Comparison of Ronstar Formulations for Efficacy and Phytotoxicity in Container Grown Landscape Plants[1]

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Abstract

Three formulations of Ronstar [oxadiazon-2-tert-butyl-4-(2,4-dichloro-5-isopropoxyphenyl)-[2]-1,3,4-oxadiazolin-5 one], were evaluated for control of 3 weed species and injury to 3 woody landscape plants over 90 days. Wettable powder (WP) 50%, 2% granular and 0.24 kg/L (2 lb/gal) emulsifiable concentrate (EC) were evaluated at 3 rates, 2.2, 4.5 and 9.0 kg/ha (2,4 and 8 lb/A). The WP formulation was generally more effective than the G formulation for control of goosegrass [*Eleusine indica* (L.) Gaert] and Pennsylvania smartweed (*Polygonum pensylvanicum* L.). Ronstar at the 4.5 kg/ha (4 lb/A) rate of WP and EC formulations provided excellent control of goosegrass and Pennsylvania smartweed. Prostrate spurge (*Euphorbia humistrata* Eagelm. ex gray) was controlled only by the 9.0 kg/ha (8 lb/A) rate of all 3 formulations.
Pronounced injury to Compact Japanese Holly (*Ilex crenata* Thumb. '*Compacta*') and 'Hershey Red' Azalea *Rhododendron obtusum* was evident at 14 and 30 days after treatment with the WP and EC formulations. Ninety days after treatment the species were marketable plants. Evergreen euonymus (*Euonymus japonica*) was not injured with any formulation or rate of Ronstar.

Index words: Euronymus, Ilex, Rhododendron, oxadiazon, holly, azalea, weed control

Introduction

Weeds cause significant losses in the production of container grown landscape plants by competing for light, water, and nutrients with additional losses attributable to control costs (4,5). Ronstar is labeled for control of weeds in turf and landscape plants with acceptable crop tolerance due to its low water solubility, strong affinity for organic matter, and negligible leaching. The granular (G) formulation is commercially available, but the WP formulation is currently under development for use in landscape plants. The emulsifiable concentrate (EC) formulation at 9.0 kg/ha (8 lb/A) provided excellent control of broadleaf weeds and grasses with little injury to holly and azalea (6). The WP formulation at 2.2 and 4.5 kg/ha (2 and 4 lb/A) caused no injury to container-grown eastern white pine or California pivet (1). Tolerance of numerous species has been observed in nurseries with the G formulation at various rates (2,3,7). Ronstar injury is expressed as small purple spots or necrosis of terminals. With the G formulation, injury occurs more often when granules remain on foliage or in leaf bases (7,9). Ronstar at 2.2 kg/ha (2 lb/A) has provided effective control

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of many broadleaf weeds for 60 days after treatment (DAT) (8,10).

Bittercress (*Cardamine* spp. L.), common chickweed [*Stellaria media* (L.) vill.] and prostrate spurge are tolerant to the G formulation of Ronstar at the labeled rates (3,7,8).

Herbicide formulations may affect weed and crop response. Goal (oxyfluorfen-[2-chloro-1-(3-ethoxy-4-nitrophenoxy0-4-(trifluro-methyl) benzene] EC and G formulations provided superior control of morningglory, [(*Ipomoea hederacea* (L) Jacq.] prickly sida (*sida spinosa* L.) and ryegrass (*Lolium perenne L.*) but were more injurious to euonymus and juniper than the WP (11).

Methods and Materials

Two experiments were conducted at Clemson University, Clemson, South Carolina in the summer of 1985 to evaluate container-grown landscape plants and weed response to 3 Ronstar formulations. Plots consisted of 9 containers, 3 species with 3 plants per species, and were arranged in a randomized complete block design with 4 replications.

Uniform liners of evergreen euonymus, compact Japanese holly and 'Hershey Red' azalea were established 2 months prior to treatment in 2.8 l (1 gal) containers. A commercial soilless medium of 3 parts pine bark:1 part peat (by vol) amended with starter fertilizers, dolomitic lime, and sand was used. Medium pH was 6.6. Each container received 17.0 g of 17 N-3.01 P-8.3 K (17-7-10) following planting. With the exception of weed-free checks, containers were seeded with 1.6 g (0.05 oz) of a mixture of goosegrass, prostrate spurge and Pennsylvania smartweed seed.

All Ronstar treatments were applied preemergence to weed species at 2.2, 4.5 and 9.0 kg ai/ha (2,4 and 8 lb ai/A). The G herbicide was applied as premeasured packets to each container. WP and EC treatments were applied with a CO_2-pressurized back-pack sprayer calibrated to deliver 187 l/ha(20 gpa) with a 11002 Tee jet nozzle tip. Containers received overhead irrigation immediately after herbicide application and subsequently 1.5 cm (3.8 in) daily.

Weed control was evaluated at 30, 60, 90 DAT based on a scale of 0 = no control to 100 = complete control. Seventy percent (70%) or better weed control was considered acceptable in this study. Crop injury was evaluated at 14, 30, 60, and 90 DAT based on a scale 0 = no injury to 100 = complete kill. Weed-free checks were used for crop injury comparisons and nontreated-weedy checks were used for weed control comparisons. Visual injury to root balls were evaluated and shoot and root fresh weights were recorded 90 DAT. Above ground weed biomass was harvested at 90 DAT by species, oven dried at 40°C (105°F) and weights recorded.

Data were subjected to analyses of variance with mean separation by least significant difference (LSD) at P = 0.05. Rate by formulation interactions are discussed when significant. Results from both experiments were similar, therefore, for brevity only the data from the first experiment will be presented.

Results and Discussion

Weed control. Superior goosegrass and prostrate spurge control (>93%) was obtained with WP and EC formulations at 30 and 60 DAT (Table 1). The WP Formulation was also more effective than the granular formulation for Pennsylvania smartweed control at 60 DAT. Of the weed species evaluated, prostrate spurge was the most difficult to control (Table 1 and 2). Acceptable goosegrass control (>79%) was obtained at 30 and 60 DAT at all rates (Table 1) regardless of formulation. Prostrate spurge and Pennsylvania smartweed required at least 4.5 kg/ha (4 lb/A) to maintain effective control (>78%) at 60 DAT.

Significant rate by formulation interactions were detected for goosegrass and Pennsylvania smartweed evaluations at 90 DAT (Table 2). Superior control (>94%) was observed for the 2.2 and 4.5 kg/ha (2 and 4 lb/A) rates of WP and EC compared to the G formulation. The highest rate of all formulations provided excellent goosegrass and Pennsylvania smartweed control (>89%). At 90 DAT prostrate spurge control was >71% with the 9 kg/ha (8 lb/A) in the concurrence with a previous report (7).

Crop injury. Phytotoxicity to azalea and holly was initially pronounced and greater with WP and EC treatments (Table 3). Euonymus was not affected by rate or formulation (data not shown). A rate by formulation interaction occurred for the 14 and 30 DAT evaluations in azalea and holly. Higher rates (4.5 and 9.0 kg/ha – 4 and 8 lb/A) of EC and

Table 1. Goosegrass, prostrate spurge, and Pennsylvania smartweed control[z] averaged over Ronstar formulations and rates for 30 and 60 days after treatment (DAT).

		Weed control (%)					
		Goosegrass		Prostrate spurge		Penn. smartweed	
Formulations		**30DAT**	**60DAT**	**30DAT**	**60DAT**	**30DAT**	**60DAT**
G		86b	81b	73b	61b	84a	71b
EC		98a	93ab	88a	79a	94a	79ab
WP		99a	99a	93a	83a	95a	88a
Rate							
(kg/ha)	**(lb/A)**						
2.2	2	88b	79b	65b	50c	77b	54c
4.5	4	96a	94a	90a	78b	96a	84b
9.0	8	99a	100a	99a	97a	100a	99a
rate × form.		*	NS	NS	NS	NS	NS

[z]Control was evaluated using a pretransformed 0 to 100 rating scale where 0 represents no control and 100 indicates 100%

[y]means within columns separated by LSD at 0.05.

ns = nonsignificant, * significant at 0.05, resp.

Table 2. Weed control[z] and weed weights[y] as influenced by Ronstar rate and formulation at 90 days after treatment.

Formulation	Rate		Goosegrass		Pennsylvania smartweed		Prostrate spurge	
			Control %	wt. (g)	Control %	wt. (g)	Control %	wt. (g)
	kg/ha	*lb/A*						
G	2.2	2	20	56	20	34	26	23
	4.5	4	74	8	53	27	30	20
	9.0	8	100	0	89	2	71	7
WP	2.2	2	94	2	56	22	35	21
	4.5	4	100	0	86	1	64	5
	9.0	8	100	0	100	0	96	1
EC	2.2	2	81	7	18	56	20	18
	4.5	4	100	0	89	2	65	6
	9.0	8	100	0	100	0	81	2
LSD = 0.05			17	17	27	NS	NS	NS
rate × formulation			**	**	*	NS	NS	NS
weedy check			0	175	0	207	0	5

[z]Control was evaluated using a pretransformed 0 to 100 rating scale where 0 represents no control and 100 indicates 100%.

[y]dry weed weights in g per 3 pots.

ns = nonsignificant, *, ** significant at 0.05 and 0.01, resp.

Table 3. Effect of Ronstar rate by formulation on azalea and Holly injury[z] 14, 30, and 60 days after treatment (DAT).

Formulation	Rate		Azalea			Holly		
			14DAT	30DAT	60DAT	14DAT	30DAT	60DAT
	kg/ha	*lb/A*						
G	2.2	2	12	13	0	6	13	0
	4.5	4	12	11	14	4	8	1
	9.0	8	3	10	3	3	15	1
WP	2.2	2	11	18	1	11	23	0
	4.5	4	28	36	3	14	33	6
	9.0	8	62	61	8	23	36	6
EC	2.2	2	18	21	1	5	21	4
	4.5	4	40	41	3	19	43	5
	9.0	8	58	55	6	38	48	6
LSD = 0.05			19	15	4	10	11	4
rate = formulation			*	**	NS	NS	NS	NS

[z]injury on a scale of 0 = no injury, 100 = complete crop kill

ns = nonsignificant, *, ** significant at 0.05 and 0.01, resp.

WP formulations were more injurious than the same rate of the G formulation. Plant recovery from WP and EC injury was evident at 60 DAT with little visible injury to either species. Injury symptoms on azalea were rapid (7 days) foliage bronzing and leaf curl. Initial injury to holly terminals was slight, but at 30 DAT significant dieback was observed.

Lowest shoot weights for all species were obtained from the weedy checks and granular 2.2 kg/ha (2 lb/A) treatments (Table 4). Generally, the largest plants were produced in containers treated with formulations providing the best weed control and in the weed-free treatments. Early foliage injury of holly and azalea from WP formulations was not reflected in root and shoot weights. With all 3 landscape plants there were no differences in growth at 4.5 kg/ha (4 lb/A) and 9.0 kg/ha (8.0 lb/A) rates of the WP formulation when compared to the weed-free checks. The 9.0 kg/ha (8 lb/A) rate of EC suppressed the shoot growth of azalea and shoot and root growth of euonymous.

Significance to the Nursery Industry

Weed control efficacy and phytotoxicity to Ronstar changes with formulation. Injury at early evaluations was crop and formulation specific, but plant recovery was evident by 60 days. If initial injury can be tolerated by the grower, the WP and EC treatments provided better residual control of goosegrass and Pennsylvania smartweed than G. For persistent weeds such as prostrate spurge, a subsequent application of Ronstar 60 days after the initial treatment and/or higher rates [9.0 kg/ha (8 lb/A)] may be necessary for control.

Our research indicates the WP formulation does improve control of prostrate spurge and goosegrass over the G formulation for 2 months after application. Injury to holly and azalea was also observed, but plants recovered within 60 days. The WP formulation may be useful for field grown landscape plants where slight injury could be tolerated for a more economical herbicide formulation.

Table 4. Effect of Ronstar rates and formulations on fresh weights and root injury of azalea, holly and euonymus.

Formulation	Rate		Azalea			Holly			Euonymus		
			Shoot wt (g)	Root wt (g)	Root injury[z] index	Shoot wt (g)	Root wt (g)	Root injury[z] index	Shoot wt (g)	Root wt (g)	Root injury[z] index
	kg/ha	*lb/A*									
G	2.2	2	15.8	77.8	1.9	22.0	30.3	2.9	20.8	14.0	2.6
	4.5	4	25.3	114.3	1.1	30.8	46.8	1.8	27.3	29.8	1.4
	9.0	8	23.0	84.8	2.0	30.8	52.3	1.4	42.3	32.3	1.3
WP	2.2	2	18.8	93.8	1.6	31.0	47.3	1.5	31.3	18.3	1.8
	4.5	4	23.5	95.8	1.6	31.8	51.0	1.1	37.5	30.3	1.0
	9.0	8	24.0	79.8	1.5	31.7	51.0	1.1	37.5	30.3	1.0
EC	2.2	2	24.8	72.0	1.1	32.5	43.8	1.5	33.3	27.0	1.4
	4.5	4	27.3	82.0	1.8	33.3	61.5	1.5	42.0	31.3	1.3
	9.0	8	18.8	69.3	2.1	31.3	48.3	1.8	26.8	19.0	2.6
weed-free ck.			31.0	107.0	1.0	33.0	62.0	1.0	39.0	36.0	1.0
weedy ck.			15.3	54.3	2.9	19.3	16.5	3.0	15.3	12.0	2.9
LSD = 0.05			7.7	NS	NS	8.4	19.8	0.9	10.8	12.8	0.8

[z]root injury ratings on a scale of 1 = no injury, 5 = no roots present.

(*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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