Herbicide Screening for U.K. Ornamental Plant Production: a Cross Sector Approach©

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INTRODUCTION

A programme of herbicide screening is important for the ornamentals sector in the U.K. to replace withdrawn herbicides and tackle resistant weeds. Over the last 5 years the number of herbicide active ingredients available to the ornamentals sector has been considerably reduced (Table 1). Many of these have been lost or their use restricted as a result of the review process within European Council Directive 91/414/EEC. Further restrictions will occur as the criteria for E.U. approval switch from risk management to hazard based. Meeting the requirements of the Water Framework Directive (2000/60/E) for water quality by 2015 will also affect pesticide use with particular implications for residual herbicides.

Table 1. Recent herbicide losses for the ornamentals sector

Herbicides lost		
Active ingredient	Product	Use
Chorthal-dimethyl	Dacthal W-75	Residual herbicide, field and container
Dichlobenil	Casoron G	Residual herbicide, field
Diuron	Diuron	Residual herbicide, field
Paraquat	Gramoxone	Contact herbicide, field
Simazine	Gesatop	Residual herbicide, field
Trifluralin	Axit GR Ardent	Residual herbicide, containers Standing bed herbicide
Herbicides restricted		
Active ingredient	Product	Use
Metazachlor	Butisan S	Residual herbicide, field and container
Propyzamide	Kerb Flow	Residual herbicide, field and container

In addition, new weed problems continue to emerge. For container nurseries the distribution of bittercress species has changed in recent years. Hairy bittercress (*Cardamine hirsuta* L.) used to be the predominant species, but it is increasingly being replaced by flexuous bittercress (*C. flexuosa* With.) and New Zealand bittercress (*C. corymbosa* Hook. f.), the former being more prevalent. This change has also been reported in Belgium where Eelden and Bulcke (1998) showed that

flexuous bittercress was less susceptible than hairy bittercress to isoxaben when applied post emergence. In field-grown crops, cockspur grass (*Echinochloa crus-galli* (L.) P. Beauv.) is another non-indigenous species causing problems in nursery stock in the southern counties of England. It can rapidly shade-out field crops leading to loss of quality and difficulty in lifting.

SOURCES OF ORNAMENTAL HERBICIDES

The ideal herbicide characteristics for container production are:

- Good residual activity for key weeds
- Minimal contact activity
- Not mobile, liable to leaching or root uptake
- Good mammalian safety data

It is unusual for herbicides to be developed specifically for the ornamentals market in the U.K. so herbicides are selected from those developed for larger scale crops. These can be for broad-leaved drilled crops (e.g., soy beans, oil seed rape, and sugar beet), perennial crops (e.g., fruit, vines, and olives), maize, and vegetables. There are several problems that have to be addressed in considering products' suitability for ornamental crops: the range of weeds controlled can be limited (e.g., oil seed rape herbicides can be weak on bittercress); there can be limited data on spring-germinating weeds for herbicides designed for autumn-drilled crops; and herbicides for vegetable crops only have to be of relatively short persistence. In all cases, unexpected phytotoxicity can be a problem because of the range of ornamental crops that are grown. In the U.K. there is a strong link between the researchers working in vegetables, fruit, and nursery sectors as the majority of R&D on these crops is grower-funded through a single organisation, the Horticultural Development Company.

HERBICIDE SCREENING FOR CONTAINER SHRUBS

In a series of trials carried out from 2007–09 (Atwood, 2009) a range of herbicides were tested on key weeds of container nursery stock production including hairy, New Zealand, and flexuous bittercress (*C. hirsuta, C. corymbosa*, and *C. flexuosa*); pearlwort (*Sagina procumbens* L.); mouse ear (*Cerastium fontanum* Baumg. subsp. *triviale* (Link) Jalas); groundsel (*Senecio vulgaris* L.); willowherb (*Epilobium ciliatum* L.); and goat and grey willow (*Salix caprea* L. and *S. cinerea* L.). Herbicides (Table 2) were tested in nursery trials on 18 species (Table 3), in most cases following successful results in pot experiments pre- and post emergence of the weeds. The results of the pot experiments confirmed that both New Zealand and flexuous bittercress were more resistant to control once germinated compared with hairy bittercress although Skirmish® (terbuthylazine + isoxaben) and Sumimax® (flumioxazine) were relatively effective even post emergence.

Table 2. Herbicides used in the 2007–9 screening.

Active ingredient	Product	Main usage / approval
Dimethachlor	Teridox	Oil seed rape (not U.K.)
Flazasulfuron	Chikara	Total weed control
Flumioxazine	Sumimax	Winter wheat, oats
Metazachlor + Dimethenamid –p	Springbok	Oil seed rape
Metosulam + flufenacet	Terano	Maize (not U.K.)
S – metolachlor	Dual Gold	Maize
Terbuthylazine + isoxaben	Skirmish	Peas and beans
Undisclosed	Code HDC H2	

Table 3. Nursery stock species used in the 2007–9 screening.

Berberis	*Kolkwitzia*	*Rosmarinus*
Buddleja	*Lavandula*	*Santolina*
Chamaecyparis	*Lonicera*	*Sambucus*
Choisya	*Philadelphus*	*Spiraea*
Escallonia	*Potentilla*	*Veronica*
Hebe	*Pyracantha*	*Vinca*

The main herbicides shown to have potential for use on nurseries were Dual Gold® (s–metolachlor), Sumimax (flumioxazine), and Skirmish (terbuthylazine + isoxaben). Dual Gold gave effective control of mouse ear, annual meadow grass, and willowherb. Control of groundsel was partial and control of all three bittercress species was unsatisfactory. Dual Gold has potential for use in U.K. nurseries as a supplement to the commonly used isoxaben product Flexidor 125 which gives unsatisfactory control of grasses, willowherb, and groundsel. Dual Gold was safe to use on a range of shrub species tested but caused slight foliar bleaching to *Hebe*. Sumimax controlled all of the key weeds tested but has a contact action so it was only tested as a dormant season treatment on shrub species. All deciduous species were unaffected following treatment but evergreen species *Escallonia, Hebe*, and *Vinca* were slightly damaged. Further work is required to quantify crop safety in other evergreen species. Skirmish was only tested as a dormant season treatment and proved safe to all except *Buddleia*, *Escallonia*, and *Hebe*. Skirmish was the only treatment tested that controlled established pearlwort and larger seedlings of all three bittercress species.

Although Teridox, Chikara, Springbok, Terano, and HDC H2 had potential for use in crops in container nurseries, lack of availability in the U.K. or approval restrictions preclude their use at present.

HERBICIDE SCREENING FOR CONTAINER-GROWN HERBACEOUS PLANTS

In a series of trials started in 2008 (Atwood, 2010) a range of herbicides including Dual Gold, Teridox, and Springbok were tested alongside standards Flexidor 125 and Ronstar 2G (oxadiazon) for crop safety on 50 herbaceous species (Table 4).

Dual Gold was safe to most of the subjects tested. Only *Campanula, Rudbeckia,* and *Stachys* suffered a temporary growth check following treatment. Dual Gold in particular could be a useful herbicide for herbaceous growers. Although there are gaps in the weed control spectrum, notably bittercress species, it could be a useful supplement to Flexidor 125 which gives poor control of willowherb and grasses. Springbok was damaging to more subjects, particularly *Bergenia, Brunnera, Campanula, Leucanthemum, Pulmonaria*, and *Rudbeckia*. Flexidor 125 was safe to use on all species except for *Brunnera* and *Rudbeckia* and in one trial *Hemerocallis* and *Penstemon* were damaged.

Table 4. Herbaceous species used in the 2009–2010 screening.

Acanthus	*Geranium*	*Paeonia*
Achillea	*Hakonechloa*	*Phlox*
Agapanthus	*Helenium*	*Polypodium*
Ajuga	*Helleborus*	*Polystichum*
Alstroemeria	*Hemerocallis*	*Pulmonaria*
Artemisia	*Heuchera*	*Rudbeckia*
Bergenia	*Hosta*	*Salvia*
Brunnera	*Iris*	*Schizostylis*
Campanula	*Kniphofia*	*Sedum*
Centaurea	*Leucanthemum*	*Sisyrinchium*
Centranthus	*Leymus*	*Stachys*
Coreopsis	*Liriope*	*Symphytum*
Crambe	*Lobelia*	*Teucrium*
Crocosmia	*Lupinus*	*Tradescantia*
Dicentra	*Matteuccia*	*Verbena*
Dryopteris	*Ophiopogon*	*Zantedeschia*
Fragaria	*Penstemon*	

Teridox is relatively unknown as a herbicide for ornamentals. Initial crop safety results from 2008 were encouraging but more damage occurred in 2009 indicating that it may have more limited application. Ronstar 2G is widely used on herbaceous crops particularly after potting. Some species suffer temporary foliage damage from Ronstar 2G however. Ronstar 2G was safe to use on all but *Penstemon* and *Crocosmia* in 2008 and *Campanula* in 2009.

PREVENTION OF ROOTING THROUGH AND WEED CONTROL ON SANDBEDS

Rooting through on sandbeds can be a problem when lifting plants for sale. Following earlier trial results (Rowell, 1996) U.K. growers have applied a trifluralin + diflufenican product, Ardent®, to the sandbed prior for standing down for prevention of rooting through and weed control. Following the withdrawal of trifluralin in 2009 an alternative was sought. Trials on heathers (*Erica* ×*darleyensis*) and shrub species showed that Stomp® and Chikara® applied to the sandbed had some activity in preventing rooting through (Atwood, 2009). For heathers Stomp was fully effective and did not reduce rooting within the pot. Chikara reduced the root development of heathers at the bottom of the pot. A limited number of shrub species were tested and Chikara was found to reduce rooting through of *Buddleia* and *Spiraea* but no effect was found on *Vinca* or *Weigela*.

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