Sencorex Flow can be recommended for weed control in roses after planting. HDC H43 also has potential as a tank mix partner with Stomp Aqua + Flexidor 500, if the appropriate EAMU is granted. Tank mixes which included Venzar Flowable (440 g/L lenacil, applied at 3.0 L/ha) also offered good weed control and showed no obvious damage to the rose crop. However, this product has been replaced with a 500 g/L product, which is approved for use at the much lower rate of 0.4 L/ha. The LTAEU in place for Venzar Flowable when this trial commenced



has since expired, however products containing lenacil such as Venzar 500 SC can be used under the LTAEU at 0.4 L/ha.

An EAMU was granted for use of Logo on roses (3437/16), but only for application from May to July. However, earlier trial work has shown that this product can be damaging when applied over rootstocks or rose maidens in May. Applying at a later timing, i.e. after budding, may be safer, but overall it is advisable to be cautious with this treatment. No notable damage was observed from the application of Betanal maxxPro; this product is a useful option as a follow-up treatment, it is currently authorised for use under the LTAEU; an EAMU should be requested to secure its longer term use in ornamentals.

Butisan S appeared effective and crop safe when applied over roses post-budding, however, the current label recommends that the product is applied as a plant base spray (to minimise any potential crop damage). Butisan S is not being marketed by the authorisation holder any more, although other products containing metazachlor with uses in ornamental plant production are still available.

While HDC H42 appeared crop safe on roses in this project, previous work has suggested that this product can cause temporary phytotoxicity (Burgess and Atwood, 2008). However, this may be more marked when used after planting. If EAMUs are granted, HDC H43 or HDC H42 show potential as tank mix partners for Stomp Aqua + Flexidor 500.

It is important to note that label use of Flexidor 500 permits only one application per year, i.e. the use of this product after planting and again post-budding would not be allowed. Application at the earlier spray timing is suggested – weed pressure will be greater at this point – with the product then omitted from subsequent spray mixes. HDC H47, an experimental product, appears to be a safe alternative to Flexidor 500 as a tank mix partner for treating roses post-heading back.

Sencorex Flow can be recommended for weed control in field trees post planting, although previous work has suggested that this product can cause temporary phytotoxicity when used on light soils and after heavy rainfall. Therefore when used on light soils the rate may need to be reduced, particularly if heavy rainfall is forecast. HDC H44 and HDC H47 also have potential as tank mix partners with Sencorex Flow and Stomp Aqua. None of the treatments tested on container hardy nursery stock appeared to cause long term damage to any of the ten species when applied after potting. However, growers should be aware of the possibility of short term scorch from Flexidor 500 on *Hydrangea* and *Weigela*; from Sunfire on *Buddleja*, *Hydrangea* and *Weigela*; and from Centurion Max on *Hydrangea* and *Spiraea*.

When applied over dormant container hardy nursery stock, none of the treatments assessed appeared to cause notable damage to any of the plant species.

## **Conclusions**

- HDC H43 shows potential for safe use on roses in a tank mix after planting, budding and/or heading back, provided an EAMU can be granted.
- HDC H42 remains a possible treatment for post-heading back of roses, though this product has a history of occasional damage (foliar bleaching and stunting), particularly when used after planting. There may be varietal susceptibility which has not been fully explored.
- Logo applied as a follow-up treatment over rose rootstocks appeared to cause some crop damage. This product may be better employed as a directed-alleyway spray treatment in wider spaced field crops.
- The EAMU for use of Sencorex Flow will allow the application of effective tank mix combinations such as Stomp Aqua + Sencorex Flow after planting and heading back.
- Sencorex Flow could form the basis of residual herbicide programmes post planting at a higher rate than previously used on field grown trees as an alternative to Flexidor.
- New products Sunfire and Centurion Max have shown potential for use over HNS foliage. In terms of crop safety, growers should be prepared for some varietal susceptibility – further testing is needed before these products are adopted for wide scale use.
- Sunfire and Defy applied as dormant season treatments appear crop safe, and are recommended for taking forward to future trials work.
- Defy could be a partial alternative to Devrinol (napropamide) as a winter treatment for container-grown hardy nursery stock if an EAMU for the latter was not available. However, a renewal of the authorisation for Devrinol on ornamentals would be preferred – its control of groundsel is superior to that of Defy.

## **Financial Benefits**

Hand weeding three times during the growing season is estimated to cost in the region of £30,000 per hectare for field crops, such as trees and roses. The effective use of residual herbicides – minimising the need for hand weeding or the application of direct contact herbicides – will help to reduce costs significantly, contributing to grower profitability. For example, herbicide mixtures of standard products with Sencorex Flowable appeared to provide improved weed control compared with the standard treatment Stomp Aqua + Flexidor 500 + Venzar Flowable. The LTAEU in place for Venzar Flowable when this trial commenced has since expired, resulting in a reduction in the rate of lenacil that can be applied, a loss which will reduce the effectiveness of the standard treatment. It is estimated

that substitution with a product such as Sencorex Flow is likely to reduce the need for hand weeding compared with no substitution by around £10,000 per hectare.

New herbicides Sunfire, Defy and Centurion Max were evaluated for container-grown hardy nursery stock production. At present there is no financial benefit for Defy because an improved EAMU permitting use over the top of dormant crops would be required; current off-label approval for use of Defy in outdoor and protected ornamental plant production (EAMU 1431/13) only allows pre-emergence use.

### **Action Points**

- For budded rose production in the field, a herbicide programme of Stomp Aqua + lenacil\* + Sencorex Flow after planting, Butisan S after budding and Stomp Aqua + Flexidor 500 + Sencorex Flow after heading back can be recommended.
- Betanal maxxPro appears safe to use as a selective contact herbicide for removal of seedling weeds in rose stocks during May, it is currently authorised for use under the LTAEU.
- The selective contact grass herbicide Centurion Max or residual herbicide Sunfire, appeared safe on container grown HNS, some species tested.

\*lenacil as Venzar 500 SC at the new LTAEU maximum rate of 0.4L/ha.