ROOTING CUTTINGS FROM PLANTS TREATED WITH HERBICIDES

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Abstract. Sixteen herbicides were tested on cultivars of *Rhododendron*, *Hydrangea* and *Chrysanthemum* over a 3 year period. Cuttings were harvested and rooted from six field and container experiments following herbicide applications. In most cases, dosages of herbicide considered adequate for control of weeds but not injurious to the nursery plants had no significant effects on rooting of cuttings. However, twice normal dosages of herbicides sometimes reduced rooting of cuttings and , in one experiment, two successive annual applications of an herbicide combination reduced the quality of roots formed by cuttings. Plant species and cultivars differed greatly in their response to the herbicides. A reduction in rooting potential of cuttings from treated plants was not always associated with plant injury The greatest effects of herbicides on rooting of cuttings from treated plants occurred in container culture with softwood cuttings. Although in most cases reductions in rooting potential of cuttings were not serious, their occurrence suggests that herbicides continue to be used with care on stock plants. Repeated annual applications of herbicides in the field and herbicide usage in containers should be further evaluated for their effects on rooting potential of cuttings

REVIEW OF LITERATURE

Herbicides are important tools in the culture of field and container-grown nursery plants. Their many advantages over hand and mechanical methods of weed control have led to their general acceptance by the nursery industry. Evaluations of the tolerance of specific horticultural plantings for herbicides have included plant appearance, shoot growth, root growth, and yield of fruit. Little attention has been given to the effects of herbicides on the rooting of cuttings from treated plants. In recent years reports have been received from growers[1] indicating rooting failures in cuttings taken from plants treated with herbicides. Therefore, in 1970 we began to include rooting of cuttings as another criterion for evaluating herbicides in field and container experiments. One study of five rhododendron cultivars grown in containers indicated that the herbicides simazine and trifluralin had no significant effect on rooting of cuttings taken 83 days or more after treatment (7).

McGuire and Pearson (15) applied simazine and diphenamid on container-grown ornamentals and harvested cuttings 30 and 80 days after treatment. Simazine killed some of the plants and reduced the rooting quality of cuttings taken 30 days after treatment from *Ilex glabra*, *Juniperus chinensis* 'San Jose', and the rhododendron

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hybrids, 'Rosebud', 'Mother's Day', and Stewartstonian'. The effects were greater with simazine at 4 lb/A. Diphenamid at 6 or 8 lb/A had no effect on rooting of the cuttings.

The work reported here summarizes the effects upon rooting of cuttings when several herbicides were applied in six field and container experiments over a 3 year period.

MATERIALS AND METHODS

Experiments were conducted in cooperation with commercial nurseries and at the Valley Laboratory of The Connecticut Agricultural Experiment Station. Samples of cuttings were harvested from plants treated with herbicides and rooted in the greenhouse. In some cases the experiments were designed to determine the herbicidal effects on weeds and on the nursery plants, and not specifically to determine herbicidal effects on rooting potential. However, every attempt was made to assure uniformity of handling of all samples of cuttings within a given experiment. Rooting was carried out in greenhouses at two commercial nurseries and in our own greenhouse, using techniques suited to each type of plant material. These techniques and conditions varied greatly from one test to another, but were uniform within experiments.

When the cuttings were lifted, rooting of each was evaluated on a scale of 1 to 6 as follows:

1=dead
2=callused, but no roots
3=poor root development — one or more very small roots
4=fair — roots developed on part of cutting
5=good — roots on all but one side of cutting
6=excellent — roots all around cutting

Percentage rooting was based on the percentage of cuttings ranking fair (class 4) or better. Cuttings judged fair or better were considered fit for transplanting with an excellent chance for survival. For analysis of variance rooting percentages were transformed into angles (20). Rooting scores were calculated by summing the ranks and dividing this by the total number of cuttings within each group. Rooting scores represent the average root quality of a group of cuttings.

The herbicides evaluated in these experiments are given in Table 1. All dosages of herbicides are given in pounds of active ingredient per acre (a.i., lb/A).

RESULTS

The results of the six experiments are given in Tables 2 to 7. Weed control information is included in some cases. In each instance pertinent details are given in these tables.

Dichlobenil was included in three experiments. At 4 or 8 lb / A applied in the fall, dichlobenil injured plants of *Rhododendron* 'Coccinea Speciosa', but reduced rooting of cuttings only at the higher rate (Table 2) Visual injury to plants of *Rhododendron* 'Harvest Moon' was less than injury to 'Coccinea Speciosa', and rooting of cuttings from 'Harvest Moon' plants treated with dichlobenil was better than rooting of cuttings from untreated controls Dichlobenil at 4 or 8 lb / A applied in April had no effect on rooting of cuttings of *Rhododendron* 'Grandiflora' (Table 3). Two successive annual applications of dichlobenil at 4 lb / A had no effect on the rooting of softwood cuttings of *Rhododendron* 'Daviesi' or *Rhododendron* 'Tunis' (Table 6).

Simazine, applied alone or in combination with other herbicides was included in all of our experiments on woody plants. A fall application at 3 lb / A injured hybrid azaleas, but rooting of softwood cuttings form injured plants was slightly less than the controls in *Rhododendron* 'Coccinea Speciosa', and higher than the controls in 'Havest Moon' (Table 2) In container-grown hydrangeas, simazine at 2 5 lb / A induced chlorosis in the lower foliage but cuttings from chlorotic plants rooted about as well as cuttings from control plants (Table 4) In other experiments even twice normal rates of simazine did not significantly affect rooting (Tables 3, 6, 7).

In most cases, cuttings from plants treated with combinations of simazine and other herbicides rooted as well or better than cuttings from control plants, but two exceptions were noted. Rooting of softwood cuttings of *Rhododendron* 'Daviesi' was reduced 17% as compared with controls following two annual applications in the fall of simazine at 1.5 lb / A plus DCPA at 9 lb / A (Table 6), and high rates of simazine plus alachlor (2.5 + 8 lb / A) significantly reduced rooting of softwood cuttings from container-grown *Rhododendron* 'PJM', but not 'Purple Gem' (Table 7).

Norea was included in only one experiment with *Rhododendron* 'Coccinea Speciosa' and 'Harvest Moon' at rates of 4 and 8 lb / A in the fall. Although Norea caused chlorosis and necrosis of the foliage of both cultivars, cuttings from these plants rooted as well or better than cuttings from control plants (Table 2).

Diphenamid was included in five of our experiments at normal (4-6 lb / A) or twice normal (8-12 lb / A) rates of application (Tables 2, 3, 5, 6, 7) The high rates of diphenamid reduced rooting of cuttings from *Rhododendron* 'Grandiflora' (Table 3), *Chrysanthemum moriflorum* 'Ruby Mound' (Table 5) and *Rhododendron* 'PJM' (Table 7), but the low rates had no significant effects. In *Rhododendron* 'Coccinea Speciosa' (Table 2) diphenamid caused slight tip burn on foliage but cuttings from injured plants rooted better than the controls. In *Chrysanthemum* 'Chapel Bells' diphenamid reduced top growth, but this injury did not cause marked reductions in rooting of the cuttings (Table 5).

DCPA was included in four of the experiments (Tables 4, 5, 6, 7) Normal dosages of DCPA (9 lb/A) did not affect rooting of any plant treated. The effect of two annual applications of DCPA plus simazine on rooting of *Rhododendron* 'Daviesi' was mentioned in the simazine section. Double rates of DCPA (18 lb/A) distorted the leaves and stunted container-grown plants of *Hydrangea acuminata preciosa*. Rooting of cuttings from these plants was significantly depressed (Table 4). Softwood cuttings from *Rhododendron* 'PJM' that were treated with DCPA at 18 lb/A also rooted less than cuttings from control plants (Table 7). However, DCPA at 18 lb/A had no marked effects on rooting of cuttings from *Rhododendron* 'Purple Gem' (Table 7), two chrysanthemum cultivars (Table 5) or *Rhododendron* 'Boule de Neige' (Table 4).

Trifluralin was included in all of the rooting tests (Tables 2-7). Only in two instances was there any indication of effects on rooting, and those were at high rates of application. In container-grown chrysanthemums (Table 5) cuttings from plants injured by trifluralin at 4 lb/A developed poorer roots than the controls Cuttings from field-grown *Rhododendron* 'Daviesi' treated with two annual applications of trifluralin at 4 lb/A in the fall also developed roots of poorer quality than control plants, but cuttings from *Rhododendron* 'Tunis' were unaffected (Table 6) Two annual applications of simazine plus trifluralin seemed to reduce rooting of cuttings *R*. Tunis', but this reduction was not statistically significant.

Bensulide was included in three experiments (Table 2, 4, 6) At 8 or 16 lb/A, bensulide did not reduce the rooting of cuttings.

Chlorpropham applied at 8 or 16 lb/A in two container-grown rhododendron hybrids, had no adverse effects on rooting of cuttings (Table 7). Similarly, both EPTC and **chloramben**, which injured chrysanthemums, did not markedly affect rooting of cuttings from the injured plants (Table 5).

Nitralin was included in three of the experiments (Tables 2, 3, 4), alone and in combination with simazine. Nitralin at 4 lb/A injured azaleas but did not affect rooting (Table 2). Similarly, cuttings from other plants treated with nitralin rooted as well or better than controls (Tables 3, 4).

A few experimental herbicides that are not now registered for use on woody plants in the United States were also tested. These included R-7465, cycloprofulan, pronamide, alachlor, and oxadiazon.

Cycloprofulan did not affect rooting of chrysanthemums (Table 5) and **pronamide** did not affect rooting of azaleas, following one or two annual applications (Table 6).

R-7465, however, significantly reduced rooting of *Rhododendron* 'Daviesi' following two annual applications at 3 lb/A without affecting rooting of *R.* 'Tunis' on the same field at 6 lb/A (Table 6). R-7465 also reduced rooting of cuttings from plants of *Rhododendron* 'PJM' in containers without affecting rooting of *Rhododendron* 'Purple Gem' (Table 7).

Alachlor alone or in combination with simazine had no effect on rooting of cuttings in field-grown *Rhododendron* 'Grandiflora' (Table 3), or container-grown *Rhododendron* 'Boule de Neige', or *Hydrangea acuminata preciosa* (Table 4). A high rate of alachlor plus simazine reduced rooting of softwood cuttings from container-grown *Rhododendron* 'PJM', but not 'Purple Gem' (Table 7).

Oxadiazon at 2 or 4 lb/A did not affect rooting of cuttings from container-grown *Rhododendron* 'PJM' or 'Purple Gem' (Table 7).

DISCUSSION

Herbicides could affect the rooting of cuttings from treated plants, either directly or indirectly. Direct effects could be produced by uptake of the herbicide and translocation to the shoot where the herbicide, or one of its metabolites could alter plant metabolism. Direct effects might also result from root inhibition which could alter shoot growth and metabolism. Indirect effects of herbicides could result from the control of weeds which compete with other plants for nutrients and water. Herbicide-treated woody plants frequently grow more vigorously than untreated plants that are periodically weeded. These indirect effects might improve rooting potential or reduce it, depending on when the cuttings are taken. The optimal time for taking cuttings from plants might be altered by the herbicide application which directly or indirectly affected plant metabolism and growth.

Since plants differ in their tolerance to herbicides, and soil and climatic conditions affect this tolerance, it will be difficult, if not impossible, to predict for all species and cultivars whether inhibition of rooting will occur from herbicide usage. We can only learn from experiments and experience on individual plants and systems of culture which herbicides are likely to cause problems. In this respect, the effects of herbicides on rooting of cuttings are similar to the effects of the herbicides on growth and appearance of the stock plants themselves. Thus, rooting potential becomes another criterion by which to evaluate herbicides in assessing their safety to horticultural plants.

In the experiments reported here, several herbicides had no adverse effects on rooting and in some instances herbicides appear to have caused improved rooting. No herbicide consistently reduced rooting. Most of the adverse effects of herbicides on rooting were obtained at twice normal dosages or in leachable container mixes that allowed greater than normal exposure of the plant root system to the herbicide.

The herbicides that adversely affected rooting of cuttings from one or more treated species included dichlobenil, simazine, diphenamid, DCPA, trifluralin and R-7465.

Dichlobenil, which acts primarily as an inhibitor of root growth, is the only preemergence herbicide currently available to nurserymen that has been effective against established perennial weeds. It has been tested for use in containers but it is primarily applied in field-grown stock during the dormant season (1, 2, 4, 6, 9, 10). It is absorbed by plant roots and is translocated to foliage (14) where it either is metabolized or evaporates. Despite some reports of success (1, 8, 10), dichlobenil appears to be too hazardous for general use in container stock because we have found that it is readily leached to root zones in the soil mix most commonly used, containing equal volumes of sand and sphagnum peat (6). Exceptions might be the use of dichlobenil on containers with less permeable soil mixes or during the winter storage period in colder climes, where minimal irrigation is used. A number of species are sensitive to dichlobenil including many of the deciduous azaleas both in the field and in containers (1, 4, 10). In the work reported here, *Rhododendron* 'Coccinea Speciosa' was injured and rooting of softwood cuttings was poorer following application of dichlobenil at 8 lb/A, but with lesser injury, rooting was unaffected at 4 lb/A (Table 2). We obtained no inhibition of rooting of cuttings with dichlobenil when we did not obtain concurrent plant injury due to excessive rates of application (Tables 2, 6).

Simazine is a widely used herbicide in woody plants for preemergence control of annual and perennial weeds. Many woody plants, particularly deciduous species, are sensitive to injury from simazine. However, studies in recent years have shown that low rates of simazine in combination with other herbicides that effectively control annual grasses, have a wide range of utility in field and container-grown woody plants (2, 4, 5).

Simazine is absorbed by plant roots and is translocated to shoots, where it inhibits photosynthesis and reduces carbohydrate levels (11). At sublethal dosages it has been reported to increase nitrate levels in plants (19). It does not directly affect root growth. Simazine is metabolized in plants; resistant plants tend to break it down more rapidly than susceptible plants (16). Perhaps this is why

Table 1. Herbicides tested for effects on rooting of cuttings from treated plants.

Common name	Chemical name	Trade name	Manufacturer
alachlor	2-chloro-2', 6'-diethyl-N-(methoxy-methyl) acetanilide	LASSO	Monsanto
bensulide	0,0-diisopropyl phosphorodithioate S-ester with N-(2-mercaptoethyl) ben-zenesulfonamide	BETASAN	Stauffer
chloramben	3-amino-2, 5-dichlorobenzoic acid	AMIBEN	Amchem
chlorpropham	isopropyl m-chlorocarbanilate	CHLORO IPC, FURLOE	Niagara
cycloprofulan	N-(cyclopropylmethyl) a, a a-tri-flouro-2, 6-dinitro-N-propyl-p-toluidine	TOLBAN	CIBA-Geigy
DCPA	dimethyl tetrachloroterephthalate	DACTHAL	Diamond Shamrock
dichlobenil	2, 6-dichlorobenzonitrile	CASORON	Thompson-Hayward
diphenamid	N, N-dimethyl-2,2-diphenylacetamide	ENIDE, DYMID	Upjohn, Eli Lilly
EPTC	S-ethyl dipropylthiocarbamate	EPTAM	Stauffer
nitralin	4-(methylsulfonyl) -2, 6-dinitro-N, N-dipropylaniline	PLANAVIN	Shell
norea	3-(hexahydro-4,7-methanoindan-5-yl)-1, 1-dimethylurea	HERBAN	Hercules
oxadiazon	2-tert-butyl-4-2'-4'-dichloro-5' isopropyloxyphenyl-1, 3, 4-oxadiaz-olin-5-one	RONSTAR	Rhodia
pronamide	N-(1,1 dimethylpropynyl)-3,5-dichlorobenzamide	KERB	Rohm & Haas
R-7465	2-(a-naphoxy)-N,N-diethylpropion-amide	DEVRINOL	Stauffer
simazine	2-chloro-4,6-bis(ethylamino) -s-triazine	PRINCEP	CIBA-Geigy
trifluralin	a, a, a-trifluro-2,6-dinitro-N,N-dipropyl-p-toluidine	TREFLAN	Eli Lilly

Table 2. Effects of fall applied herbicides on visual injury and rooting of cuttings from treated azaleas — 1970 [1]

Herbicide	Rate a.i., lb/A	*Rhododendron 'Coccinea speciosa'*			*Rhododendron 'Harvest Moon'*		
		Injury [2]	No of Cuttings	% rooted	Injury [2]	No of Cuttings	% rooted
Untreated controls		0	53	57	0	28	36
simazine	1.5	0	64	73	—	—	—
	3	3	33	45	2	26	46
dichlobenil	4	4	88	68	0	25	72
	8	5	7	29	2	17	71
trifluralin	2	0	61	66	0	19	63
	4	1	81	62	0	27	81
nitralin	2	1	62	48	0	32	66
	4	3	60	78	2	27	63
diphenamid	5	1	60	73	0	29	52
	10	2	65	63	0	27	41
norea	4	1	79	58	1	26	69
	8	3	34	62	3	30	70
bensulide	8	0	62	77	0	24	38
	16	0	81	55	3	36	33
simazine + trifluralin	1.5+2	0	34	76	—	—	—
Average				62		27	57

[1]The herbicides were applied on 11-18-69 on plants established in April 1969. Softwood cuttings were taken on 6-6-70 and rooted under mist with 1% IBA. Norea was applied as a spray in 50 gal solution per acre, all other herbicides were applied in granular form. Weed control and injury evaluations in this experiment are published elsewhere (4).

[2]Injury to the plants were rated on a scale of 0 to 10, where 0=no injury and 10=dead plants.

Table 3. Effects of herbicides on control of crabgrass and the rooting of *Rhododendron* 'Grandiflora' [1].

Herbicide	Rate, a.i., lb/A	Crabgrass control ratings[2]			Cuttings taken July 29, 1970		
		June 11	July 29	Sept 24	No. of cuttings	Percentage rooted	Rooting score
Untreated controls		0	2.2	1.9	98	87	5.0
simazine	2	5.3	7.0	3.3	35	91	4.8
	4	7.0	7.5	4.0	47	96	5.3
dichlobenil	4	9.0	9.0	8.0	51	90	5.2
	8	9.5	9.2	9.3	51	84	4.7
trifluralin	3	9.8	8.8	9.5	52	79	4.7
	6	9.8	9.0	9.3	50	90	5.3
nitralin	3	8.3	6.7	8.8	51	80	4.8
	6	8.2	7.2	9.0	46	89	4.9
diphenamid	5	8.6	8.7	8.5	51	88	5.0
	10	9.3	9.5	9.2	52	69	4.3
R-7465	6	7.7	7.3	8.5	50	94	5.2
alachlor	4	9.2	8.5	6.0	49	94	5.1
	8	9.6	8.8	8.2	50	94	5.1
simazine trifluralin	1.5 + 3	9.6	8.2	8.7	49	84	4.8
simazine nitralin	1.5 + 3	7.7	8.3	8.3	48	88	5.2
simazine diphenamid	1.5 + 5	8.6	8.3	9.2	50	84	5.0
simazine alachlor	1.5 + 4	8.6	7.3	6.8	51	90	5.1
Average						87	5.0

[1] The herbicides were applied on 4-8-70 over plants established in 1969. R-7465 was applied as a spray. All other herbicides were applied in granular form. Certain plants treated with dichlobenil at 8 lb/A were slightly discolored. No injury was dectectable from the other treatments. Cuttings were dipped in 1% IBA and rooted under mist.

[2] 0 = no weed control, 10 = 100% control of crabgrass (Digitaria spp.). All plots were weeded after each rating.

Table 4. Effect of granular herbicides on control of weeds in containers and on rooting of cuttings from the treated plants [1].

Herbicide	Rate, a i, lb/A	Average No of weeds per gallon container [2]				*Rhododendron* 'Boule de Neige'[3]	*Hydrangea acuminata preciosa* [4]	
		Crabgrass		Broadleaf		Percentage rooted	Percentage rooted	Rooting score
		8/4	9/1	8/4	9/1			
Untreated controls		25 0	1 5	4 5	3 3	51	86	4 8
simazine	1 25	6 7	1 2	0 6	0 7	62	86	4 8
	2 5	0 3	0 1	0	0 1	54	81	4 5
trifluralin	2	0 3	0 4	0 9	1 4	50	98	5 2
	4	0 1	0 2	0 6	1 3	54	86	4 8
nitralin	2	0 4	1 1	1 1	1 2	47	86	4 7
	4	0 2	0 1	0 6	1 2	67	92	5 0
alachlor	4	1 2	0 5	1 6	1 0	59	90	5 0
	8	0	0	0 5	0 3	78	87	5 0
bensulide	8	0 3	0 7	1 4	1 9	83	91	4 8
	16	0	0 1	0 3	0 7	91	86	4 8
DCPA	9	1 5	0 6	2 7	0 9	75	81	4 5
	18	0 4	0 2	1 8	0 6	80	71	4 3 *
simazine + trifluralin	1 25 + 2	0 1	0 2	0	0 7	74	90	4 6
simazine + nitralin	1 25 + 2	0	0 1	0 3	0 8	83	81	4 6
simazine + alachlor	1 25+4	0	0	0	0	91	90	5 0
simazine + bensulide	1 25+8	0 1	0	0	0 7	70	90	5 2
simazine + DCPA	1 25+9	0 1	0 1	0 1	0 1	82	82	4 6
Average						70	86	4 8

[1]The herbicides were applied 7-9-70. Rhododendron cuttings were taken 11-20-70, dipped in 1% IBA plus 5% Captan. Hydrangea cuttings were taken 10-6-70 and rooted without hormone.

[2]Crabgrass (**Digitaria spp.**) seeds were sown before treating 1 gal. plantless containers with the same soil mix as the plants were grown in. All weeds were pulled and counted 8-4-70 and 9-1-70. The soil mix was 1/6 sand, 1/6 sand, 1/6 perlite, 1/3 peat, and 1/3 humus by volume.

[3]The number of cuttings taken was 50 for untreated controls and 25 for each treatment.

[4]The number of cuttings taken was 120 for untreated controls and 60 for each treatment.

* Figure significantly less than untreated controls at 5 % probability level.

Table 5. Effect of herbicides on foliage injury, top growth, and rooting of cuttings from container-grown chrysanthemums — 1971[1].

Herbicide	Rate, a.i., lb/A	'Ruby Mound'			'Chapel Bells'		
		Fresh weight			Fresh weight		
		Injury[2]	Tops[3]	Percentage rooted	Injury[2]	Tops[3]	Percentage rooted
Untreated controls		0	121	77	0	160	100
trifluralin	2	2	138	70	1	138	97
	4	4	116	64	3	117 *	88
DCPA	9	0	134	80	0	136	89
	18	0	135	89	0	165	95
diphenamid	4	0	116	76	0	124 *	97
	8	0	134	31	0	111 *	92
cycloprofulan	2	1	137	76	0	152	96
	4	3	116	71	0	115 *	97
EPTC	4	0	139	75	0	137	93
	8	5	76 *	83	2	118 *	90
chloramben	4	0	116	77	1	132	97
	8	6	52 *	77	3	69 *	100
Average			118	73		129	95

[1] Chrysanthemum rooted cuttings were planted in containers on 7-20-70 and treated 8-1-70 with herbicide sprays in 50 gal solution per acre. The soil mix was 25 percent loam, 50 percent peat and 25 percent perlite by volume. After harvesting top growth in October, 1970, 35-40 cuttings were taken from mature stems of each treatment and rooted in sand.

[2] 0 = no injury, 10 = dead plants.

no injury, 10 dead plants.

[3] Mean of 4 units of 3 plants each.

*Values significantly different from untreated controls at the 5% probability level.

Table 6. Effects of one and two annual applications of herbicides on the rooting of softwood cuttings from treated azalea hybrids.

		1971[1]		1972[2]			
Herbicide	Rate, a i, lb / A	R Daviesii' Percentage rooted	R 'Tunis' Percentage rooted	R 'Daviesi' Percentage rooted	Rooting score	R 'Tunis' Percentage rooted	Rooting score
Untreated controls		87	89	95	5 7	78	4 9
simazine	1 5	89	83	92	5 6	72	4 6
	3	92	83	82	5 2	73	4 6
trifluralin	2	98	81	92	5 6	86	5 2
	4	82	87	82	5 1	84	5 0
simazine + trifluralin	1 5+2	88	88	92	5 7	58	4 0
DCPA	9	92	85	91	5 6	81	4 9
simazine DCPA	1 5 + 9	91	79	78	4 9	82	5 2
bensulide	8	89	84	—	—	66	4 4
diphenamid	6	90	69	88	5 4	92	5 5
simazine + diphenamid	1 5+6	87	93	—	—	—	—
dichlobenil	4	90	92	98	5 9	92	5 4
pronamide	1 5	94	88	98	5 9	80	5 1
	3	91	88	—	—	—	—
R-7465	3	91	83	76	4 9	85	5 4
	6	—	77	—	—	77	4 9
Average		90	84	89	5 5	79	4 9
Least significant difference P= 05		N S	N S	N S	0 6	N S	N S

N S differences not statistically significant at P= 05

[1]The herbicides were applied on 12-10-70 or 4-5-71 and the softwood cuttings were taken in early June 1971. Rooting data from the fall and spring applications were averaged.

[2]Plants treated with herbicides on 12-10-70 were re-treated 12-13-71 and softwood cuttings were taken in June 1972.

All cuttings were rooted under intermittent mist after dipping in 1%IBA plus 5 percent Captan in 1971 and in 0.7 percent IBA and 10 percent Benlate in 1972.

Table 7. Effects of granular herbicides on control of seeded crabgrass and rooting of softwood cuttings from treated rhododendrons. [1]

Herbicide	Rate, a i, lb/A	No of crabgrass plants per gallon container	'PJM'		'Purple Gem'	
			Percentage rooted	Rooting score	Percentage rooted	Rooting score
Untreated controls		15 0	49	3 5	100	5 9
simazine	1 25	7 9	29	2 6	97	5 9
	2 5	5 9	54	3 7	98	5 9
trifluralin	3	0 1	42	3 1	100	6 0
	6	0 2	50	3 5	100	5 9
DCPA	9	0 8	41	3 2	100	6 0
	18	0 2	20	2 0	95	5 9
diphenamid	6	0 9	48	3 3	100	5 9
	12	0 8	14	1 8	97	5 9
chlorpropham	8	0 1	55	3 7	100	6 0
	16	0 2	57	3 9	98	5 9
R-7465	3	0 5	14	1 9	100	5 8
	6	0 2	25	2 5	100	6 0
oxadiazon	2	1 6	52	3 4	93	5 6
	4	0 9	41	3 1	98	5 9
simazine + trifluralin	1 25+3	0 1	56	3 3	98	5 9
simazine + DCPA	1 25+9	1 1	44	3 2	100	6 0
simazine + alachlor	1 25+4	0 3	45	3 2	100	5 9
	2 5+8	0 1	25	2 2	100	6 0
Average			40	3 0	99	5 9
Least significant difference P = 05			22	1 2	N S	N S

N S = Differences not statistically significant at P= 05

[1]The rhododendrons were planted into gallon containers on 4-20-72 and treated with herbicides 6-12-72. The soil mix was equal volumes of sand and peat.
Crabgrass (Digitara spp.) seeds were sown over 30 of the 54 containers of each cultivar. The cuttings were harvested from 'PJM' 7-26-72 and from 'Purple Gem' 8-8-72. Fifteen cuttings were taken from each of three replicates for treatments and 30 were taken from each replicate for controls The cuttings were dipped in 1% IBA, plus 20% Benlate, plus 30% Manzate, and rooted under intermittent mist. No injury was observed on any of the plants at the time the cuttings were taken

we found no effect of normal rates of simazine on rooting of cuttings. Even where simazine caused visual injury to the plants, rooting of cuttings was not greatly affected. McGuire and Pearson (15) reported that rooting of softwood cuttings of several container-grown plants was markedly inhibited by applications of simazine 30 days before harvesting of cuttings. Cuttings taken 80 days after application were less affected. A greater time between treatment and harvesting of cuttings would allow greater metabolism of simazine in the plant and might lessen its effects Where herbicides were applied 34 days before harvesting cuttings of *Rhododendron* 'PJM', simazine alone had no significant effects on rooting, but a high rate of simazine combined with alachlor reduced rooting percentage and quality (Table 7). From these varied results we can conclude that further investigation is needed, but there is little indication that simazine poses a threat to plant propagation.

Diphenamid, DCPA, and trifluralin have been widely used in woody plants for the preemergence control of annual weeds, particularly annual grasses. Diphenamid is absorbed by plant roots and translocated to shoots (8, 13), but DCPA and trifluralin are more tightly bound by roots and are translocated to a much lesser extent (12, 17, 18). All threee are inhibitors of root growth (3, 13, 21). Visual injury to the foliage of woody plants is seldom observed with these herbicides except at extremely high rates. *Hydrangea acuminata preciosa* is one of the few woody plants on which we have observed foliage injury with DCPA. DCPA and trifluralin are very insoluble in water and are more resistant to leaching in soil than is diphenamid. Resistance to leaching has made DCPA and trifluralin excellent for fall applications in the field (4) and for container applications (3, 5, 6). Twice normal rates of diphenamid, trifluralin, and DCPA have reduced the rooting potential of cuttings in several, but not all, of our experiments. Although combinations of DCPA or trifluralin with simazine applied in two successive seasons may have reduced rooting of deciduous azaleas, the reductions occurred in only one of two cultivars.

The experimental herbicide, R-7465, has proven effective against annual grasses, certain broadleafed weeds, and yellow nutsedge (*Cyperus esculentus* L.) in several of our experiments over a 3 year period. We have seen no injury from R-7465 on any of several species of woody nursery stock in the field or in containers. Nevertheless, R-7465 reduced the rooting quality in cuttings from *Rhododendron* 'Daviesi' in the field and *Rhododendron* 'PJM' in containers. Therefore, further attention should be given to the potential effects of R-7465 on rooting of cuttings.

Although the bulk of our information to date indicates that the herbicides widely used in nurseries pose little threat to plant propagation by cuttings, the occasional reduced rooting obtained largely with excessive dosages reinforces the need for proper application and particular caution in stock plants, especially in leachable soils or soil mixes.

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RALPH SHUGERT: That is some interesting information and, I might add, that there is also a paper on this same subject by John in the September, 1972, issue of *The Plant Propagator.*

Our next speaker will be telling us about the growing of *Betula* in a controlled environment. Dr. Don Krizek has spoken to us before and his paper caused some interesting comment and so we have him back again.