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Evaluation of Herbicides for Phytotoxicity to Rose Plants and Efficacy[1]

Martha P. Gonzalez and John Karlik[2]
University of California Cooperative Extension
1031 S. Mt. Vernon, Bakersfield, CA 93307

Abstract

Roses frequently occur in gardens and landscapes and may require weed management. Herbicide trials were conducted with 10 herbicides applied at label rates to plots containing a hybrid tea rose cultivar. The primary objective was to evaluate injury to rose plants when herbicides were sprayed over-the-top at two stages of growth: bud break and full leaf. A secondary objective was to evaluate the efficacy of the herbicides. The soil residual (pre-emergent) herbicides Devrinol (napropamide), Goal (oxyfluorfen) and the dinitroaniline herbicides Surflan (oryzalin), Treflan (trifluralin) and Prowl (pendimethalin) did not injure roses when applied at bud break. The herbicides Ornamec (fluazifop-p-butyl), Poast (sethoxydim) and Envoy (clethodim), which have post-emergent activity, also did not injure roses when applied to roses at bud break or when applied in late spring when plants had fully developed leaves. Roses oversprayed at bud break with the herbicides Roundup (glyphosate) and Trimec Classic (2,4-D + MCPA + dicamba) did not show phytotoxicity symptoms immediately after application but had significantly shorter shoots beginning six weeks after treatment (WAT). Roses with fully developed leaves which were oversprayed with Roundup and Trimec Classic did show symptoms of injury one WAT and thereafter.

Index words: rose, rosa, rose injury, weed management, landscape herbicides.

Herbicides used in this study: Envoy (clethodim), (E,E)-(±)-2[1[[(3-chloro-2-propenyl)oxy]imino]propyl]-5-[2(ethylthio)propyl]-3-hydroxy-2-cyclohexen-1-one; Devrinol (napropamide), (R,S)-N,N-diethyl-2-(1-naphthylenyloxy)propionamide; Goal (oxyfluorfen), 2-chloro-1-(3-ethoxy-4-nitrophenoxy)-4-(trifluoromethyl)benzene; Ornamec (fluazifop-p-butyl), butyl (R)-2-[4-[[5-trifluoromethyl)-2-pyridinyl]oxy]phenoxy]propanoate; Pennant (metolachlor), 2-chloro-N-(2-ethyl-6-methylphenyl)-N-(2-methoxy-1-methylethyl) acetamide; Prowl (pendimethalin), N-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzenamine; Roundup (glyphosate), N-(phosphonomethyl)glycine; Surflan (oryzalin), 4-(dipropylamino)-3,5-dinitrobenzenesulfonamide; Treflan (trifluralin), 2,6-dinitro-N,N-dipropyl-4-(trifluoromethyl)benzamine; Trimec Classic (2,4-D + MCPA + dicamba), 2,4-dichlorophenoxyacetic acid + (4-chloro-2-methyl)phenoxyacetic acid + 3,6-dichloro-2-methoxybenzoic acid.

Significance to the Nursery Industry

Roses are one of the most popular garden plants in the United States and are also used as floriferous shrubs in landscape plantings. Weed management with herbicides may offer time and cost savings to managers of residential and commercial landscapes and allow roses to be used on an expanded basis in landscape plantings. Several herbicides having pre-emergent activity against weeds did not injure roses when applied at label rates over-the-top, but they were effective in suppressing germinating weeds. Selective herbicides that had post-emergent activity against grasses did not injure roses when applied over-the-top at bud break or when rose leaves were fully developed, but they did control grasses beneath rose plants.

Introduction

Roses have been used in landscape plantings since antiquity (4), and roses are probably the most frequently-occurring woody shrub in residential plantings in the United States. In addition to their use in the garden, the ease of care, color and versatility of roses, especially shrub or landscape types (2), are strong reasons for their use as flowering shrubs in landscape plantings. It is possible to grow roses with a minimum of attention by following a systems approach, including careful attention to variety selection, environmental management, and pest management, including weed management (1, 3). Several weed management methods may be used around roses, including use of mulches, mechanical cultivation, or herbicides, which may be applied over the entire planting or as directed sprays. However, little published information exists on the tolerance of rose plants in landscaped areas to herbicides. Therefore, three experiments were conducted with two objectives. The primary objective was to evaluate injury to rose plants when herbicides were sprayed over-the-top at two stages of growth: bud break and full leaf. A secondary objective was to evaluate the efficacy of the herbicides.

Materials and Methods

On January 13, 1993, grade #1 *Rosa hybrida* 'Summer Dream' hybrid tea roses were planted one plant per 1.2 × 1.5 m (4 × 5 ft) plot in a loam soil at the UC Cooperative Extension experimental field in Bakersfield, CA. Soil was a thermic Typic Torriorthent, a Panoche clay loam with a surface layer typically 0.5 m deep of a loam texture, experimentally determined to be composed of 38, 44, and 18 percent sand, silt and clay, respectively, with a cation exchange capacity of 13.2 milliequivalents per 100 g. All roses had been recently harvested in production fields ca. 30 miles distant and were planted within 48 hr after shipment from cold storage. Any plants that did not appear vigorous two weeks after planting were excluded from the trials. The experimental design was a randomized complete block with four replicated plots per treatment. Soil was fallow when roses were planted. Annual ryegrass (*Lolium multiflorum* Lam.) and common bermudagrass (*Cynodon dactylon* (L.) Pers.) were sown in the plots of the second and third trials, respectively. The generic and trade names of the chemicals evaluated, their for-

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[2]Staff Research Associate and Horticulture Advisor, respectively.

Table 1. Herbicide formulations and rates applied to rose plots.

Herbicide	Rate (kg ai/ha)	Rate (lb ai/acre)
Devrinol 50DF (napropamide)	4.5	4.0
Envoy 0.94EC (clethodim) + COC[z] (second experiment)	0.14	0.13
Envoy 0.94EC (clethodim) + COC[z] (third experiment)	0.28	0.25
Goal 1.6EC (oxyfluorfen)	1.1	1.0
Ornamec 0.5EC (fluazifop-p-butyl) + NIS[y]	0.43	0.38
Pennant 7.8EC (metolachlor)	3.4	3.0
Poast 1.5EC (sethoxydim) + COC[z] (second experiment)	0.45	0.40
Poast 1.5EC (sethoxydim) + COC[z] (third experiment)	0.53	0.47
Prowl 3.3EC (pendimenthalin)	2.2	2.0
Roundup 4S (glyphosate)	1.8	1.6
Surflan 4AS (oryzalin)	2.2	2.0
Treflan 5EC (trifluralin)	2.2	2.0
Trimec Classic 2S + 1S + 0.2S (2, 4-D + MCPA + dicamba)	1.6	1.4

[z]Crop oil concentrate at 7.8 ml/liter (1 oz/gal).

[y]Non-ionic surfactant at 3.4 ml/liter (0.5 oz/gal).

Table 2. Rose injury, mean shoot length and blooms per plant following herbicide application, when applied at bud break.

Herbicide	Rate kg ai/ha	Injury 2 WAT	Mean shoot length (cm) 3 WAT	4 WAT	5 WAT	6 WAT	Mean blooms per plant 12 WAT
Untreated	—	1.3[z]	4.0	10	11	15	0.0
Pennant	3.4	0.8	7.4	13	14	18	0.0
Surflan	2.2	1.0	3.3	7.6	11	13	0.0
Treflan	2.2	0.0	5.1	6.4	10	15	0.0
Prowl	2.2	1.3	5.8	8.4	11	14	0.3
Devrinol	4.5	1.3	3.6	7.9	8.9	14	0.0
Goal	1.1	2.5	3.0	6.1	10	11	0.5
LSD 0.05		NS	NS	NS	NS	NS	NS

[z]Injury was rated on a 0–10 scale, 0 = no injury and 10 = kill, and measurements were made at the indicated week after treatment (WAT).

mulation and rates, are given in Table 1. Visual evaluation of injury to rose plants was made using a 0 to 10 scale (0 = no injury and 10 = complete kill). Weed control was also evaluated visually using the 0–10 scale (0 = no injury and 10 = complete kill).

In the first experiment, applications of soil residual preemergent herbicides at their respective label rates were made February 2, 1993, to roses emerging from dormancy with 0.6 to 1.2 cm (0.25 to 0.5 in) shoots beginning to grow. Applications were made using a CO_2 backpack sprayer under calm conditions with clear skies and a moist soil surface. London rocket (*Sisymbrium irio* L.) was just emerging at the time of treatment. At 2 weeks after treatment (WAT) injury to roses was evaluated. At 3, 4, 5 and 6 WAT, measurements of rose shoot length were made. Visual evaluations of weed control were made at 2, 3, and 4 WAT.

Table 3. Effect of herbicide treatment on control of London Rocket and total weed count in roses.

Treatment	Rate kg ai/ha	London rocket control 2 WAT	3 WAT	4 WAT	Weed count (plants/plot) 12 WAT
Untreated	—	0.0	0.0	0.0	16
Pennant	3.4	0.8	1.5	0.5	2.5
Surflan	2.2	1.0	1.0	0.8	4.5
Treflan	2.2	1.3	1.5	1.0	6.3
Prowl	2.2	2.0	5.5	4.8	2.8
Devrinol	4.5	0.0	0.0	0.0	7.8
Goal	1.1	9.8	9.3	7.3	0.8
LSD 0.05		1.9	1.5	3.0	—

[z]Injury was rated on a 0–10 scale, 0 = no injury and 10 = kill, and measurements were made at the indicated week after treatment (WAT).

In the second experiment, applications of post-emergent herbicides at their respective label rates (Table 1) were made February 2, 1993 to rose plants with 0.6–1.2 cm (0.25 to 0.5 in) shoots. Treatments were made with calibrated spray bottles and rose plants were oversprayed with no attempt to avoid stems or foliage. A dense stand of annual ryegrass (*Lolium perenne* L.) was present which had been mowed to a height of 5 cm (2 in) prior to application. At 1 and 2 WAT, a visual injury evaluation was made and at 3, 4, 5, 6, and 7 WAT measurements of rose shoot length were taken. Ryegrass control was evaluated at 2, 3, 4, 5, and 6 WAT.

In the third experiment, applications of post-emergent herbicides at their respective label rates (Table 1) were made May 25, 1993 with calibrated spray bottles. The rose plants were 60–76 cm (24–30 in) tall and blooming. As in previous trials, the rose plants were not avoided and shoots were sprayed. Established bermudagrass had been mowed May 21. Visual evaluations of rose injury were made at 1, 2, 3, 4 and 11 WAT. Evalutions of bermudagrass control were made 1, 2, 3, and 4 WAT.

Data were analyzed and differences in mean values determined at p = 0.05 for least significant difference (LSD) using Fisher's protected LSD test.

Results and Discussion

In the first experiment with applications of pre-emergent herbicides, no evidence of injury to the roses from any of the herbicides was noted during 6 weeks of evaluations (Table 2). At 2, 3 and 4 weeks after treatment, Goal was most effective in controlling London rocket (Table 3). Prowl showed some post-emergent control of this weed, whereas the other herbicides showed none.

In the second experiment, the selective herbicides active against grasses, Envoy, Ornamec, and Poast, caused no injury to the roses but the broadleaf herbicide Trimec and the non-selective herbicide Roundup were phytotoxic. As seen in Table 4, roses treated with Roundup began displaying shoots significantly shorter than roses treated with Trimec at 6 WAT. However, injury was minimal, probably because the roses had not completely emerged from dormancy when treatments were made. As would be expected, Roundup effectively controlled annual ryegrass (Table 5). Of the selective grass herbicides, Poast and Envoy appeared to have greater efficacy against annual ryegrass than did Ornamec.

In the third experiment, the same herbicides used in the second trial were evaluated, but in this trial roses were in full leaf at the time of application. As seen in Table 6, Trimec and Roundup caused injury to shoots within 1 week of application. While injury from Trimec was initially worse than

Table 4. Rose injury, mean shoot length and blooms per plant following herbicide application, when applied at bud break.

Treatment	Rate kg ai/ha	Injury		Mean shoot length (cm)					Mean blooms per plant	
		1 WAT	2 WAT	3 WAT	4 WAT	5 WAT	6 WAT	7 WAT	10 WAT	12 WAT
Untreated	—	0.3[z]	0.0	3.6	6.1	9.7	11	17	0.0	0.0
Ornamec + NIS	0.43	1.3	0.5	2.8	4.8	8.4	15	16	1.0	1.0
Poast + COC	0.45	1.0	2.0	2.5	4.1	8.4	14	20	0.8	0.8
Envoy + COC	0.14	0.8	0.8	2.0	4.6	7.6	12	14	0.8	0.8
Roundup	1.8	0.5	1.3	2.5	4.6	4.8	6.4	8.4	1.5	1.5
Trimec Classic	1.6	1.3	2.8	2.0	3.0	2.5	2.8	1.5	0.0	0.0
LSD 0.05		NS	NS	NS	NS	NS	7.6	10	NS	NS

[z]Injury was rated on a 0–10 scale, 0 = no injury and 10 = kill, and measurements were made at the indicated week after treatment (WAT).

Table 5. Effect of herbicide treatment on ryegrass growth.

Treatment	Rate kg ai/ha	Ryegrass growth				
		2 WAT	3 WAT	4 WAT	5 WAT	6 WAT
Untreated	—	0.0[z]	0.0	0.0	0.0	0.0
Ornamec + NIS	0.43	3.5	5.0	5.0	5.8	6.0
Poast + COC	0.45	4.3	6.8	6.5	8.3	7.8
Select + COC	0.14	4.3	7.8	6.5	7.5	7.5
Roundup	1.8	4.8	7.3	7.8	7.8	6.5
Trimec Classic	1.6	0.0	0.0	0.0	0.0	0.0
LSD 0.05		0.8	0.7	0.9	1.1	1.3

[z]Injury was rated on a 0–10 scale, 0 = no injury and 10 = kill, and measurements were made at the indicated week after treatment (WAT).

Table 6. Rose injury following application of herbicides over plants at full leaf.

Treatment	Rate kg ai/ha	Rose injury				
		1 WAT	2 WAT	3 WAT	4 WAT	11 WAT
Untreated	—	0.0[z]	0.0	0.0	0.0	0.6
Ornamec + NIS	0.43	0.0	0.0	0.0	0.0	0.0
Poast + COC	0.53	0.0	0.0	0.0	0.0	0.0
Envoy + COC	0.28	0.2	0.0	0.0	0.0	0.0
Roundup 4S	1.8	4.8	4.6	4.4	4.6	5.0
Trimec Classic	1.6	6.2	6.8	7.6	7.4	4.8
LSD 0.05		0.8	0.5	0.7	0.7	1.8

[z]Injury was rated on a 0–10 scale, 0 = no injury and 10 = kill, and measurements were made at the indicated week after treatment (WAT).

Table 7. Control of bermudagrass following herbicide application.

Treatment	Rate kg ai/ha	Bermudagrass injury			
		1 WAT	2 WAT	3 WAT	4 WAT
Untreated	—	0.0[z]	0.0	0.0	0.0
Ornamec + NIS	0.43	3.2	7.8	8.2	8.6
Poast + COC	0.53	4.0	8.4	8.2	8.6
Envoy + COC	0.28	3.0	7.6	7.8	8.6
Roundup 4S	1.8	8.0	8.4	8.8	9.0
Trimec Classic	1.6	0.0	0.0	0.0	0.0
LSD 0.05		0.6	0.6	0.6	0.5

[z]Injury was rated on a 0–10 scale, 0 = no injury and 10 = kill, and measurements were made at the indicated week after treatment (WAT).

that from Roundup, plants seemed to recover about 11 weeks after Trimec treatment, whereas injury from Roundup persisted throughout the season. Roundup and the selective grass herbicides Envoy, Ornamec, and Poast adequately controlled bermudagrass, as seen in Table 7. Trimec was not evaluated for bermudagrass control.

Results from the second and third experiments showed that roses oversprayed with Roundup when dormant were able to recover from injury more easily than when treated at full leaf. Green rose stems as well as leaves can absorb this herbicide, to the detriment of the plant. The effects of Roundup may be delayed due to the time of application and corresponding plant metabolic activity. For example, injury has been observed in spring in rose production fields from Roundup application the previous autumn.

Conclusion

Data from these experiments encourage the use of certain selective herbicides for managing weeds in rose plantings, as labels permit. The tolerance of roses to several common herbicides also indirectly encourages the use of roses on a broader scale in landscape plantings.

These results indicate the utility and safety of certain soil residual pre-emergent herbicides for weed management around roses in landscaped areas. The pre-emergent herbicides Devrinol, Goal, and the dinitroaniline herbicides Surflan, Treflan and Prowl did not injure roses when applied at bud break at label rates. Of these, Surflan and Prowl have been used successfully in rose plant production in California, and may possess greater margins of safety to rose plants than the other pre-emergent herbicides evaluated in these experiments.

The post-emergent herbicides Ornamec, Poast, and Envoy also did not injure roses when applied to roses at bud break or when applied in late spring when plants had fully developed leaves. The data suggest these herbicides could be used safely in rose plantings as directed sprays to suppress encroaching grasses.

Roses oversprayed at bud break with Roundup or Trimec Classic did not show phytotoxicity symptoms immediately after application but had significantly shorter shoots beginning six WAT. Roses with fully developed leaves which were oversprayed with Roundup and Trimec Classic showed injury symptoms beginning one WAT and thereafter. Roundup and Trimec Classic should not be used around rose plantings and care should be taken to avoid contact with rose foliage or stems if these latter two herbicides are used in adjacent landscaped areas.

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