Rooting Performance of Hardwood Stem Cuttings from Herbicide-treated Nursery Stock Plants[1]

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Abstract

Bed-grown nursery stock was treated with preemergence herbicides semiannually for 3 years at maximum label use rates. Herbicides included Devrinol, Pennant, Ronstar, Southern Weedgrass Control, Surflan, Treflan, Ornamental Herbicide 2, Rout, and XL. Hardwood cuttings were taken after two and four herbicide applications ('Nellie R. Stevens' holly), or after two and six applications (shore juniper, Pfitzer juniper, glossy privet). Herbicides did not affect rooting of cuttings or growth of stock plants of the taxa tested.

Index words: adventitious rooting, asexual propagation, field-grown nursery stock, woody landscape plants, preemergence herbicides.

Herbicides used in this study: Devrinol (napropamide), *N,N*-diethyl-2-(1-naphthalenyloxy)propanamide; Gramoxone Super (paraquat), 1,1'-dimethyl-4,4'-bipyridinium ion; Pennant (metolachlor), 2-chloro-*N*-(2-ethyl-6-methylphenyl)-*N*-(2-methoxy-1-methylethyl)acetamide; Ronstar (oxadiazon), 3-[2,4-dichloro-5-(1-methylethoxy)phenyl]-5-(1,1-dimethylethyl)-1,3,4-oxadiazol-2-(3*H*)-one; Southern Weedgrass Control (pendimethalin), *N*-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzenamine; Surflan (oryzalin), 4-(dipropylamino)-3,5-dinitrobenzenesulfonamide; Treflan (trifluralin), 2,6-dinitro-*N,N*-dipropyl-4-(trifluoromethyl)benzenamine; Ornamental Herbicide 2 (oxyfluorfen), 2-chloro-1-(3-ethoxy-4-nitrophenoxy)-4-(trifluoromethyl)benzene + (pendimethalin); Rout (oxyfluorfen) + (oryzalin); and XL, (benefin), *N*-butyl-*N*-ethyl-2,6-dinitro-4-(trifluoromethyl)benzenamine + (oryzalin).

Species used in this study: 'Nellie R. Stevens' holly (*Ilex* x 'Nellie R. Stevens'); shore juniper (*Juniperus conferta* Parl.); Pfitzer juniper (*Juniperus* × *media* vanMelle 'Pfitzerana'); glossy privet (*Ligustrum lucidum* Ait.).

Significance to the Nursery Industry

Suspicions have persisted in the nursery industry for several decades that preemergence herbicides applied to stock plants cause reduced rooting of stem cuttings. This research was conducted to identify effects of widely used preemergence herbicides (Devrinol, Pennant, Ronstar, Southern Weedgrass Control, Surflan, Treflan, Ornamental Herbicide 2, Rout and XL) on propagation of selected woody landscape plants. Results of this study and previous research by other investigators suggest that herbicides applied at normal use rates generally have no effect on rooting of cuttings of most woody landscape species, even when stock plants are treated repeatedly over several years.

Introduction

In the 1960s and '70s, certain plant propagators questioned the advisability of preemergence herbicide use on nursery stock plants (7,12). Growers often blamed herbicides when rooting of their cuttings was less than satisfactory, and some growers discontinued use of all herbicides on stock plants.

Studies were performed during the 1960s and '70s to examine the indirect effects of herbicides on rooting of cuttings. Most studies utilized container-grown stock plants. McGuire and Pearson (11) reported reduced rooting of softwood cuttings of *Ilex, Juniperus*, and *Rhododendron* (azalea) from container-grown plants treated with Princep (simazine) but not with Dymid (diphenamid). Ticknor (13,14) found that of five landscape taxa treated with up to four herbicide applications, only *Calluna* exhibited reduced rooting. When Fretz (9) treated two cultivars of *Rhododendron* (azalea) with 1X and 3-4X rates of six herbicides, only the high rate of Eptam (EPTC) and Casoron (dichlobenil) reduced rooting of softwood cuttings. Briggs (7) found that rooting of cuttings of *Cotoneaster* was promoted by a low rate of certain herbicides and inhibited by a high rate of others, whereas recommended rates generally did not affect rooting. Cohen (8) found no effect of three herbicides on rooting of *Rhododendron* and *Pyracantha.*

Ahrens (1,2,3) studied potential herbicidal effects by applying numerous herbicides to a wide range of woody landscape plants. Some herbicides were applied at 2-4X rates up to five times in containers and up to three times in the field. He concluded that normal rates of herbicides generally had no effect on rooting of cuttings. This finding is supported by additional studies performed on field-grown woody taxa (6,10).

Many of the preemergence herbicides evaluated in the 1960s and '70s for long-term effects on landscape plants have been replaced by newer products, some of which have not been tested. The objective of this study was to evaluate the effects of commonly used preemergence herbicides on the rooting of cuttings of several woody landscape taxa.

Materials and Methods

Field. Field bed preparation of a Cecil clay soil at North Carolina State University Horticulture Field Laboratory, Raleigh, included incorporation of 7.5 cm (3 in) of pine bark and adjustment of pH and fertility to within recommended ranges for field-grown woody landscape plants (15). Liners (#1) of each taxon were planted in Fall 1987 in a randomized

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complete block design with six blocks and 11 treatments per block. Each of the 66 plots contained one plant of each taxon, spaced 1.5 m (5 ft) apart within a 13 × 1.2 m (42 × 4 ft) growing area. Adjacent plots were separated by a buffer zone planted in tall fescue (*Festuca arundinacea*). The zone was 1.2 m (4 ft) wide between plots within each block, with a 2.4 m (8 ft) strip between blocks. Throughout the study, cultural practices were similar to those performed by commercial nurseries to maintain stock plants in good vigor.

Preemergence herbicides included Devrinol 5G, Pennant 5G, Ronstar 2G, Surflan 4AS, and Treflan 10G, each at 4.5 kg ai/ha (4 lb ai/A), and Ornamental Herbicide 2 (OH 2) 2+1G, Rout 2+1G, Southern Weedgrass Control 2.45G, and XL 1+1G, each at 3.4 kg ai/ha (3 lb ai/A). Gramoxone Super 1.5L at 0.6 kg ai/ha (0.5 lb ai/A) + 0.25% nonionic surfactant was included as a chemical check treatment. A cultivated check was hand-hoed as needed to reduce weed competition.

Herbicides were applied semiannually for 3 years: March and August 1988, May and August 1989, and March and August 1990. Granular herbicides were applied on a weight per plot basis and dispersed with a hand-held centrifugal spreader. Liquid treatments were applied with a CO_2 backpack sprayer with TeeJet 8003 XR flat fan nozzles (Spraying Systems Co., Wheaton, IL) delivering 411 l/ha (44 gpa) at 103 kPa (15 psi).

Stock plants were inspected periodically for symptoms of herbicide injury, and plant size was determined in May 1988 and January 1990. Plant width in two directions (perpendicular to each other) was recorded and plant area calculated. Plant height was also recorded for all taxa except shore juniper, and trunk diameter was recorded for holly and Pfitzer juniper. Holly plants were harvested in August 1990 and fresh weights recorded.

Cuttings of all taxa were taken in January 1989, after two field treatments. Cuttings of holly were retaken after four treatments (February 1990), whereas cuttings from the remaining three taxa were retaken after 6 treatments (January 1991). Six hardwood cuttings were taken from each of the 66 plants (11 treatments x 6 blocks) on each date. Fifteen cm (6 in) subterminal cuttings were taken from the junipers, whereas 10 cm (4 in) terminal cuttings were taken from the holly and privet. Cuttings were placed in plastic bags, syringed, and held overnight at 4°C (40°F). Cuttings were prepared for rooting on the following day.

Greenhouse. Cuttings were rooted in a glass greenhouse in a raised bed containing a medium of perlite:peat (2:1 by vol). Immediately prior to sticking cuttings, leaves were stripped from the basal 3.8-5.1 cm (1.5-2.0 in). A 2.5 cm (1 in) heavy wound was made at the base of each cutting of Pfitzer juniper and privet. Two heavy wounds were made on cuttings of holly. The basal portion of each cutting was dipped for 5 sec in a 5,000 ppm solution of indolebutyric acid (IBA) (free acid) in 50% ethanol. Cuttings were arranged in the propagation bed in a randomized complete block design. Mist was applied for 8 sec every 10 min during daylight hours.

Data were collected when cuttings of each taxon had developed a commercially acceptable rootball (7.5-15 weeks after sticking). For junipers, root number and individual root lengths were recorded on a per cutting basis. All roots at least 10 mm (0.4 in) long were included in evaluations. For holly and privet, root number, rootball diameter, and visual rootball rating were recorded on a per cutting basis. Visual rootball rating was performed using a scale of 1 to 6 with 1 = no rooting and 6 = highest root number and length.

Statistical analysis. Data on stock plants and cuttings were analyzed for each taxon independently. Data were subjected to the analysis of variance (ANOVA) procedure and the Student-Newman-Keuls multiple range test at the 5% level of significance.

Results and Discussion

Plant growth. None of the parameters evaluated revealed differences in growth among treatments (data not presented).

Rooting of cuttings. Data analysis revealed no treatment by year interactions, so rooting data were combined across years for each taxon. Data for 'Nellie R. Stevens' holly and

Table 1. Rooting of stem cuttings of 'Nellie R. Stevens' holly and glossy privet after repeated treatment of bed-grown stock plants with selected preemergence herbicides.

Treatment	Formulation	Rate (kg/ha)	'Nellie R. Stevens' Holly[z] Rooting[x] (%)	'Nellie R. Stevens' Holly[z] Rootball diam.[w] (mm)	'Nellie R. Stevens' Holly[z] Root no.[w]	Glossy Privet[y] Rooting[x] (%)	Glossy Privet[y] Rootball diam.[w] (mm)	Glossy Privet[y] Root no.[w]
Devrinol	5G	4.5	64[v]	50	14.0	43	60	6.3
Pennant	5G	4.5	69	54	16.6	53	58	6.2
Ronstar	2G	4.5	61	62	17.7	65	63	6.4
Surflan	4G	4.5	75	76	22.2	51	63	6.0
Treflan	5G	4.5	75	61	15.3	53	58	6.1
Southern Weedgrass Control	2.45G	3.4	74	69	19.0	60	63	6.4
Ornamental Herbicide 2 (oxyfluorfen + pendimethalin)	2 + 1G	2.2 + 1.1	74	56	14.6	56	53	5.9
Rout (oxyfluorfen + oryzalin)	2 + 1G	2.1 + 1.1	65	62	12.2	49	56	5.4
XL (benefin + oryzalin)	1 + 1G	1.7 + 1.7	67	62	19.4	56	60	6.2
Gramoxone Super	1.5L	0.5	65	67	21.1	47	55	5.8
Check, cultivated	—	—	81	75	21.0	58	56	5.9

[z]Cuttings were taken in January 1989 and February 1990, after two and four treatments, respectively.

[y]Cuttings were taken in January of 1989 and 1991, after two and six treatments, respectively.

[x]All values are means based on 72 cuttings per treatment.

[w]Only cuttings that rooted are included in means.

[v]Treatment means are not significantly different (P=0.05), but are included to emphasize the lack of treatment effects.

Table 2. Rooting of stem cuttings of shore juniper and Pfitzer juniper after repeated treatment of bed-grown stock plants with selected preemergence herbicides.

Treatment	Formulation	Rate (kg/ha)	Shore Juniper[z] Rooting[y] (%)	Shore Juniper[z] Mean root length[x] (mm)	Shore Juniper[z] Root number[x]	Pfitzer Juniper[z] Rooting[y] (%)	Pfitzer Juniper[z] Mean root length[x] (mm)	Pfitzer Juniper[z] Root number[x]
Devrinol	5G	4.5	89[v]	80	8.4	75	81	9.2
Pennant	5G	4.5	92	86	7.3	79	81	9.7
Ronstar	2G	4.5	88	83	6.7	85	81	8.7
Surflan	4G	4.5	89	77	7.9	76	74	9.6
Treflan	5G	4.5	93	80	7.6	85	80	9.5
Southern Weedgrass Control	2.45G	3.4	85	72	8.5	78	87	8.8
Ornamental Herbicide 2 (oxyfluorfen + pendimethalin)	2 + 1G	2.2 + 1.1	92	84	8.2	79	88	9.5
Rout (oxyfluorfen + oryzalin)	2 + 1G	2.1 + 1.1	96	74	7.8	83	79	9.2
XL (benefin + oryzalin)	1 + 1G	1.7 + 1.7	93	82	8.4	79	87	10.0
Gramoxone Super	1.5L	0.5	93	75	8.8	82	81	10.7
Check, cultivated	—	—	89	89	6.8	72	85	8.9

[z]Cuttings were taken in January 1989 and 1991, after two and six treatments, respectively.

[y]All values are means based on 72 cuttings per treatment.

[x]Only cuttings that rooted are included in means.

[v]Treatment means are not significantly different (P=0.05), but are included to emphasize the lack of treatment effects.

glossy privet are presented in Table 1, and data for shore juniper and Pfitzer juniper are presented in Table 2. No significant treatment effects were observed for any parameter on any of the four taxa. Lack of treatment effects was due in part to variable rooting response among cuttings within each treatment.

Results herein demonstrate that common preemergence herbicides applied repeatedly at maximum label use rates did not affect either the growth of four taxa of woody plants or the rooting of cuttings taken from them. Although decreased rooting of cuttings has been reported on taxa with marginal tolerance to a particular preemergence herbicide, our findings and those of other researchers indicate no such effect on most taxa tested. This lack of observable effects is consistent with reports on herbicidal properties and their behavior in plants. Dinitroanilines (benefin, oryzalin, pendimethalin, and trifluralin) and diphenylethers (oxyfluorfen) have little to no mobility in plants (4). Even the amides metolachlor and napropamide, which have good mobility in the apoplast of some species (4), are likely to be relatively immobile in woody plants (5). Research findings to date and consideration of the processes by which plants interact with preemergence herbicides suggest that concerns regarding reduced rooting of cuttings are generally unfounded.

(*Ed. note*: This paper reports the results of research only, and does not imply registration of a pesticide under amended FIFRA. Before using any pesticide mentioned in this research paper, be certain of their registration by appropriate state and/or federal authorities.)

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