



Agriculture & Horticulture
DEVELOPMENT BOARD



Grower Summary

HNS 166

Hardy ornamentals: herbicide
screening for herbaceous
perennials and grasses

Final 2011

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Further information

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

HDC
Stoneleigh Park
Kenilworth
Warwickshire
CV8 2TL

Tel – 0247 669 2051

HDC is a division of the Agriculture and Horticulture Development Board.

Project Number: HNS 166

Project Title: Hardy ornamentals: herbicide screening for herbaceous perennials and grasses

Project Leader: John Atwood

Contractor: ADAS UK Ltd

Industry Representative: Jeanie Gillford, Walberton Nursery

Report: Final 2011

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Previous report/(s): Annual Report, 2010
Annual Report, 2009

Start Date: 1 April 2008

End Date: 31 May 2011

Project Cost: £45,700

Headline

- A number of residual herbicides (the most promising being Dual Gold and Springbok) were assessed for crop safety when applied to newly potted and established container grown herbaceous perennials.
- A number of currently used herbicides including Ronstar 2G, Flexidor 125, Devrinol and Venzar Flowable were assessed for crop safety over a wider range of newly potted and established container grown herbaceous perennials.

Background and expected deliverables

Good weed control continues to be important for hardy ornamentals growers to ensure that plant quality is maintained and that the required retail specifications are achieved. Herbicides remain the most cost-effective weed control method although some herbaceous plant subjects are particularly susceptible to herbicide damage.

With the loss of a number of herbicides and changes in weed populations on nurseries it is important to continue to assess new plant protection products to help combat resistant weed species and extend the range of subjects screened for which herbicides can be used.

The HDC project HNS 139 (Control of problem weeds in hardy nursery stock) identified herbicides, new to the UK, which appeared to have potential for use on herbaceous perennial and grass crops. The focus of HNS 139 was mainly on shrub species, so further screening work was required specifically on herbaceous perennial and grass crops.

This project has evaluated several new herbicides for safety for use on a wide range of container-grown herbaceous subjects as well as extending the range of species specific phytotoxicity information for currently used herbicides

Summary of the project

In 2008, an experiment was undertaken to investigate the phytotoxicity of six herbicide treatments on a range of container-grown herbaceous species in a commercial nursery situation. A further summer experiment examined treatments applied immediately after potting. Full results were presented in the 2009 annual report.

In 2009, two further experiments were undertaken, similar to those conducted in 2008, on a different range of herbaceous species. One experiment was set up at Howard Nurseries

using newly potted 9 cm plants, the other at Hawkesmill Nurseries using established 2 or 3 litre container plants. Full results were presented in the 2010 annual report.

In 2010, the final year of the trial, experiments were carried out on a further group of herbaceous species at Hawkesmill Nurseries with module potted and bare-root potted plants in early spring and summer of 2010. Full results are detailed in the Science Section of the full version of this report. The herbicides used during this project are summarised in Table 1.

Table 1. Herbicides used in herbaceous plant nursery experiments with rates of use and approval status on outdoor ornamentals as of May 2011

Product	Active ingredient	Rate of use	Approval status
Ronstar 2G	oxadiazon (2 % w/w)	200 kg/ha	Label
Teridox ¹	dimethachlor (500 g/L)	3.0 L/ha	Not in UK
Lenacil 80W ² or Venzar Flowable	lenacil (80 % w/w) lenacil (440 g/L)	2.8 kg/ha 4.0 L/ha	Not approved LTAEU ⁴
Flexidor 125	isoxaben (125 g/L)	1.0 L/ha	Label
Springbok	metazachlor (200 g/L) + dimethenamid-p (200 g/L)	2.5 L/ha	LTAEU ⁴
Devrinol ³	napropamide (450 g/L)	9.0 L/ha	Label
Dual Gold	s – metolachlor (960 g/L)	0.7 -1.4 L/ha	Not approved ⁵
New Code A ¹	not disclosed	2.8 kg/ha	Not in UK

¹These herbicides were not included in the final year of the project as their future availability was uncertain. ²Lenacil 80W was no longer available and replaced with Venzar Flowable in the final year of the project. ³Devrinol was only used in one set of trials due to doubts about future availability. ⁴LTAEU indicates that the product can be used off-label at grower's own risk under the Revised Long Term Arrangements for Extension of Use. ⁵HDC is in the process of submitting an Extension of Authorisation for minor use (EAMU) (previously called a SOLA).

Susceptibility to herbicide damage

Plant susceptibility to herbicides is displayed in Table 2 using a categorisation system based on all three years of phytotoxicity testing. A green colour (tolerant) indicates a treatment was found to be safe, although a slight check may be possible. An orange colour (moderately

susceptible) indicates that a more severe check or stunting occurred, although recovery normally occurs by the end of the growing season. A red colour (susceptible) indicates that this species should not be treated. A blank cell indicates that the treatment combination was not trialled and phytotoxicity information is not known.

'Size Category' provides information on the stage at which the treatment was first applied: 1 = newly potted module into 9 cm pot; 2 = newly potted module into 2 – 3 L pot; 3 = 9 cm liner newly potted into 1 – 3 L pot; 4 = Bare root newly potted into 2 – 3 L pot; 5 = Established 1 – 3 L pot;

Table 2. Herbicide tolerance of herbaceous perennials and grasses: summary of three years' experiments

Plant species	Size category	Devrinol	Dual Gold	Flexidor 125	Flexidor 125 + Dual Gold	Lenacil 80 W or Venzar Flow	Ronstar 2G	Springbok
<i>Acanthus spinosus</i>	5							
<i>Achillea</i> 'Moonshine'	2							
<i>Achillea</i> 'Salmon Beauty' ('Lachsshönheit')	1							
<i>Agapanthus</i> 'Headbourne Hybrids'	5							
<i>Agapanthus</i> 'Headbourne Hybrids'	4							
<i>Ajuga reptans</i> 'Catlin's Giant'	5							
<i>Ajuga reptans</i> 'Sugar Plum'	2							
<i>Alstroemeria lutea</i>	3							
<i>Anthemis tinctoria</i> 'Charme'	2							
<i>Artemesia absinthium</i> 'Lambrook Mist'	1							
<i>Artemesia</i> 'Powis Castle'	2							
<i>Aster x fricartii</i> 'Monch'	2							
<i>Astilbe x arendsii</i> 'Fanal'	4							
<i>Astilbe x arendsii</i> 'White Gloria' ('Weisse Gloria')	4							
<i>Athyrium</i> 'Ghost'	5							
<i>Bergenia</i> 'Baby Doll'	3							
<i>Bergenia</i> 'Bressingham Ruby'	2							
<i>Bergenia</i> 'Eroica'	5							

Plant species	Size category	Devrinol	Dual Gold	Flexidor 125	Flexidor 125 + Dual Gold	Lenacil 80 W or Venzar Flow	Ronstar 2G	Springbok
<i>Brunnera macrophylla</i>	1		Green	Yellow			Green	Red
<i>Brunnera macrophylla</i>	5		Green	Green		Green	Green	Red
<i>Campanula glomerata</i> 'Superba'	1		Yellow	Green			Red	Red
<i>Campanula lactiflora</i> 'White Pouffe'	2		Green	Yellow	Yellow		Yellow	
<i>Centaurea montana</i> 'Parham'	1		Green	Green			Green	Green
<i>Centranthus ruber</i> 'Albus'	1		Green	Green			Green	Green
<i>Coreopsis verticillata</i> 'Moonbeam'	2	Green			Green	Green		Green
<i>Coreopsis</i> 'Rum Punch'	5		Green	Green		Green		Green
<i>Coreopsis verticillata</i> 'Zagreb'	1		Green	Green			Green	Green
<i>Crambe cordifolia</i>	1		Green	Green			Green	Green
<i>Crocosmia x crocosmiiflora</i> 'Babylon'	4	Green	Green	Green			Green	Green
<i>Crocosmia x crocosmiiflora</i> 'James Coey'	1		Green	Green			Green	Green
<i>Crocosmia</i> 'Kathleen'	1		Green	Green			Yellow	Green
<i>Crocosmia</i> 'Lucifer'	4	Green	Green	Green			Green	Green
<i>Crocosmia masoniorum</i>	5		Green	Green		Green	Green	Green
<i>Dahlia</i> 'Rosalind'	4	Green	Green	Green			Green	Green
<i>Delphinium</i> 'Galahad'	4	Red	Yellow	Yellow			Green	Green
<i>Delphinium</i> 'Guinevere'	4	Yellow	Yellow	Yellow			Green	Green
<i>Dicentra</i> 'Spring Morning'	1		Green	Green			Green	Green
<i>Dryopteris affinis</i> 'Crispa Congesta'	5		Green	Green		Green	Green	Green
<i>Dryopteris affinis</i> 'Crispa Congesta'	2		Green	Green	Green		Red	Green
<i>Dryopteris goldinia</i>	3		Green	Green			Green	Green
<i>Echinacea purpurea</i> 'Bressingham Hybrid'	4	Green	Yellow	Green			Green	Green
<i>Erysium</i> 'Bowles Mauve'	2	Green	Green	Yellow	Yellow	Green	Green	Green
<i>Fragaria x ananassa</i> 'Pink Panda'	1		Green	Green			Green	Green
<i>Gaura lindheimeri</i>	2		Green	Green	Green		Green	Green
<i>Geranium x cantabrigiense</i> 'Biokovo'	4	Green	Green	Green			Green	Green
<i>Geranium</i> 'Brookside'	5		Green	Green		Green	Green	Green
<i>Geranium</i> 'Rozanne'	4	Green	Green	Green			Green	Green
<i>Geranium nodosum</i>	3		Green	Green			Green	Green
<i>Geranium sanguinuen var. striatum</i>	1		Green	Green			Green	Green

Plant species	Size category	Devrinol	Dual Gold	Flexidor 125	Flexidor 125 + Dual Gold	Lenacil 80 W or Venzar Flow	Ronstar 2G	Springbok
<i>Hakonechola macra</i> 'Aureola'	5							
<i>Helenium</i> 'Bruno'	1							
<i>Helenium</i> 'Moerheim Beauty'	2							
<i>Helleborus orientalis</i> (pink/white)	5							
<i>Hemerocallis</i> 'Catherine Woodbery'	5							
<i>Hemerocallis</i> 'Stafford'	3							
<i>Hemerocallis</i> 'Stella d'Or'	1							
<i>Hemerocallis</i> 'Stella d'Or'	4							
<i>Heuchera</i> 'Chocolate Ruffles'	5							
<i>Heucherella</i> 'Stoplight'	2							
<i>Hosta</i> 'Albomarginata'	3							
<i>Iris germanica</i> 'Jane Philips'	3							
<i>Iris pallidis</i> 'Aureo variegata'	4							
<i>Iris pseudoacorus</i>	4							
<i>Kniphofia</i> 'Tetbury Torch'	1							
<i>Lamium maculatum</i> 'Beacon Silver'	2							
<i>Leucanthemum x superbum</i> 'Agalia'	2							
<i>Leymus arenaria</i>	3							
<i>Lilium</i> 'Silver Gazer'	4							
<i>Liriope muscari</i> 'Blue'	5							
<i>Lobelia cardinalis</i> 'Queen Victoria'	3							
<i>Lobelia x speciosa</i> 'Russian Princess'	1							
<i>Lobelia x speciosa</i> 'Russian Princess'	5							
<i>Lupinus</i> 'Galaxy mixed'	3							
<i>Matteuccia struthiopteris</i>	5							
<i>Millium effusum</i> 'Aureum'	2							
<i>Monarda</i> 'Cambridge Scarlet'	2							
<i>Ophiopogon planiscapus</i> 'Nigrescens'	5							
<i>Papaver orientale</i> 'Pattys Plum'	4							
<i>Penstemon</i> 'Sour Grapes'	3							
<i>Peonia</i> 'Prima Verde'	3							
<i>Phlox paniculata</i> 'Purple Eye Flame'	5							
<i>Phlox paniculata</i> 'White Admiral'	4							

Plant species	Size category	Devrinol	Dual Gold	Flexidor 125	Flexidor 125 + Dual Gold	Lenacil 80 W or Venzar Flow	Ronstar 2G	Springbok
<i>Polypodium vulgare</i>	5							
<i>Polystichum setiferum</i> 'Herrenhausen'	5							
<i>Pulmonaria</i> 'Cotton Cool'	1							
<i>Pulmonaria saccharata</i> 'Dora Bielefeld'	4							
<i>Rhodohypoxis milloides</i>	4							
<i>Rudbeckia fulgida</i> var. <i>deamii</i>	1							
<i>Salvia nemerosa</i> 'East Friesland' ('Ostfriesland')	2							
<i>Schizostylis coccinea</i> 'Sunrise'	3							
<i>Sedum</i> 'Autumn Joy' ('Herbstfreude') ('Herbstfreude')	3							
<i>Sedum</i> 'Autumn Joy' ('Herbstfreude') ('Herbstfreude')	2							
<i>Sisyrinchium striatum</i>	1							
<i>Stachys byzantina</i> 'Silver Carpet'	1							
<i>Symphytum</i> 'Wisley Silver'	3							
<i>Teucrium hircanicum</i> 'Purple Tails'	5							
<i>Tradescantia</i> 'Billberry Ice'	4							
<i>Tradescantia</i> 'Zwanenburg Blue'	1							
<i>Verbena bonariensis</i>	1							
<i>Verbena rigida</i>	5							
<i>Veronica spicata</i> 'Red Fox'	2							
<i>Zantedeschia aethiopica</i> 'Crowborough'	5							

Key features of the herbicides tested

Ronstar 2G granules proved to be one of the safest treatments, as in previous herbaceous weed control projects. Most subjects tolerated treatment applied after potting. Ronstar 2G can cause temporary foliar scorch if granules are allowed to lodge in soft foliage. Normally, plants grow away from this satisfactorily. Ronstar 2G did however cause a more severe scorch to *Penstemon* and severely stunted two *Campanula* varieties, *Millium* and *Dryopteris*. In one trial a *Crocsmia* suffered yellowing following treatment but the effect was not seen subsequently in other varieties. *Sedums* were not damaged by Ronstar 2G applied in the summer in this project but a spring application caused temporary damage. Previous studies have shown that *Sedum* can be vulnerable to damage.

Flexidor 125 proved safe on a range of species but with damage occurring to some. Generally damage took the form of stunting sometimes with leaf yellowing and twisting. For *Penstemon* and *Delphinium* developing flower spikes were killed out. In less severe cases (e.g. *Phlox*), slight leaf yellowing was only temporary and the plants grew away normally.

Dual Gold has just become available on the UK market and, if authorised for use (HDC is in the process of submitting an Extension of Authorisation for minor use - EAMU), will be a useful additional product for herbaceous producers being suitable for a number of subjects that are normally susceptible to herbicides. It has proved to be relatively safe. Only a few subjects such as *Campanula*, *Echinacea*, *Monarda*, *Rudbeckia*, *Stachys* and *Tradescantia* were damaged. Where damage occurred it took the form of stunting (e.g. *Echinacea*) with leaf twisting and in some cases (e.g. *Phlox* and *Delphinium*) bleaching. In most case plants did recover.

Although Dual Gold could be used on its own, there are gaps in the weed control spectrum (e.g. bittercress). Results from HNS 139 showed that it does give good control of willowherb and grasses and some control of groundsel so it could be a useful supplement to Flexidor 125 which gives poor control of these weeds. The safety of this tank mix was compared with the products applied separately. Generally the tank mix was safe but in cases where there was marginal susceptibility to Flexidor 125, the addition of Dual Gold increased susceptibility. For example *Anthemis* and *Salvia* were stunted by the tank mix, whereas when the herbicides had been applied individually they had proven to be relatively safe.

Springbok appeared safe on a limited range of subjects but some (e.g. *Campanula* and *Tradescantia*) suffered severe stunting or leaf distortion and, for *Bergenia*, veinal yellowing. Unfortunately recently applied label restrictions for metazachlor, one of the components of Springbok, limiting application on the same site to one year in three, will make the use of this herbicide impractical in most nursery situations.

Other herbicides **Devrinol** and **Venzar Flowable** have a place in nursery production but mainly for winter use either due to label restrictions (Devrinol) or crop safety issues, particularly on newly potted plants (Venzar Flowable).

This project has focused on crop safety rather than weed control, as the HDC project HNS 139 (Control of problem weeds in hardy nursery stock) provided information about efficacy of most of these herbicides against common weeds of nursery stock. For completeness, results from HNS 139 are summarised below (Table 3).

Table 3. Herbicide efficacy against some common nursery stock weeds (results from HNS 139)

Weed	Dual Gold	Flexidor 125	Ronstar 2G	Springbok
Bittercress	R	S	S	mS
Groundsel	mS	mR	S	mS
Mouse ear	mS	S	R	-
Pearlwort	S	S	R	S
Willowherb	S	R	S	S

R = resistant, mS = moderately susceptible and S = susceptible

Financial benefits

The benefits from extending the range of crops to which Ronstar 2G and Flexidor 125 can be applied over can be estimated to save around £2,500/ha in hand-weeding costs for those crops, less the cost of the herbicide around £55/ha for Flexidor 125, £82/ha for Venzar Flowable and £1,182/ha for Ronstar 2G. The use of Dual Gold will similarly enable a further

range of crops to be treated. For Dual Gold used at 1.4 L/ha the cost is relatively low at £28/ha.

Action points for growers

- The crop safety matrix presented in this Grower Summary should be used alongside the information contained in the HDC Practical weed control for nursery stock handbook when planning herbicide programmes for herbaceous crops.
- If a EAMU is successfully obtained for its use in outdoor ornamental production, undertake test applications of Dual Gold if improved control of groundsel, grasses and willowherb is required.