CONTAINER-GROWN TEMPERATE NURSERY STOCK: HERBICIDE SCREENING AND WEED CONTROL

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Summary. Thirteen herbicide treatments were applied to 50 plant species or cultivars in weed free containers. Growth and quality of treated plants were compared to those from hand weeded controls. Overall, damage to nursery stock from the herbicides was very limited and manifested principally as a reduction in growth rather than as an effect on plant quality. The most damaging treatments were those containing oxyfluorfen. No herbicide treatment was totally safe to all species. The most sensitive species was *Hydrangea macrophylla*. The effectiveness of the herbicides was generally poor. Overall, effective long-term weed control without significant plant damage was provided only by oxadiazon.

INTRODUCTION

Weeds in container nursery stock reduce plant growth through competition, adversely affect plant quality and saleability and increase the spread of weeds to new sites. The high moisture and soil fertility conditions maintained in containers lead to rapid weed growth.

Weed control options in containers are limited. Cultivation is not feasible and hand weeding and mulching are the only practicable alternatives to herbicide application. Hand weeding is expensive, estimated at up to 30 times the cost of herbicide application (1) and costed in Australia at over $10,000 per hectare in 1985 (6). Mulching has not been investigated extensively but limited research suggests that it is expensive to implement and of poor effectiveness (3, Harradine, pers. obs.).

Research has led to the development of herbicide recommendations for weed control in container-grown plants (e.g. 2, 5, 6, 7) and the registration of several herbicides for this use in Australia. Problems have recently been encountered in the local nursery industry with the withdrawal of the widely used nursery herbicide chloroxuron and possible restrictions on the use of herbicides such as simazine and oryzalin following their restriction overseas. In addition, reliance on a single product or on a limited type of product may lead to the development of herbicide resistance in target weeds and is hence undesirable.

Ideal herbicide treatments for use in container-grown nursery stock will:

- be cost effective against the fairly specific range of weeds encountered,
- will have residual activity under the free draining and high moisture conditions of container growth,
- will not cause residue problems in nursery runoff or in nursery water recirculation systems,
- will be tolerated by the very large variety of species and cultivars grown by the Australian nursery industry, and
- have herbicide components with varying modes of activity to reduce the risk of development of herbicide resistance.

A three year research project was undertaken by the authors to develop herbicide recommendations based on these criteria. This paper reports the first of a series of experiments to screen nursery stock for tolerance to a range of potential herbicide treatments.

METHODS

The trial site was a commercial wholesale nursery at Seven Mile Beach near Hobart, Tasm!nia. Thirteen herbicide treatments wer% appl)ed to 50 ornamental plant species in 12 or 14 cm diameter pots (Table 1 and 2). There were six replicates per treatment.

The species were chosen to represent as wide a range as possible of plant types and species common to the temperate nursery industry. The species choice was restricted to those normally potted or repotted in late spring to early summer as it was proposed to test the herbicide tolerance of plants soon after potting into sterilised media. The potting mix was 90% composted pine bark and 10% sand.

Table 1. Plant species and cultivars used in the trial

No.	*Species*/Cultivar	No.	*Species*/Cultivar
1.	*Acacia howittii*	26.	*Hebe buxifolia*
2.	*Berberis darwinii*	27.	*Hebe* sp. La Seduisante
3.	*Betula alba*	28.	*Hydrangea macrophylla* Dwarf Red
4.	*Boronia heterophylla*	29.	*Ixodia achilleoides*
5.	*Brachyscome multifida*	30.	*Jasminum humile*
6.	*Callistemon* sp. Kings Park	31.	*Lavendula alba*
7.	*Calytrix tetragona*	32.	*Leptospermum juniperum* Horizontalis
8.	*Chrysanthemum frutescens*	33.	*Leptospermum nanum rubrum*
9.	*Chrysocoma coma-aurea*	34.	*Lippia citriodora*
10.	*Cistus candaniferens*	35.	*Melaleuca armillaris*
11.	*Clematis spooneri*	36.	*Potentilla* sp. Miss Wilmot
12.	*Coleonema* sp. Gold form	37.	*Prostanthera rotundifolia*
13.	*Convolvulus cneorum*	38.	*Pseudopanax* sp. Gold Splash
14.	*Correa decumbens*	39.	*Rhododendron hybrid* Red Wings
15.	*Cotoneaster horizontalis*	40.	Azalea
16.	*Crowea* sp. Festival	41.	*Rosa x.* Snow Carpet
17.	*Cytisus* sp. Snow Queen	42.	*Sagina subulata*
18.	*Dianthus alba*	43.	*Saxifraga* sp. Red Hedgehog
19.	*Dianthus caryophyllus* Knight Rose	44.	*Scaevola microphylla*
20.	*Dodonaea viscosa*	45.	*Serissa* sp. Snowleaves
21.	*Erica melanthera* Improved	46.	*Sollya heterophylla* White form
22.	*Erica* sp. Mrs Maxwell	47.	*Spiraea* sp. Snow Mound
23.	*Eucalyptus gunnii*	48.	*Thuja orientalis* Aurea nana
24.	*Grevillea curviloba*	49.	*Verbena tenera* Pink form
25.	*Hardenbergia violaceae*	50.	*Viburnum opulus* Sterile
			Westringia sp. Wynyabbie Gem

Other weed situations

The normal sequence of commercial operations on the nursery resulted in species becoming available for spraying over a period of three weeks. They varied in age from one day to four weeks after potting at the time of herbicide application. Any weeds present in the pots were removed by hand prior to herbicide application.

Herbicides were applied on 6 and 20 December 1991 for 34 and 16 of the species respectively. The granular herbicide oxadiazon was weighed out and applied to the pots by hand. Other herbicides were applied by boom spray in 212 litres of water/ha through fan nozzles operating at 210 kpa. All herbicides were applied over the top of the plants and were washed off foliage with approximately 10 mm of overhead watering immediately after application.

On 23 April 1992, the herbicide application was repeated on 9 of the species. The other species were not retreated as the pot surface had been covered by plant foliage by this time.

After herbicide application, species 25, 28 and 39 were placed in a shade house (70% light transmission) and all other plants were placed in the open. Pots were randomised within the areas and maintained as for pots in the adjacent commercial nursery areas.

Notes on the effect of the herbicides were made at approximately fortnightly intervals. The effects of the herbicides were also quantitatively determined by measuring the height and width of the treated plants and scoring the parameters: "foliar damage", "flower quality", and "saleability". These data were compared with those for a fourteenth treatment: "hand weeded" (no herbicide application). All plants were measured over the period 30 March to 3 April 1992. Retreated plants were measured on 15 June 1992.

Plant growth data were analysed by analysis of variance for a species x herbicide factorial in a completely randomised design. After initial analysis, each species was analysed separately across the herbicide treatments. In this latter analysis, the means for each of the herbicide treatments were compared to that for the hand weeded treatment.

Weeds that established in the containers during the trials were identified, recorded and removed at approximately fortnightly intervals. Data are presented as cumulative weed numbers per pot for separate periods of the trial and analysed as a completely random design for herbicide treatments (across all species).

RESULTS AND DISCUSSION

Overall, damage to nursery stock from the herbicides was very limited and, in most instances, was manifested as a reduction in growth rather than as an effect on plant quality. The most damaging treatments were those containing oxyfluorfen and, to a lesser extent, the isoxaben + oryzalin mix. No herbicide treatment was totally safe to all species.

Widespread tolerance to oxadiazon granules and sensitivity to oxyfluorfen and isoxaben by nursery stock have been reported in other trials and from commercial experience (e.g. 2, 6, 7) although oxyfluorfen may be well tolerated when applied as a granular treatment (4, 5).

The most sensitive species overall was *Hydrangea macrophylla,* followed by *Brachycome multifida, Chrysocoma coma-aurea, Potentilla* "Miss Wilmot", *Jasminum humile* and *Grevillea curviloba.* Sixteen species (1, 7, 12, 18, 19, 20, 22, 25, 29, 31, 33, 41, 43, 46, 47 and 49) were

tolerant of all herbicides tested. None of the most sensitive species from the first herbicide application was retreated. However, significant phytotoxicity was caused by several of the treatments to *Correa decumbens*, a species that was only slightly damaged by the initial application. Full details of the individual species responses (5 parameters for each of the 650 species-herbicide combinations) are available from the senior author.

Weed numbers were low during the first six weeks of the trial, demonstrating a lag phase while weed seeds spread into the pots from surrounding areas (Table 2). The main weeds were willow herb (*Epilobium* sp.), hairy bitter cress (*Cardamine hirsuta*), sowthistle (*Sonchus oleraceus*) and cudweed (*Gnaphalium* sp.).

The effectiveness of the herbicides was generally poor (Table 2). Cumulative weed number per pot was significantly lower than the hand weeded treatment for diphenamid, isoxaben + oryzalin, oryzalin + oxyfluorfen, oxadiazon and oxyfluorfen and for diphenamid, isoxaben, oryzalin + oxyfluorfen, oxadiazon and oxyfluorfen for the first and second six week periods of the trial respectively (Table 2). Treatments which significantly reduced weed number over the six week period after the second herbicide application were oryzalin + oxyfluorfen, oxadiazon and oxyfluorfen (Table 2).

Table 2. Mean cumulative number of weeds per pot for each of the 13 herbicide treatments and the hand weeded control six weeks and twelve weeks after the first herbicide application and six weeks after the second application.

Herbicide	Commercial product	Rate (kg ai/ha)	Six weeks[a]	Twelve weeks[a]	Six weeks[b]
chlorthal-dimethyl	Dacthal W750	8.25	0.66	6.52	5.69
diphenamid	Enide	5.50	0.25	3.03	4.43
isoxaben	Gallery	0.75	0.27	2.76	3.24
isoxaben + oryzalin	Gallery + Surflan DF 850	0.45+ 1.70	0.05	4.54	5.15
lenacil	Venzar	1.60	0.42	3.50	2.85
napropamide	Devrinol	2.25	0.38	5.11	4.02
norflurazon	Solicam	2.00	0.32	3.43	4.76
oryzalin	Surflan 850 DF	2.55	0.54	9.00	4.13
oryzalin + oxyfluorfen	Surflan DF 850 + Goal	1.70+ 0.72	0.02	3.17	1.02
oxadiazon	Ronstar Granules	4.00	0.04	1.17	0.52
oxyfluorfen	Goal	0.72	0.13	2.94	0.58
pendimethalin	Stomp 330E	0.99	0.48	5.37	7.13
simazine	Flowable Gesatop	1.10	0.31	4.73	7.83
handweeded			0.55	6.37	5.03
l.s.d. (P=0.05)			0.24	2.97	3.52

[a] Based on data for 300 pots for first herbicide application.
[b] Based on data for 54 pots for second herbicide application.

Other weed situations

The effectiveness of oxadiazon and oxyfluorfen has previously been reported (1, 4, 5, 6, 7). However, the poor performance of oryzalin in this trial contrasts with its reported effectiveness for a similar weed spectrum (2).

Mean total weed number per pot for the twelve weeks after the first herbicide application was 6.9 for the hand weeded control and 1.2 for the most effective herbicide treatment (oxadiazon). While this indicates a highly significant decrease in weed number due to herbicide application, the actual weed number still represents a considerable weed problem in practice. In a small pot, even a single weed can compete strongly with the growing plant.

Overall, effective long term weed control without unacceptable plant damage to a large number of the species tested was achieved only with oxadiazon (Ronstar Granules™).

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