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Herbicide Use In Propagation: Effects on Rooting and Root Growth of Stem Cuttings[1]

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Abstract

Two experiments were conducted to determine the effects of several preemergence applied herbicides on rooting, root quality and subsequent root growth of selected woody cuttings. In the first experiment *Ilex* x *attenuata* Ashe 'Fosteri' rooting percentage, primary root numbers and root ratings were suppressed with Surflan (oryzalin). In the second experiment, the long-term effects of herbicide use in propagation were monitored for 13 months after potting. Suppression of one or more rooting variables occurred with the 3 species, *Abelia* X *grandiflora* 'Sherwoodii', *Buxus microphylla* var. *koreana*, and *Ilex crenata* 'Compacta', 8 weeks after cuttings were placed in propagation. Thirteen months later, Surflan treated boxwood exhibited root and shoot growth suppression while 'Compacta' holly exhibited suppressed root growth.

Index words: weed control, injury

Herbicides used in this study: Ronstar (oxadiazon), 3-[2,4-dichloro-5-(1-methylethoxy)phenyl]-5-(1,1-dimethylethyl)-1,3,4-oxadiazol-2-(3H)-one; Goal (oxyfluorfen), 2-chloro-1-(3-ethoxy-4-nitrophenoxy)-4-(trifluoromethyl)benzene; Prowl (pendimethalin) N-(1-ethylpropyl)-3,4-dimethyl 1-2,6 dinitro-benzenamide; Surflan (oryzalin), 4-(dipropylamino)-3, 5-dinitro-benzenesulfonamide, Eptam (EPTC), S-ethyldipropylthiocarbamate; Casoron (dichlobenil), 2,6-dichlorobenzonitrile, and Princep (Simazine), 6-chloro-N,N′-diethyl-1,3,5-triazine-2,4-diamine.

Species used in this study: Sherwood abelia (*abelia* x *grandiflora* (Andre)Rehd. 'Sherwoodii'); Korean boxwood (*Buxus microphylla* var. *koreana* Nakai); Foster's holly (*Ilex* x *attenuata* 'Foster's #2'); Compacta Japanese holly (*Ilex crenata* Thunb 'Compacta'); blue rug juniper (*Juniperus horizontalis* Moench 'Wiltoni').

Significance to the Nursery Industry

Limited information is available on the use of herbicides in the propagation of woody nursery crops. This study shows that potential exists for the safe use of herbicides, depending on the crop and herbicide. Surflan (oryzalin) and Surflan based herbicides were more likely to suppress rooting than other herbicides tested. Ronstar (oxadiazon) was the safest for use in propagation with the species tested. Each producer should conduct a test on a small-scale before treating an entire crop.

Introduction

Many growers propagate by sticking cuttings in small containers (rose pots) then placing them under mist in greenhouses or outdoor groundbeds. Weed control in these areas is a problem currently addressed by hand weeding. Use of herbicides to control weeds in these areas would be beneficial; however, limited information is available on how herbicide effects rooting and subsequent root growth of woody cuttings.

Cohen (3), Ahrens (1) and Fretz (5) evaluated propagation of cuttings taken from stock plants previously treated with herbicides. No reduction of rooting or root quality occurred when herbicides were applied at the recommended rate; however, materials such as Eptam (EPTC), Casoran (dichlobenil) and Princep (simazine) reduced rooting at 3 and 4 times normal use rates (5). Research has also shown Surflan to suppress root growth of woody plants (6). Johnson (7) reported suppressed rooting and root quality when herbicides were broadcast over the top of cuttings during propagation. Defoliation of some species was also observed.

In commercial production where many growers stick cuttings directly into individual pots; pots are filled with media, placed in flats, and the flats are moved to the propagation house 1–2 days prior to sticking the cuttings. During this time the pots are watered to thoroughly wet the medium. Application of preemergence herbicides to the pots before sticking the cuttings may avoid direct herbicide injury reported by Johnson (7). The objective of this study was to determine if pre-propagation application of preemergence applied herbicides would affect rooting and subsequent root growth of selected woody plants.

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Materials and Methods

Experiment 1 was initiated in November 1986, when 7.5 cm (3 in) square pots (0.4 l) were filled with a pinebark and sand medium (1:1 by vol) amended per m^3 (lb/yd^3) with 3.6 kg (6 lb/yd^3) Osmocote 18N-2.6P-10K (18-6-12), 3.0 kg (5 lb/yd^3) dolomitic limestone, and 0.9 kg (1.5 lb/yd^3) Micromax. Treatments included 5 herbicides and a non-treated control. The following 4 herbicides were applied at 3.4 kg/ha (3.0 lb/A) a.i.: Rout (oxyfluorfen 2G + oryzalin 1G); OH-2 (oxyfluorfen 2G + pendimethalin 1G); Surflan and Prowl 4L (Pendimethalin). Ronstar 2G was applied at 4.5 kg/ha (4.0 lb/A a.i.). These herbicides were selected for evaluation because a) Rout, OH-2 and Ronstar are the 3 major herbicides used in container production, b) Surflan is one of the most widely used herbicides in ornamental crops and c) Prowl, has shown similar activity to Surflan in previous studies (4). Granular formulations were applied with a hand-held shaker; Surflan and Prowl were applied with a CO_2 sprayer at 29 psi with 187 L/ha (20 gal/A) of water. All herbicides were applied to the medium prior to sticking cuttings. The base of each cutting was dipped in a 5000 ppm K-IBA solution prior to sticking and placed under intermittent mist (2.5 sec/5 min from 8AM–5PM) in a 50% shade glass house. Two species, Foster holly and blue rug juniper were used. The experiment was arranged in a randomized complete block design with 4 replications. Each replication consisted of 4 pots with one cutting/pot. Data collected in February 1987, included rooting percentage, root number and root rating scale: 1 = distorted roots < 1 cm (0.4 in), 2 = 1–4 roots 1–5 cm (0.4–2.0 in) long, 3 = 5–10 roots 1–5 cm (0.4–2.0 in) long, 4 = 10–15 roots 1–5 cm (0.4–2.0 in) long, 5 = 16+ roots 1–5 cm (0.4–2.0 in) long. Data for each species were subjected to analysis of variance procedures and treatment mean separation determined using Duncan's multiple range test at P = 0.05.

Experiment 2 was initiated in June 1987. Species used were: Sherwood abelia, Korean boxwood and Compacta Japanese holly. Procedures and treatments were identical to those in experiment 1. Initial rooting data was collected 8 weeks later (August), growth indices and root density ratings were measured in December 1987 (4 months after potting-MAP), March 1988 (7 MAP), and September 1988 (13 MAP). Cuttings were maintained in the greenhouse until May 1988 in the original 7.5 cm (3 in) pots when they were potted into 3.8 litter (1 gal) containers using the media previously described except that the Osmocote rate was 8.4 kg/ha (14 lb/yd^3) and moved to an outdoor container growing area. The root density rating scale was: 1 = no roots visible on outer edge of rootball, 3 = root development to outer edge of rootball, 5 = total root coverage of rootball.

Results and Discussion

In experiment 1, blue rug juniper rooting percentage, root number and root ratings were not affected by any herbicide treatment (Table 1). In contrast, rooting percentage (3% vs 36%) and root ratings (1.0 vs. 2.3) of Foster holly were severely suppressed with Surflan compared to nontreated controls. These data on Foster holly concur with Johnson (7), who reported suppressed rooting percentage of azalea and cotoneaster and reduced rooting quality of azalea, cotoneaster and Japanese holly when Surflan was applied over-the-top of the 4 species. None of the other herbicide treatments affected Foster holly rooting percentage or root quality.

Table 1. Rooting of blue rug juniper and Foster holly as affected by herbicides in Experiment 1.

Herbicide	Rate (kg ai/ha)	Rooting (%)[z]		Root rating[y]	
		juniper	holly	juniper	holly
Rout	3.4	97 a[x]	25 a	3.7 a	1.9 ab
OH-2	3.4	97 a	26 a	3.8 a	2.2 a
Ronstar	4.5	83 a	34 a	3.7 a	2.4 a
Surflan	3.4	92 a	3 b	3.8 a	1.0 b
Prowl	3.4	94 a	44 a	3.9 a	1.9 ab
Control	—	95 a	36 a	3.7 a	2.3 a

[z]Cutting stuck in November 1986; data collected February 1987.

[y]Root rating scale: 1 = distorted roots < 1 cm, 2 = 1–4 roots 1–5 cm, 3 = 5–10 roots 1–5 cm, 4 = 10–15 roots 1–5 cm, 5 = 16+ roots 1–5 cm; 10 August 1987.

[x]Mean separation within columns with Duncan's multiple range test (5% level).

In experiment 2, Korean boxwood rooting percentage and root ratings 8 weeks after sticking were suppressed with Surflan compared to all other treatments (Table 1). Growth indices measurements indicated shoot growth suppression continued up to 13 MAP with Surflan compared to non-treated control. Korean boxwood root growth suppression also continued throughout the test with Surflan. These data concur with Gilliam and Fare (6) where reduced root growth of Japanese holly liners occurred with Surflan treated plants. There were no measurable affects with the other treatments until 13 MAP, when root density ratings were suppressed with Rout, OH-2, and Prowl. This data indicates potential long term affects from using products containing dinitroaniline herbicides in the propagation of woody plants. Both Rout and OH-2 are commonly used in commercial production of container nursery crops and producers may consider their use in propagation since these products would be available on the nursery. Ronstar and nontreated plants were similar throughout the test.

Compacta Japanese holly rooting percentage was suppressed with Surflan and initial root ratings were lower with Surflan and Rout (Table 2). Root density ratings 4 MAP showed that all treatments resulted in less root growth compared to nontreated plants. At the end of the study 13 MAP, root fresh weights were less with Surflan compared to the nontreated control (57.6 g vs 94.9 g); shoot fresh weight was not affected by Surflan application. All other treatments had similar root and shoot fresh weight compared to the nontreated plants (data not shown).

Initial Sherwood abelia root ratings were lower with Rout and Surflan; while rooting percentage was lower with OH-2; however, at 4 MAP, root and shoot growth were similar among all treatments (data not shown).

This study demonstrates several important considerations when using preemergence applied herbicides in propagation of woody plants. First, plant response varies with herbicide application. In experiment 1, blue rug juniper rooting percentage was not affected by any preemergence herbicide application, while in experiment 2, both Korean boxwood and Compacta Japanese holly rooting percentage was less with Surflan.

Table 2. Root and shoot growth response of Korean boxwood propagated in herbicide treated medium, Experiment 2.

Treatment	Rate (kg ai/ha)	Rooting[z] %	Root rating[y]	Growth index[x] Months after potting 4	Growth index[x] Months after potting 7	Growth index[x] Months after potting 13	Root density rating[w] 4	Root density rating[w] 13
Rout	3.4	82 a	2.7 a	10.0 abc	20.2 ab	19.5 abc	4.0 a	2.3 bc
OH-2	3.4	92 a	2.6 a	10.0 abc	20.6 ab	20.0 ab	4.0 a	2.6 b
Ronstar	4.5	92 a	2.8 a	10.2 abc	20.8 ab	21.4 a	3.9 ab	2.8 ab
Surflan	3.4	75 b	1.2 b	9.2 c	17.4 b	17.6 c	3.7 b	2.0 c
Prowl	3.4	83 a	2.7 a	10.9 ab	21.9 a	21.6 a	4.1 a	2.5 bc
Nontreated	—	90 a	3.1 a	11.3 a	20.1 a	20.5 ab	4.2 a	3.2 a

[z]Rooting % taken August 1987, 8 weeks after sticking.

[y]Root rating scale: 1 = distorted roots < 1 cm, 2 = 1–4 roots 1–5 cm, 3 = 5–10 roots 1–5 cm, 4 = 10–15 roots 1–5 cm, 5 = 16+ roots 1–5 cm; 10 August 1987.

[x]Growth index [height + width at widest point + width perpendicular to widest point]/3.

[w]Root density rating scale: 1 = no roots visible on outer edge of rootball, 3 = root development to outer edge of rootball, 5 = total root coverage of rootball.

[v]Mean separation within columns with Duncan's multiple range test (5% level).

Table 3. Root and shoot growth response of Compacta Japanese holly propagated in herbicide treated medium, Experiment 2.

Treatment	Rate (kg ai/ha)	Rooting[z] %	Root rating[y]	Growth index[x] Months after potting 4	Growth index[x] Months after potting 7	Growth index[x] Months after potting 13	Root density rating[w] 4
Rout	3.4	97 ab	1.5 c	10.1 a	15.1 a	31.2 bc	3.8 bc
OH-2	3.4	92 abc	3.4 ab	10.6 a	15.4 a	30.9 bc	3.3 c
Ronstar	4.5	100 a	3.5 ab	9.9 a	15.4 a	31.1 bc	3.6 c
Surflan	3.4	78 c	1.1 c	8.2 a	12.0 b	28.0 c	2.8 d
Prowl	3.4	90 abc	4.0 a	10.6 a	15.3 a	34.4 a	4.2 bc
Nontreated	—	100 a	3.6 ab	10.6 a	15.8 a	32.6 ab	4.4 a

[z]Rooting % taken August 1987, 8 weeks after sticking.

[y]Root rating scale: 1 = distorted roots < 1 cm, 2 = 1–4 roots 1–5 cm, 3 = 5–10 roots 1–5 cm, 4 = 10–15 roots 1–5 cm, 5 = 16+ roots 1–5 cm; 10 August 1987.

[x]Growth index [height + width at widest point + width perpendicular to widest point]/3.

[w]Root density rating scale: 1 = no roots visible on outer edge of rootball, 3 = root development to outer edge of rootball, 5 = total root coverage of rootball.

[v]Mean separation within columns with Duncan's multiple range test (5% level).

The results also demonstrate that herbicide application may have varying lengths of root inhibition depending on the plant species. In experiment 2, Sherwood abelia root growth was suppressed initially; however, by 4 MAP all abelia had similar growth. With Korean boxwood, root suppression continued 13 MAP. In all cases of extended suppression of root growth, dinitroanaline herbicides (Surflan and Prowl) were involved. Since root inhibition of annual crops is a major characteristic of dinitroanaline herbicides (2) and in consideration of previous work with woody plants (6,7), strong evidence is provided against the use of Surflan or Prowl and their combination products in the propagation process.

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

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