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Project number:	HNS PO 192
Project leader:	John Atwood, ADAS
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Location of project:	Darby Nursery Stock Ltd, Norfolk. Hawkesmill Nursery c/o Webbs of Wychbold, Worcs. Cut Flower Centre, Lincs.
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AUTHENTICATION

We declare that this work was done under our supervision according to the procedures described herein and that the report represents a true and accurate record of the results obtained.

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Signature Date 5 December 2014

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Headlines

- New herbicides HDC H22, HDC H25 and HDC H27 where found to be safe to a range of 33 shrub and 20 herbaceous species subjects when applied after potting. Some species suffered temporary damage but grew away from it.
- Springbok (dimethenamid-p + metazachlor) which can be used on outdoor ornamentals under the LTAEU was also safe to most subjects when applied shortly after potting to a range of 33 shrub species – it was not tested on the herbaceous species because previously it has been found to be damaging.
- The new liverwort and moss control product Mosskade was found to be safe when applied six weeks after potting to a range of 33 shrub species and when applied immediately after potting to 20 herbaceous species.

Background

The HNS (Hardy Nursery Stock) industry is currently relying on relatively few herbicides to control weeds, leading to an increasing concern about the development of resistance. With the loss of Ronstar 2G and other products containing oxadiazon, there are very few summer treatments left that are available to the HNS industry to control a wide range of weeds on container-grown plants after potting and during the growing season. Restrictions on the use of straight metazachlor products (e.g. Butisan S) have only complicated the situation further. Once supplies of Ronstar 2G (and other products) have run out, the industry will be heavily dependent upon Flexidor 125 (isoxaben) for summer herbicide applications. Unfortunately Flexidor 125 does not control groundsel, willowherb or grasses and the reliance on one herbicide increases the likelihood of weeds developing resistance.

Results from HNS 139 and HNS 139a demonstrated how Dual Gold (S-metolachlor) could help improve control of weeds, however the current EAMU only permits use during May leaving a gap in control measures during the summer and autumn. HDC H22 from the SCEPTRE CP 77 programme has the characteristics (residual weed control with minimal contact activity) that could make it useful in ornamental production. Springbok

(dimethenamid-p + metazachlor) was first trialed in a small scale in HNS 139 but it wasn't developed further for container-grown shrubs as it did not offer any advantage over Butisan S. However, as Springbok has a lower metazachlor content than Butisan S, together with the active dimethenamid-p, it can be used at an appropriate application rate without exceeding the limit for metazachlor. Earlier results from HNS 166 demonstrated that a number of herbaceous crops could be damaged. Therefore Springbok was not included in the herbaceous trial within this project. Three further new products were made available for testing in 2014, including granular product HDC H25 for general weed control and a liverwort and moss control product Mosskade. HDC H27 was included as an alternative granular product to be tested. This product is widely used in arable systems as a grass herbicide with efficacy against annual meadow grass and some broad leaved weeds.

All herbicide treatments were also included in a second shrub nursery trial and evaluated for weed control spectrum under project CP 86 HDC/EMT/HTA Weeds Fellowship. Results from these trials are summarised in this grower section for information. Full details of these trials will be included in the annual report for CP 86 available in 2015.

The aim of this project was to determine crop safety of the new herbicides when applied as a summer treatment shortly after potting. The industry standard, Flexidor 125, and an untreated control were also included in the treatment list to allow comparisons to be made. The subjects were monitored for phytotoxicity and any effects were recorded. These findings will allow recommendations for future treatment.

Summary

The trials were carried out on two commercial nurseries; shrub species at Darby Nursery Stock, Norfolk and herbaceous species at Hawkesmill Nurseries, Webbs of Wychbold site. The aim was to cover a range of hardy nursery stock and herbaceous subjects that are commonly grown on commercial nurseries in the UK and assess their susceptibility or tolerance to applications of the new herbicides.

The trials were carried out in summer 2014. Treatments were applied with the exception of Mosskade on 19 and 20 May 2014 to the shrub species (Darby Nursery Stock), all treatments were applied to the herbaceous subjects on 20 June 2014 (Hawkesmill Nurseries) as a treatment over the foliage after potting on (**Table 1**). Mosskade was applied

30 June 2014 at Darby Nursery Stock as this is a contact acting liverwort herbicide so would not be applied as a residual at potting. Mosskade was applied on the same date as other treatments at Hawkesmill Nurseries as this would test phytotoxicity when plants were at their most susceptible growth stage. HDC H25 was used at two rates (the expected label rate and half rate) in the trial on herbaceous subjects at Hawkesmill Nurseries as there was concern that the full label rate may be damaging to herbaceous stock. The plots were assessed for any damage or growth effects two, six and twelve weeks after treatment. Weed assessments were also carried out at these times although the primary focus of the trials was to assess crop safety.

Table 1. Treatments applied to plots during summer 2014 at 1000 L water/ha

Treatment	**Active ingredient**	**Rate kg/ha or L/ha**	**Approval status**
Untreated	-	-	-
Flexidor 125	Isoxaben (125 g/L)	1	Approved
Mosskade	Starch, proteins, oils	100	Outside scope
Springbok[1]	Dimethenamid-p (200 g/L) + metazachlor (200 g/L)	1.66	LTAEU
HDC H22	Confidential		Not approved
HDC H25	Confidential		Not approved
HDC H27	Confidential		Not approved

[1] Not used in the herbaceous trial

HNS shrub trial

Table 2 provides a summary of all the subjects assessed, showing the plants which are tolerant (T) to herbicide applications and the plants which are moderately susceptible (MS) or susceptible (S) to the herbicide applications. MS plants may have shown some initial damage caused by the herbicide but they grew on to be saleable plants. The majority of subjects tested showed little or no damage or growth defects caused by the different treatments.

Table 2. Tolerance of HNS subjects to applications of HDC H22, HDC H25, HDC H27, Springbok, Flexidor 125 and Mosskade (tolerant – T, moderately susceptible – MS, susceptible – S). This table also includes crop safety data for additional species tested within CP 86 at Wyevale Nurseries at similar rates and timings.

Varieties	H22	H25	H27	Springbok	Flexidor 125	Mosskade
Abelia grandiflora 'Goldsport'	T	T	T	T	T	T
Azalea 'Geisha Orange'	T	T	T	T	T	T
Berberis darwinii	T	T	T	T	T	T
Buddleja davidii 'Empire Blue'	MS	T	T	MS	MS	T
Camellia japonica 'Tristem Carlyon'	T	T	T	T	T	T
Caryopteris clandonensis 'Heavenly Blue'	T	T	MS	T	T	T
Chamaecyparis Lawsoniana 'Elwood's Gold'	T	T	T	T	T	T
Choisya ternata	T	T	T	T	T	T
Cistus corbariensis	T	T	T	T	T	T
Clematis repens	T	T	T	T	T	T
Cornus sericea 'Hedgerows Gold'	T	T	T	T	T	T
Erica x darleyensis	T	T	T	T	T	T
Escallonia 'Iveyi'	T	T	T	T	T	T
Hebe topiaria	T	T	T	T	T	T
Hebe vernicosa	T	T	T	T	T	T
Hydrangea macrophylla	T	T	T	T	T	T
Hypericum moserianum	T	T	T	T	T	T
Jasminum officinale	T	T	T	T	T	T
Lavandula angustifolia 'Imperial Gem'	T	T	T	T	T	T
Ligustrum ovalifolium	T	T	T	T	T	T
Lonicera 'Red Tips'	T	T	T	T	T	T
Olearia macrodonta major	S	T	T	S	T	T
Phormium tenax	T	T	T	T	T	T
Potentilla 'Primrose Beauty'	T	T	T	T	T	T
Prunus laurocerasus	T	T	T	T	T	T
Rhododendron 'Cary Ann'	T	T	T	T	T	T
Sambucus nigra 'Black	T	T	T	T	T	T

Varieties	H22	H25	H27	Springbok	Flexidor 125	Mosskade
Lace'						
Santolina chamaecyparissus	T	T	T	T	T	T
Spiraea japonica 'Golden Princess'	T	T	T	T	T	T
Thuja occidentalis 'Rheingold'	T	T	T	T	T	T
Viburnum tinus 'Gwenllian'	T	T	T	T	T	T
Vinca minor	T	T	T	T	T	T
Weigela 'Kosteriana Variegata'	T	T	T	T	T	T

Very little damage was observed over the course of the trial across the majority of species. Flexidor 125, H22 and Springbok showed some damage to *Buddleja* two weeks after treatment with some twisting, crinkling and curling to the leaves (**Figure 1**). The affected *Buddleja* grew away from the damage by six weeks after treatment.

HDC H27 also had some phytotoxic effect on *Caryopteris* at the two week assessment (**Figure 2**), the *Caryopteris* showing spotting on the leaves. This species grew away from this damage by the six week assessment and by 12 weeks after treatment had almost fully recovered.

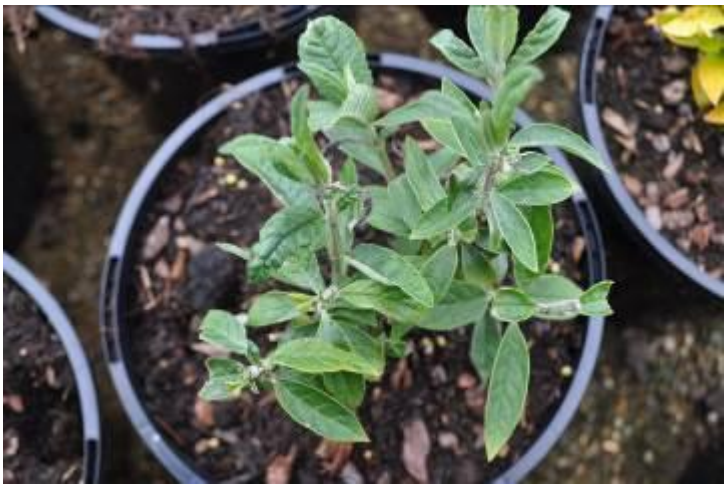

Figure 1. *Buddleja* – phytotoxic effects of H22 two weeks after treatment

Figure 2. *Caryopteris* – phytotoxic effects of H27 two weeks after treatment

HDC H27 caused very slight damage six weeks after treatment on *Hydrangea* and Springbok caused very slight damage six weeks after treatment on *Lonicera,* in both cases plants were still commercially acceptable.

In the CP 86 trial at Wyevale HDC H22 and Springbok resulted in more marked damage on *Olearia* that was not considered commercially acceptable by 12 weeks after treatment.

HNS herbaceous trial

Some damage was noted on various species at the first assessment, two weeks after treatment with Flexidor 125 the most damaging treatment. However the majority of species grew away from initial damage by the second assessment, six weeks after treatment. By the time the final score was carried out at 12 weeks after treatment (**Table 3**) there was very little evidence of lasting damage with only *Eryngium planum* treated with HDC H22 and *Geranium* 'Rozanne' treated with HDC H27 showing signs of damage at this stage. The *Eryngium planum* were classed as susceptible to HDC H22. Damage to *Geranium* 'Rozanne' was less severe, and these and other species initially affected but which recovered sufficiently to be saleable, were classed as moderately susceptible in Table 3. HDC H25 proved to be very safe with little difference between rates, only *Veronica* 'Royal Blue' suffered slight initial damage at the full rate.

Table 3. Tolerance of herbaceous subjects to applications of HDC H22, HDC H25, HDC H27, Flexidor 125 and Mosskade (tolerant – T, moderately susceptible – MS, susceptible – S).

Varieties	H22	H25 full rate	H25 half rate	H27	Flexidor 125	Mosskade
Anemone 'White Swan'	T	T	T	T	MS	T
Anthyrium felix-femina	T	T	T	T	MS	T
Astilbe 'Visions in Red'	T	T	T	T	T	T
Campanula 'White Pouffe'	MS	T	T	T	MS	T
Delphinium 'Galahad'	T	T	T	T	MS	T
Echinacea purpurea	MS	T	T	T	T	T
Echinops bannaticus 'Blue Globe'	T	T	T	T	T	T
Epimedium 'Frohnleiten'	T	T	T	T	T	T
Eryngium planum	S	T	T	T	T	T
Geranium 'Rozanne'	T	T	T	MS	T	T
Helenium 'Helena Red Shades'	T	T	T	T	T	T
Helleborus 'Red Lady'	T	T	T	T	T	T
Hemerocallis 'Burning Daylight'	T	T	T	T	T	T
Heuchera 'Melting Fire'	T	T	T	T	T	T
Iris pseudacorus	T	T	T	T	T	T
Papaver 'Pizzicato Globe'	T	T	T	T	T	T
Pennisetum 'Hameln'	T	T	T	T	T	T
Sedum 'Autumn Joy'	T	T	T	T	T	T
Verbascum 'Olympicum'	MS	T	T	MS	MS	T
Veronica 'Royal Blue'	T	MS	T	T	MS	T

Damage on *Eryngium planum* treated with HDC H22 resulted in poor growth and very small, weak flower stems whist damage on *Geranium* 'Rozanne' treated with HDC H27 resulted in puckered, distorted leaves.

Weed distribution through both trials was very patchy and consisted of groundsel (*Senecio vulgaris*), hairy bitter cress (*Cardamine hirsute*), sowthistle (*Sonchus oleraceus*) and liverwort (*Marchantia polymorpha*). More weed was observed in the untreated plots but it was not possible to draw conclusions on weed control efficacy. However, a seeded pot weed screen was carried out within project CP 86.

Seeded pot weed screen

The main objective of this trial was to assess the weed control efficacy and spectrum of control of the four herbicides assessed for crop safety; HDC H22, HDC H25, HDC H27 and Springbok compared with Flexidor 125 as the industry standard.

The herbicides were trialled on eight common horticultural weeds, applied both as pre- and post-emergence sprays.

Table 4. Pre-emergence - percentage reduction in weed number in relation to the untreated control – ADAS Boxworth Summer 2014

Species	**Percentage reduction in weed number in relation to the untreated control (100% = complete control, 0% = no control)**				
	Flexidor 125	**HDC H22**	**HDC H25**	**HDC H27**	**Springbok**
Hairy bittercress	47.3	36.4	**100**	0.0	47.3
Flexuous bittercress	66.7	0.0	**85.4**	0.0	11.9
NZ bittercress	**71.1**	45.3	**81.1**	22.7	**62.1**
Pearlwort (heath)	**100**	**86.2**	**100**	0.0	**89.7**
Groundsel	9.3	12.5	**73.6**	0.0	31.0
American willowherb	0.0	**63.8**	**94.6**	0.0	42.6
Common chickweed	0.0	2.3	**97.1**	0.0	11.6
Annual meadow grass	0.0	32.4	**89.7**	**89.7**	29.4
Common mouse ear	0.0	31.6	**90.6**	**60.1**	13.2

* Percentages in **bold** show statistical significance at the 95% level

Table 5. Post-emergence (three true leaves) - percentage reduction in weed number in relation to the untreated control – ADAS Boxworth Summer 2014

Species	**Percentage reduction in weed number in relation to the untreated control (100% = complete control, 0% = no control)**

	Flexidor 125	HDC H22	HDC H25	HDC H27	Springbok
Hairy bittercress	**74.5**	29.0	**88.3**	49.7	42.1
Wavy bittercress	51.0	7.8	**86.3**	16.7	15.7
NZ bittercress	**73.1**	7.7	**86.5**	21.2	23.1
Pearlwort (heath)	21.4	32.1	23.0	34.2	23.0
Groundsel	15.2	12.3	10.3	0.0	15.2
American willowherb	43.3	43.3	0.0	29.9	24.7
Common chickweed	0.0	0.0	0.0	0.0	5.0
Annual meadow grass	17.5	12.5	12.5	17.5	**67.5**
Common mouse ear	0.0	0.0	0.0	0.0	0.0

* Percentages in **bold** show statistical significance at the 95% level

All the herbicides were more effective when applied as pre-emergence (**Table 4**). HDC H25 was the most effective herbicide and gave a significant reduction of all species pre-emergence including groundsel. Flexidor 125, the industry standard, gave a significant reduction in pearlwort (100%) and some reduction in the three bittercress species, particularly NZ bittercress. HDC H27 reduced annual meadow grass and common mouse ear chickweed. HDC H22 significantly reduced pearlwort (86.2%) and willowherb while Springbok effectively reduced the population of pearlwort (89.7%) and NZ bittercress.

Post-emergence, HDC H25 was again the most effective herbicide for the bittercress species with population reductions of 80% plus (**Table 5**). Other treatments were less effective post-emergence, with only Flexidor 125 showing any real reduction in the level of bittercresses; HDC H22 reduced the willowherb population to an extent while Springbok effectively reduced the annual meadow grass population.

The data strongly suggest that HDC H25 is crop safe to all subjects tested and provided the most complete weed control spectrum pre-emergence and some control of bittercress post-emergence.

Financial Benefits

An increase in options available for summer weed control will enable growers to produce weed-free container plants without excessive hand weeding costs. The cost of relying entirely on hand weeding is put at around £43,000 per ha per year including three weeding sessions and a cleanup at dispatch. Having more herbicides available for weed control would be beneficial to all container nursery stock growers.

Action Points

- The granular product HDC H25 will be a suitable replacement for Ronstar 2G for use after potting, being suitable for most shrub and herbaceous species with a very good weed control spectrum. It is anticipated that HDC H25 will be available as a commercial product with a label approval for outdoor ornamental plant production during mid-2016.
- Springbok could be used after potting for many shrub species but granular products are preferred and Springbok may be better employed as a follow-up treatment. Springbok can currently be used in ornamental plant production under the LTAEU, but ultimately an EAMU will also be required for this herbicide.
- HDC H22 is further away from the market but when available could be a useful summer herbicide for growers providing an EAMU could be obtained.
- HDC H27 did not perform as well as HDC H25 in terms of weed control spectrum or safety and it seems unlikely that it will be possible to obtain a EAMU for use in ornamental plant production.
- Mosskade was not particularly damaging, where damage was seen plants rapidly grew away from any damage.

Science Section HNS trials

Science Section HNS trials - Introduction

There are very few active ingredients currently available to the HNS industry, because of the loss of key active ingredients in recent years, with limited options available for summer herbicide treatments. Restrictions on the use of straight metazachlor products, such as Butisan S, have only compounded the problem. Ronstar 2G (oxadiazon) has been a very important herbicide that is widely used on container grown HNS. Ronstar 2G's popularity has been due to its easy handling, its safety to crops and its effectiveness on a wide range of weed species, including groundsel and willow herb. Unfortunately, remaining supplies of Ronstar 2G have to be used up by the 30th June 2015, after this the industry will be very heavily reliant on Flexidor 125 (isoxaben) for summer herbicide applications. Flexidor 125 has been shown to be ineffective in controlling groundsel, willowherb, grasses and in some cases pearlwort which are all troublesome weeds for the HNS industry. Some shrub and many herbaceous species are sensitive to Flexidor 125 and increased reliance on one herbicide will ultimately lead to resistance problems. This project includes the assessment of five herbicides; HDC H22, HDC H25, HDC H27, Springbok (dimethenamid-p + metazachlor) and Mosskade (plant derived starch, proteins, oils, lactic acid). The latter, Mosskade, is used specifically for liverwort and moss control.

The aim of this project was to trial these five herbicides for crop safety over a range of container grown nursery stock (shrub and herbaceous subjects) that are widely grown on commercial nurseries in the UK. The species chosen were discussed with industry stakeholders and the technical managers of the host nurseries. The specific objective of this trial was to:

- Test HDC H25, Mosskade, HDC H27, HDC H22 and Springbok for crop safety when applied to container grown nursery stock subjects as a summer treatment.

Materials and methods

The trials were carried out on two commercial nurseries; shrub species at Darby Nursery Stock, Norfolk and herbaceous species at Hawkesmill Nurseries Worcestershire site. Nursery stock subjects were supplied by Darby Nursery Stock and Osberton Nurseries and herbaceous by Hawkesmill Nurseries. The species list was decided upon by the study

director in discussion with industry stakeholders to complement the subjects tested in CP 86 and to cover a wide range of species grown on commercial nurseries. Details of the potting mix, pesticide applications and irrigation can be found in the appendix, along with an image of each subject on the day of application.

The experiments were laid out in a randomized split plot design with two treatment factors (i) chemical treatment (seven), (ii) crop species (20), with three replicate blocks, giving a total of 21 plots. Each plot contained five plants of each species and measured 1.5m x 4m (shrubs) and 1.5m x 4m (herbaceous). The treatments were applied to the pots using an OPS sprayer and a 1 m single nozzle lance with an 02f110 nozzle, to achieve a medium spray quality at 1000 L/ha. The five herbicides used were: HDC H22, H25, HDC H27, Mosskade, and Springbok, except at Hawkesmill where a half rate HDC H25 treatment was used instead of Springbok. Treatments also included an industry standard, Flexidor 125, and an untreated control. All herbicide rates are shown in **Table 1**. HDC H25 and HDC H27 were applied to newly potted plants at Darby Nursery Stock on 19 May 2014. HDC H22, Springbok and Flexidor 125 were all applied to newly potted plants on the same site on the 20 May 2014 and Mosskade was applied on 30 June 2014 as this is a contact acting treatment. No other herbicide applications were used in this trial.

All treatments were applied to herbaceous subjects at Hawkesmill Nurseries on 20 June 2014, no additional herbicide applications were applied.

Phytotoxicity was assessed two, six and twelve weeks after the herbicides were applied. Comparing the treated plots to the untreated controls and scoring on a scale of zero to nine where zero is dead, seven is damage that would be acceptable commercially, and nine is comparable with an untreated control. Photographs were taken of phytotoxicity symptoms at the various assessments.

Assessments were also carried out at the same time for weed control. A percentage score was recorded for weeds found over the five pots in each plot at the trial and weed species were recorded. There were insufficient weeds present within the trial carried out at Hawkesmill nurseries to justify carrying out assessments of weed coverage.

Table 1. Treatment list for Darby Nursery Stock trial - applied 19 and 20 May 2014

Treatment	Active ingredient	Rate kg/ha or L/ha
1. Untreated	-	-

2. HDC H25	confidential	-
3. Mosskade*	starch, proteins, oils	100
4. Flexidor 125	isoxaben	1
5. HDC H27	confidential	-
6. HDC H22	confidential	-
7. Springbok	metazachlor + dimethenamid-p	1.66

*Mosskade applied 30 June 2014

Table 2. Treatment list Hawkesmill Nurseries – 20 June 2014

Treatment	**Active ingredient**	**Rate kg/ha or L/ha**
1. Untreated	-	-
2. HDC H25 (full rate)	confidential	-
3. HDC H25 (half rate)	confidential	-
4. Mosskade	starch, proteins, oils	100
5. Flexidor 125	Isoxaben	1
6. HDC H27	Confidential	-
7. HDC H22	Confidential	-

Results

Results are detailed in **Tables 3 - 5** for the shrub trials at Darby Nursery Stock and **Tables 6 – 8** for the herbaceous trial at Hawkesmill Nurseries. Results are summarised for each herbicide treatment combined from both experiments.

HDC H25 was safe on almost all subjects assessed there was some minor leaf scorching to *Sambucus* however plants grew away from this by 12 weeks after treatment and no scores were below seven so would still be considered tolerant as the plants were assessed as saleable. The higher rate of HDC H25 caused slight damage on *Verbascum* at two weeks after treatment and on *Veronica* at six weeks after treatment; this was the only herbaceous species noticeably damaged by this treatment at this assessment. Both *Veronica* and *Verbascum* grew away from damage by 12 weeks after treatment.

Flexidor 125 caused damage in the form of crinkled and twisted leaves which was recorded at two weeks after treatment on *Buddleja* (**Figure 3**). The affected *Buddleja* grew away from the damage by six weeks after treatment. In the herbaceous trial, Flexidor 125 was the most damaging treatment with various species affected (mainly stunting and yellowing) at the first score carried out two weeks after treatment. However all species grew away from the damage and by six weeks after treatment only *Anthyrium* and *Delphinium* were still showing signs of damage. Both *Anthyrium* and *Delphinium* had grown away from damage by 12 weeks after treatment. A number of species that suffered initially damage but recovered were classed as moderately susceptible (see Grower Section Table 3), none were considered fully susceptible.

HDC H27 had some phytotoxicity effect on *Buddleja* and *Caryopteris* two weeks after treatment. The damage to *Buddleja* resulted in crinkled and twisted leaves (**Figure 4**), whereas scorch spots were seen on *Caryopteris* (**Figure 8**). Both species were growing away from this damage at the six weeks after treatment assessment and by 12 weeks after treatment both species had almost fully recovered. HDC H27 also caused some slight scorching to *Sambucus* at six weeks after treatment, however plants had mostly grown away from this damage at 12 weeks after treatment. In the herbaceous trial HDC H27 had some phytotoxicity effect on nine of the species within the trial; *Verbascum* were most severely affected at this assessment. All species had grown away from damage by the six week after treatment score. Interestingly *Geranium* did not show signs of phytotoxic damage until six weeks after treatment. Although this species had started to grow away from this damage by 12 weeks after treatment *Geranium* was classed as moderately susceptible to this treatment (Grower Section Table 3).

HDC H22 caused phytotoxic symptoms on *Buddleja* including crinkled and twisted leaves at two weeks after treatment (**Figure 2**). The majority of the plants had recovered by six weeks after treatment and all plants were fully recovered by 12 weeks after treatment. In the herbaceous trial HDC H22 caused initial damage on various species including *Campanula, Echinacea, Eryngium* and *Verbascum*. Although initial damage was significant, all species recovered by 6 weeks after treatment (with the exception of *Eryngium*) and these species were classed as moderately susceptible. Damage persisted on *Eryngium* at 12 weeks after treatment, it was therefore classed as susceptible.

Springbok caused damage to *Buddleja* two weeks after treatment, leaf crinkling and twisting, but the plants were fully recovered by 12 weeks after treatment. Springbok also caused some minor phytotoxicity effects to *Sambucus* at six weeks after treatment but the plants had mostly grown away from this at the final assessment and it was considered safe. Springbok was not included within the herbaceous trial.

Mosskade caused no phytotoxic effects on any shrub subjects assessed. In the herbaceous trial minor phytotoxic symptoms were observed on *Anthyrium*, *Echincea* and *Veronica* two and six weeks after treatment but the plants had mostly grown away from this at the final assessment and it was considered safe.

Phytotoxicity was scored on a 0 – 9 scale with 0 representing plant death and 9 being comparable with controls. The tables below list the mean scores given to all species and treatments at two, six and 12 weeks after treatment, when compared to controls.

Table 3. Mean phytotoxicity results assessment one, two weeks after treatment – Darby Nursery Stock summer 2014

	Scores								
Variety	**UTC**	**H25**	**Mosskade**	**Flexidor 125**	**H27**	**H22**	**Springbok**	**P value**	**LSD (df 12)**
Abelia grandiflora 'Goldsport'	9.0	9.0	9.0	9.0	9.0	9.0	9.0	**NS**	
Azalea 'Geisha Orange'	9.0	9.0	9.0	9.0	9.0	9.0	9.0	**NS**	
Buddleja davidii 'Empire Blue'	9.0	8.6	9.0	6.4	7.7	6.7	5.7	**<.001**	**1.177**
Camellia japonica 'Tristem Carlyon'	9.0	9.0	9.0	9.0	9.0	8.9	9.0	**NS**	
Caryopteris clandonensis 'Heavenly Blue'	9.0	8.7	9.0	8.5	6.9	8.1	9.0	**0.019**	**1.188**
Chamaecyparis lawsoniana 'Ellwood's Gold'	9.0	9.0	9.0	9.0	9.0	9.0	8.5	**NS**	
Choisya ternata	9.0	9.0	9.0	8.7	9.0	8.7	9.0	**NS**	
Cistus corbariensis	9.0	9.0	9.0	9.0	9.0	9.0	8.8	**NS**	
Clematis repens	9.0	8.7	9.0	8.9	9.0	9.0	9.0	**NS**	
Cornus sericea 'Hedgerows Gold'	9.0	9.0	9.0	9.0	9.0	9.0	8.9	**NS**	
Erica x darleyensis	9.0	9.0	9.0	9.0	9.0	8.9	9.0	**NS**	
Hebe topiaria	9.0	9.0	9.0	9.0	9.0	9.0	9.0	**NS**	
Hypericum moserianum	9.0	9.0	9.0	8.9	9.0	8.5	9.0	**NS**	
Jasminum officinale	9.0	8.8	9.0	9.0	8.8	8.7	9.0	**NS**	
Lavandula angustifolia 'Imperial Gem'	9.0	9.0	9.0	9.0	9.0	9.0	9.0	**NS**	
Rhododendron 'Cary Ann'	9.0	9.0	9.0	9.0	9.0	9.0	9.0	**NS**	
Sambucus nigra 'Black Lace'	9.0	9.0	9.0	9.0	9.0	9.0	9.0	**NS**	
Spiraea japonica 'Golden Princess'	9.0	8.8	9.0	8.9	8.9	9.0	7.7	**NS**	
Thuja occidentalis 'Rheingold'	9.0	9.0	9.0	9.0	9.0	9.0	9.0	**NS**	
Vinca minor	9.0	9.0	9.0	9.0	9.0	9.0	9.0	**NS**	
Weigela 'Kosteriana Variegata'	9.0	9.0	9.0	9.0	9.0	8.5	8.0	**0.051**	**0.696**

Table 4. Mean phytotoxicity results assessment two, six weeks after treatment – Darby Nursery Stock summer 2014

	Scores								
Variety	**UTC**	**H25**	**Mosskade**	**Flexidor 125**	**H27**	**H22**	**Springbok**	**P value**	**LSD (df 12)**
Abelia grandiflora 'Goldsport'	9.0	8.5	9.0	9.0	9.0	8.7	9.0	**NS**	
Azalea 'Geisha Orange'	9.0	9.0	9.0	9.0	9.0	9.0	9.0	**NS**	
Buddleja davidii 'Empire Blue'	9.0	9.0	9.0	9.0	8.3	8.6	8.0	**0.010**	**0.5679**
Camellia japonica 'Tristem Carlyon'	9.0	9.0	9.0	9.0	9.0	9.0	9.0	**NS**	
Caryopteris clandonensis 'Heavenly Blue'	9.0	8.8	9.0	9.0	9.0	9.0	8.7	**NS**	
Chamaecyparis lawsoniana 'Ellwood's Gold'	9.0	8.5	9.0	8.8	9.0	9.0	8.5	**NS**	
Choisya ternata	9.0	9.0	9.0	9.0	9.0	9.0	9.0	**NS**	
Cistus corbariensis	9.0	9.0	9.0	9.0	9.0	9.0	9.0	**NS**	
Clematis repens	9.0	8.1	9.0	8.7	8.3	8.5	7.8	**NS**	
Cornus sericea 'Hedgerows Gold'	9.0	7.2	9.0	8.4	7.8	8.3	7.7	**NS**	
Erica x darleyensis	9.0	9.0	9.0	9.0	8.6	9.0	9.0	**NS**	
Hebe topiaria	9.0	8.9	9.0	8.9	9.0	8.9	8.5	**NS**	
Hypericum moserianum	9.0	9.0	9.0	8.7	8.3	8.5	8.1	**NS**	
Jasminum officinale	9.0	8.7	9.0	9.0	9.0	8.3	8.7	**NS**	
Lavandula angustifolia 'Imperial Gem'	9.0	9.0	9.0	9.0	8.8	8.8	8.8	**NS**	
Rhododendron 'Cary Ann'	9.0	9.0	9.0	9.0	9.0	9.0	9.0	**NS**	
Sambucus nigra 'Black Lace'	9.0	8.3	9.0	8.7	8.2	9.0	8.0	**0.017**	**0.6371**
Spiraea japonica 'Golden Princess'	9.0	8.8	9.0	8.9	8.5	8.7	8.5	**NS**	
Thuja occidentalis 'Rheingold'	9.0	9.0	9.0	8.7	9.0	9.0	8.7	**NS**	
Vinca minor	9.0	8.3	9.0	8.7	8.1	8.5	8.5	**NS**	

	Scores								
Variety	**UTC**	**H25**	**Mosskade**	**Flexidor 125**	**H27**	**H22**	**Springbok**	**P value**	**LSD (df 12)**
Weigela 'Kosteriana Variegata'	9.0	9.0	9.0	8.7	8.9	8.9	8.5	**NS**	

Table 5. Mean phytotoxicity results assessment three, twelve weeks after treatment – Darby Nursery Stock summer 2014

	Scores								
Variety	**UTC**	**H25**	**Mosskade**	**Flexidor 125**	**H27**	**H22**	**Springbok**	**P value**	**LSD (df 12)**
Abelia grandiflora 'Goldsport'	9.0	8.5	9.0	9.0	9.0	8.7	9.0	**NS**	
Azalea 'Geisha Orange'	9.0	9.0	9.0	9.0	9.0	9.0	9.0	**NS**	
Buddleja davidii 'Empire Blue'	9.0	9.0	9.0	9.0	8.3	8.6	8.0	**0.010**	**0.5679**
Camellia japonica 'Tristem Carlyon'	9.0	9.0	9.0	9.0	9.0	9.0	9.0	**NS**	
Caryopteris clandonensis 'Heavenly Blue'	9.0	8.8	9.0	9.0	9.0	9.0	8.7	**NS**	
Chamaecyparis lawsoniana 'Ellwood's Gold'	9.0	8.5	9.0	8.8	9.0	9.0	8.5	**NS**	
Choisya ternata	9.0	9.0	9.0	9.0	9.0	9.0	9.0	**NS**	
Cistus corbariensis	9.0	9.0	9.0	9.0	9.0	9.0	9.0	**NS**	
Clematis repens	9.0	8.1	9.0	8.7	8.3	8.5	7.8	**NS**	
Cornus sericea 'Hedgerows Gold'	9.0	7.2	9.0	8.4	7.8	8.3	7.7	**NS**	

	Scores								
Variety	**UTC**	**H25**	**Mosskade**	**Flexidor 125**	**H27**	**H22**	**Springbok**	**P value**	**LSD (df 12)**
Erica x darleyensis	9.0	9.0	9.0	9.0	8.6	9.0	9.0	**NS**	
Hebe topiaria	9.0	8.9	9.0	8.9	9.0	8.9	8.5	**NS**	
Hypericum moserianum	9.0	9.0	9.0	8.7	8.3	8.5	8.1	**NS**	
Jasminum officinale	9.0	8.7	9.0	9.0	9.0	8.3	8.7	**NS**	
Lavandula angustifolia 'Imperial Gem'	9.0	9.0	9.0	9.0	8.8	8.8	8.8	**NS**	
Rhododendron 'Cary Ann'	9.0	9.0	9.0	9.0	9.0	9.0	9.0	**NS**	
Sambucus nigra 'Black Lace'	9.0	8.3	9.0	8.7	8.2	9.0	8.0	**0.017**	**0.6371**
Spiraea japonica 'Golden Princess'	9.0	8.5	9.0	9.0	9.0	8.7	9.0	**NS**	
Thuja occidentalis 'Rheingold'	9.0	9.0	9.0	9.0	9.0	9.0	9.0	**NS**	
Vinca minor	9.0	9.0	9.0	9.0	8.3	8.6	8.0	**0.010**	**0.5679**
Weigela 'Kosteriana Variegata'	9.0	9.0	9.0	9.0	9.0	9.0	9.0	**NS**	

Figure 1. *Buddleja* – Untreated plant at two weeks after treatment.

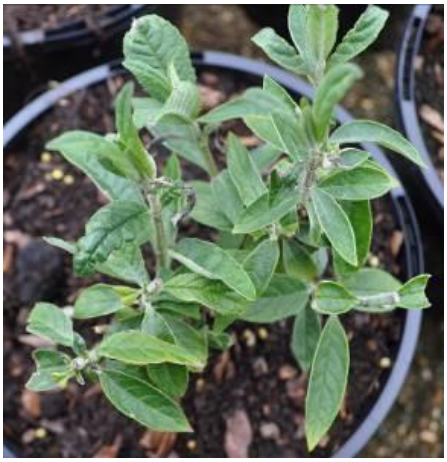

Figure 2. *Buddleja* - Leaf crinkling caused by HDC H22 at two weeks after treatment.

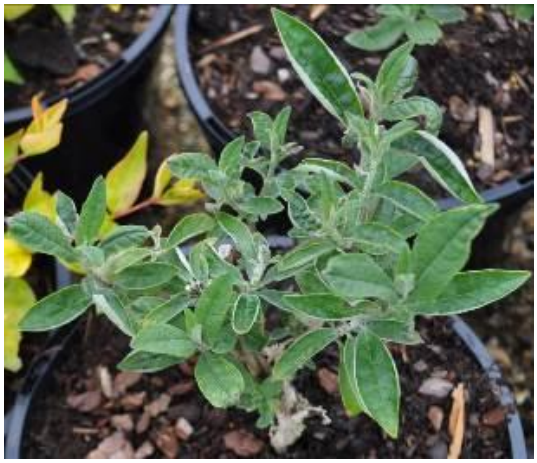

Figure 3. *Buddleja* - Leaf crinkling and twisting caused by Flexidor 125 at two weeks after treatment.

Figure 4. *Buddleja* - Phytotoxicity caused by HDC H27 two weeks after treatment.

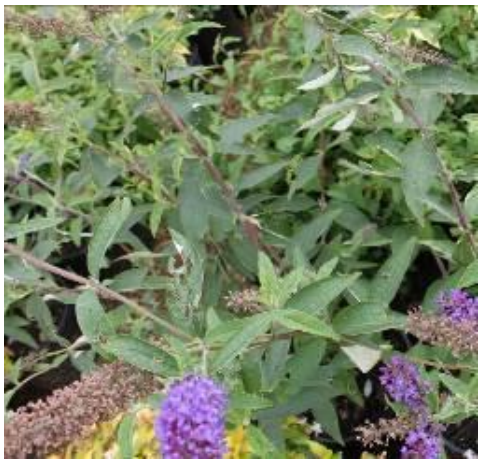

Figure 5. *Buddleja* - An untreated plant at 12 weeks after treatment.

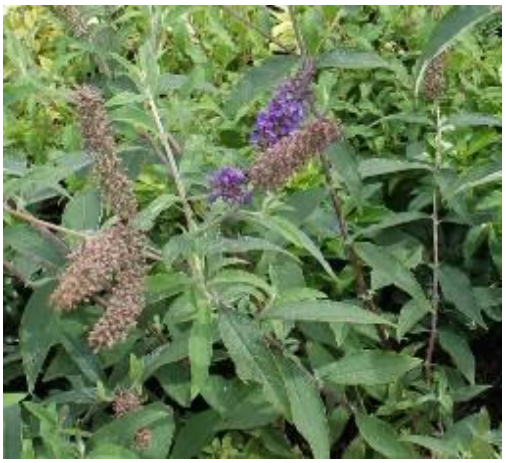

Figure 6. *Buddleja* - Grown away from phytotoxicity caused by HDC H27 at 12 weeks after treatment.

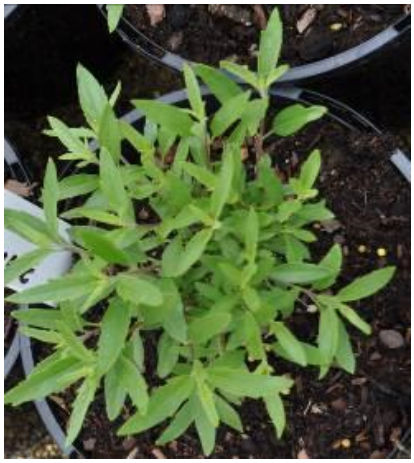

Figure 7. *Caryopteris* - Untreated plant at two weeks after treatment.

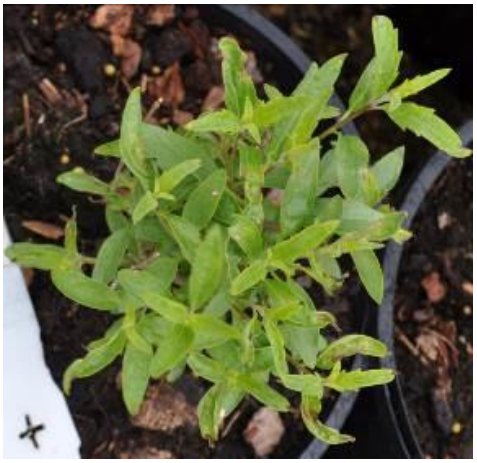

Figure 8. *Caryopteris* - Scorch spots caused by HDC H27 two weeks after treatment.

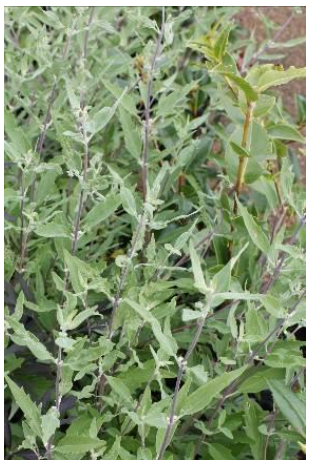

Figure 9. *Caryopteris* - Untreated plant at 12 weeks after treatment,

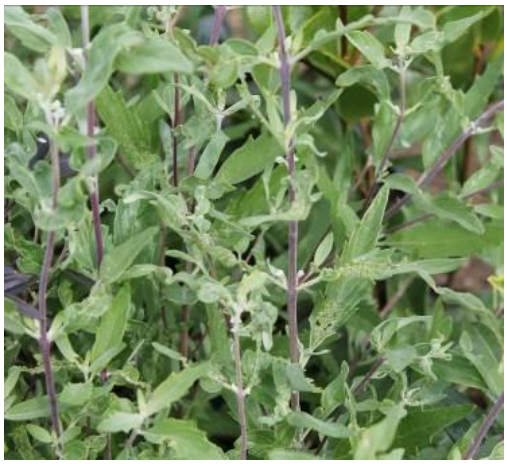

Figure 10. Caryopteris - Grown away from phytotoxicity caused by HDC H27 at 12 weeks after treatment. The puckering and distortion shown was caused by capsid bugs feeding within the crop.

Table 6. Mean phytotoxicity results assessment one, two weeks after treatment – Hawkesmill Nurseries summer 2014

	Scores								
Variety	**Untreated**	**H25 full rate**	**H25 half rate**	**Mosskade**	**Flexidor 125**	**H27**	**H22**	**P value**	**LSD (df 12)**
Anemone 'White Swan'	9.0	9.0	9.0	9.0	4.0	9.0	7.0	**NS**	
Anthyrium felix-femina	9.0	7.3	8.0	7.6	4.0	8.0	8.0	**<0.001**	**0.5256**
Astilbe 'Visions in Red'	9.0	7.0	7.3	8.0	8.3	8.0	8.0	**<0.001**	**0.5714**
Campanula 'White Pouffe'	9.0	8.0	8.7	7.3	4.7	8.3	6.0	**<0.001**	**0.964**
Delphinium 'Galahad'	9.0	8.0	8.3	9.0	8.6	9.0	8.6	**0.037**	**0.6535**
Echinacea purpurea	9.0	8.7	8.3	7.0	7.0	7.7	6.6	**0.027**	**1.478**
Echinops bannaticus 'Blue Globe'	9.0	9.0	9.0	9.0	9.0	9.0	9.0	**NS**	
Epimedium 'Frohnleiten'	9.0	9.0	8.7	8.3	9.0	9.0	9.0	**0.580**	**0.897**
Eryngium planum	9.0	9.0	9.0	9.0	6.0	7.3	6.0	**<0.001**	**0.7764**
Geranium 'Rozanne'	9.0	9.0	9.0	9.0	9.0	9.0	8.3	**0.020**	**0.3882**
Helenium 'Helena Red Shades'	9.0	9.0	9.0	9.0	6.6	9.0	9.0	**<0.001**	**0.3882**
Helleborus 'Red Lady'	9.0	9.0	9.0	9.0	9.0	9.0	7.3	**0.029**	**1.027**
Hemerocallis 'Burning Daylight'	9.0	9.0	9.0	9.0	9.0	9.0	9.0	**NS**	
Heuchera 'Melting Fire'	9.0	9.0	9.0	9.0	9.0	9.0	9.0	**NS**	
Iris pseudacorus	9.0	9.0	9.0	9.0	9.0	9.0	9.0	**NS**	
Papaver 'Pizzicato Globe'	9.0	7.3	8.0	9.0	9.0	8.3	9.0	**0.002**	**0.7434**
Pennisetum 'Hameln'	9.0	9.0	9.0	9.0	9.0	9.0	9.0	**NS**	
Sedum 'Autumn Joy'	9.0	9.0	9.0	9.0	9.0	7.0	7.6	**<0.001**	**0.7263**
Verbascum 'Olympicum'	9.0	6.7	8.0	8.7	4.0	4.0	4.0	**<0.001**	**1.765**
Veronica 'Royal Blue'	9.0	8.0	8.3	7.7	4.0	8.0	8.0	**<0.001**	**0.5256**

Table 6. Mean phytotoxicity results assessment two, six weeks after treatment – Hawkesmill Nurseries summer 2014

Scores									
Variety	**Untreated**	**H25 full rate**	**H25 half rate**	**Mosskade**	**Flexidor 125**	**H27**	**H22**	**P value**	**LSD (df 12)**
Anemone 'White Swan'	9.0	9.0	9.0	9.0	9.0	9.0	9.0	**NS**	
Anthyrium felix-femina	9.0	8.0	9.0	7.3	7.7	9.0	8.7	**0.180**	**1.616**
Astilbe 'Visions in Red'	9.0	9.0	9.0	9.0	9.0	9.0	9.0	**NS**	
Campanula 'White Pouffe'	9.0	9.0	9.0	9.0	9.0	8.6	9.0	**0.468**	**0.3882**
Delphinium 'Galahad'	9.0	9.0	9.0	9.0	7.0	9.0	7.0	**0.003**	**1.165**
Echinacea purpurea	9.0	9.0	9.0	8.3	8.0	8.0	8.0	**0.396**	**1.453**
Echinops bannaticus 'Blue Globe'	9.0	9.0	9.0	9.0	9.0	9.0	9.0	**NS**	
Epimedium 'Frohnleiten'	9.0	8.0	8.6	8.6	8.6	9.0	8.6	**0.193**	**0.7764**
Eryngium planum	9.0	9.0	9.0	9.0	8.0	9.0	4.6	**<0.001**	**0.7764**
Geranium 'Rozanne'	9.0	9.0	9.0	9.0	9.0	5.7	9.0	**0.020**	**1.941**
Helenium 'Helena Red Shades'	9.0	9.0	9.0	9.0	9.0	9.0	9.0	**NS**	
Helleborus 'Red Lady'	9.0	9.0	9.0	8.7	9.0	9.0	7.3	**0.045**	**1.087**
Hemerocallis 'Burning Daylight'	9.0	9.0	9.0	9.0	9.0	9.0	9.0	**NS**	
Heuchera 'Melting Fire'	9.0	9.0	9.0	9.0	9.0	9.0	9.0	**NS**	
Iris pseudacorus	9.0	9.0	9.0	9.0	9.0	9.0	9.0	**NS**	
Papaver 'Pizzicato Globe'	9.0	9.0	8.6	9.0	9.0	9.0	9.0	**0.468**	**0.3882**
Pennisetum 'Hameln'	9.0	9.0	9.0	9.0	9.0	9.0	9.0	**NS**	

Sedum 'Autumn Joy'	9.0	8.0	9.0	9.0	9.0	9.0	8.3	**0.389**	**1.197**
Verbascum 'Olympicum'	9.0	8.3	8.7	9.0	8.0	8.7	8.3	**0.170**	**0.839**
Veronica 'Royal Blue'	9.0	6.7	9.0	7.0	9.0	9.0	9.0	**0.231**	**2.590**

Table 7. Mean phytotoxicity results assessment three, twelve weeks after treatment – Hawkesmill Nurseries summer 2014

	Scores								
Variety	**Untreated**	**H25 full rate**	**H25 half rate**	**Mosskade**	**Flexidor 125**	**H27**	**H22**	**P value**	**LSD (df 12)**
Anemone 'White Swan'	9.0	9.0	9.0	9.0	9.0	9.0	9.0	NS	
Anthyrium felix-femina	9.0	8.6	9.0	9.0	9.0	9.0	9.0	0.468	0.3882
Astilbe 'Visions in Red'	9.0	9.0	9.0	9.0	9.0	9.0	9.0	NS	
Campanula 'White Pouffe'	9.0	9.0	9.0	9.0	9.0	9.0	9.0	NS	
Delphinium 'Galahad'	9.0	9.0	9.0	9.0	8.0	9.0	8.6	0.077	0.7263
Echinacea purpurea	9.0	9.0	9.0	8.3	8.6	8.6	9.0	0.250	0.6535
Echinops bannaticus 'Blue Globe'	9.0	9.0	9.0	9.0	9.0	9.0	9.0	NS	
Epimedium 'Frohnleiten'	9.0	9.0	9.0	9.0	9.0	9.0	9.0	NS	
Eryngium planum	9.0	9.0	9.0	9.0	8.6	9.0	6.6	<.001	0.5714
Geranium 'Rozanne'	9.0	9.0	9.0	9.0	9.0	7.6	9.0	0.020	0.7764
Helenium 'Helena Red Shades'	9.0	9.0	9.0	9.0	9.0	9.0	9.0	NS	
Helleborus 'Red Lady'	9.0	9.0	9.0	9.0	9.0	9.0	9.0	NS	
Hemerocallis 'Burning Daylight'	9.0	9.0	9.0	9.0	9.0	9.0	9.0	NS	
Heuchera 'Melting Fire'	9.0	9.0	9.0	9.0	9.0	9.0	9.0	NS	
Iris pseudacorus	9.0	9.0	9.0	9.0	9.0	9.0	9.0	NS	

Papaver ‘Pizzicato Globe’	9.0	9.0	9.0	9.0	9.0	9.0	9.0	NS	
Pennisetum ‘Hameln’	9.0	9.0	9.0	9.0	9.0	9.0	9.0	NS	
Sedum ‘Autumn Joy’	9.0	9.0	9.0	9.0	9.0	9.0	9.0	NS	
Verbascum ‘Olympicum’	9.0	9.0	9.0	9.0	9.0	9.0	9.0	NS	
Veronica ‘Royal Blue’	9.0	9.0	9.0	9.0	9.0	9.0	9.0	NS	

Figure 11. *Verbascum* – Damage to growing tip caused by HDC H25 at full rate, 2 weeks after treatment.

Figure 12. *Verbascum* – Damage caused by Flexidor 125 at 1L/ha, 2 weeks after treatment.

Figure 13. *Verbascum* – Damage caused by HDC H27, 2 weeks after treatment.

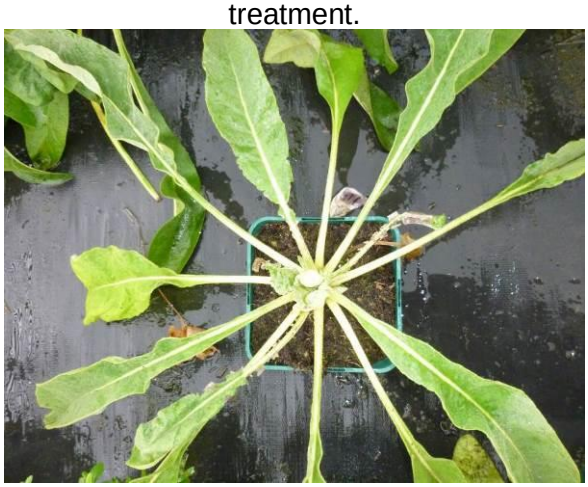

Figure 14. *Verbascum* – Damage caused by HDC H22, 2 weeks after treatment.

Figure 15. *Eryngium* – Damage caused by HDC H22 6 weeks after treatment

Figure 16. Geranium – Damage caused by HDC H27 6 weeks after treatment

Discussion

HDC H25 did not cause any significant long term damage to any of the species in this trial and any slight damage that was initially caused by this herbicide did not affect saleability on any of the species in any of the trials by 12 weeks after treatment. Therefore, it looks very promising as a residual herbicide for use in the HNS industry.

Flexidor 125 is a proven residual herbicide which is known to be safe to various species of nursery stock. Although Flexidor 125 caused some damage to *Buddleja* two weeks after treatment, this species were comparable with the untreated controls by six weeks after treatment. This level of damage could be tolerable on a commercial nursery, however *Buddleja* and a number of herbaceous species are known to be moderately sensitive to a number of herbicides including Flexidor 125 and growers would need to decide whether to treat moderately susceptible species (particularly herbaceous) and accept a temporary check.

HDC H27 did initially damage *Buddleja* and *Caryopteris*, however both species had almost recovered after six weeks and were fully recovered 12 weeks after treatment. *Buddleja* are sensitive to a range of herbicides so this damage was not surprising and it was good to see the plants fully recovered by 12 weeks after treatment. This treatment resulted in temporary damage on various herbaceous species that were classed as moderately susceptible. *Verbascum* was most severely damaged however all of the affected species had grown away from damage by six weeks after treatment. Damage did not become apparent on *Geranium* until six weeks after treatment and persisted to some extent up to 12 weeks after treatment.

HDC H22 caused some damage two weeks after treatment to *Buddleja* but the majority of the plants were fully recovered by six weeks after treatment. This treatment also resulted in damage on various herbaceous species noted at two weeks after treatment. Most of the affected species had grown away from damage by six weeks after treatment. Damage only persisted significantly on *Eryngium* affecting marketability at 12 weeks after treatment. This species was therefore classed as susceptible to the treatment.

Springbok also caused damage to *Buddleja* two weeks after treatment, however the plants were fully recovered by 12 weeks after treatment.

Mosskade caused no phytotoxic effects on any shrub subjects assessed. In the herbaceous trial minor phytotoxic symptoms were observed on *Anthyrium*, *Echincea* and *Veronica* two and six weeks after treatment but the plants had mostly grown away from this at the final assessment and it was considered safe.

Conclusion

None of the new herbicides tested caused any long lasting damage to all the species tested. The granular product HDC H25 will be a suitable replacement for Ronstar 2G for use after potting, being suitable for most shrub and herbaceous species. It is anticipated that HDC H25 will be available as a commercial product with a label approval for outdoor ornamental plant production during mid-2016.

Springbok could be used after potting for many shrub species but a granular product is preferred and Springbok may be better employed as a follow up treatment. Springbok can currently be used in ornamental plant production under the LTAEU but ultimately an EAMU will also be required for this herbicide. HDC H22 is further away from the market but when available could be a useful summer herbicide for growers providing an EAMU could be obtained. HDC H27 did not perform as well as HDC H25 for crop safety or weed control spectrum and indications are that it may prove to be difficult to obtain an EAMU for use in ornamental plant production.

Knowledge and Technology Transfer

Herbaceous Trial, Hawkesmill Nursery – Crop Walk. 31 July 2014

HDC News Article – due February 2015

Appendix

Appendix 1. HNS Shrub trial (Darby Nursery Stock) growth stage prior to treatment on 20/05/14.

Abelia grandiflora 'Goldsport'

Azalea 'Geisha Orange'

Buddleja davidii 'Empire Blue'

Camellia japonica 'Tristem Carlyon'

Chamaecyparis lawsoniana 'Ellwood's Gold'

Caryopteris clandonensis 'Heavenly Blue'

Choisya ternata

Cistus corbariensis

Clematis repens

Cornus sericea 'Hedgerows Gold'

Erica x darleyensis

Hebe topiaria

Hypericum moserianum

Jasminum officinale

Lavandula angustifolia 'Imperial Gem'

Rhododendron 'Cary Ann'

Sambucus nigra ʻBlack Lace'

Spiraea japonica ʻGolden Princess'

Thuja occidentalis 'Rheingold'

Vinca minor

Weigela 'Kosteriana Variegata'

Appendix 2. Herbacous trial (Hawkesmill) growth stage prior to treatment on 20/06/14.

Anemone ‘White Swan’

Anthyrium felix-femina

Astilbe ‘Visions in Red’

Campanula ‘White Pouffe’

Delphinium ‘Galahad’

Echinacea purpurea

Echinops bannaticus ‘Blue Globe’

Epimedium ‘Frohnleiten’

Eryngium planum

Geranium ‘Rozanne’

Helenium ‘Helena

Helleborus ‘Red

Red Shades’ Lady’

No photo available.

Hemerocallis ‘Burning Daylight’ *Heuchera* ‘Melting Fire’ *Iris pseudacorus* *Papaver* ‘Pizzicato Globe’

Pennisetum ‘Hameln’ *Sedum* ‘Autumn Joy’ *Verbascum* ‘Olympicum’ *Veronica* ‘Royal Blue’

Appendix 3. Potting mix

The potting mix used at Darby Nursery stock was a personalised peat wood fibre mix which they have requested to keep confidential.

Table 8: Growing media additives and Genus, species and cultivars:

Growing media component	**Amount in kilograms (kg) or litres (L)**				
Nutricote 140 day 16-10-10	2 kg	2 kg	4 kg	-	2 kg
Nutricote 100 day 16-10-10	2 kg	2 kg	2 kg	2.5 kg	2 kg
Base fertiliser 15-10-20+TE	1.5 kg	1.5 kg	1.5 kg	1.25 kg	1.5 kg
Met52 granular bioinsecticide	0.5 kg	-	0.5 kg	0.5 kg	0.5 kg
Forest Gold Plus	200 L	200 L	200 L	200 L	200 L
Nitrochalk	0.2 kg	0.2 kg	0.2 kg	0.25 kg	0.2 kg
Lime/Dolodust	4.5 kg	4.5 kg	4.5 kg	3.5 kg	4.5 kg
Wetting agent	0.4 L	0.4 L	0.4 L	0.4 L	0.4 L
Species potted into this mix	*Anemone* Wild Swan, *Astilbe* Visions in Red, *Epimedium x*	*Veronica* Royal Blue, *Campanula* White Pouffe, *Papaver* pizzicato, *Pennisetum* Hameln, *Echinops*	*Echinacea purpurea*	*Athyrium filix-femia*	*Helleborus* Red Lady

	perralchicum Frohnleiten, *Geranium* Rozanne, *Heuchera* Melting Fire, *Iris pseudacorus, Sedum* Autumn Joy.	*bannaticus, Eryngium planum, Helenium* Helena Red Shades, *Delphinium* Galahad, *Hemerocallis* Burning Daylight, *Verbascum* Olympicum			

All growing media: 10% Sod Peat, 30% Dark Peat & 60% Light Peat, Peat grade for all mixes, all 0 - 18mm

Appendix 4. Crop husbandry

Darby Nursery Stock and Hawkesmill Nurseries took care of irrigation requirements of the plants, irrigating early in the morning. No other acts of crop husbandry took place on the trial at Darby nursery stock during this trial. The herbaceous trial at Hawkesmill Nurseries was sprayed with Amistar at 1 ml/L on 23/06/14 to control and prevent low levels of powdery and downy mildew