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Weed Control in Container-Grown Crops with Herbicide-Coated Fertilizers[1]

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Abstract

Nursery Special 12N–2.6P–5.0K (12–6–6), Osmocote 17N–3.1P–10.0K (17–7–12), and Polyon 24N–1.7P–10.0K (24–4–12) were coated with Ronstar 50WP (oxadiazon) at 4 concentrations and compared to spray applied Ronstar 50WP and broadcast Ronstar 2G. With Osmocote and Nursery Special-coated fertilizers, the lowest Ronstar rate resulted in less weed control than traditional herbicide application methods. Ronstar-coated fertilizers applied at the recommended rate or higher provided similar weed control to broadcast- and spray-applied pre-emergence herbicides.

Index words: herbicide application, non-target herbicide loss, controlled release fertilizers.

Herbicide 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}.

Weed species evaluated in this study: prostrate spurge (*Chamaesyce maculata* (L.) Small), large crabgrass (*Digitaria sanguinalis* (L.) Scop).

Significance to the Nursery Industry

Non-target herbicide loss is a concern to the nursery industry due to potential contamination of runoff water. Previous research demonstrated the potential of Nursery Special fertilizer coated with Ronstar 50WP (oxadiazon) to provide weed control in container-grown plants. These data show that other controlled release fertilizers can be coated with Ronstar 50WP at the manufacturer's recommended rate and provide weed control similar to standard broadcast applications. Among the fertilizers coated with Ronstar, Polyon consistently provided superior weed control compared to Osmocote.

Introduction

Weed control is essential in producing quality container-grown landscape plants. Standard weed control methods include broadcast or spray application of pre-emergence herbicides over container-grown plants. However, previous work has shown that with broadcast herbicide applications non-target herbicide losses may range up to 86% depending on container spacing and plant growth habit (4, 11). Non-target herbicide losses are a primary contributor to herbicides in runoff water from container-grown nurseries (9, 10).

Numerous techniques have been evaluated to reduce or eliminate chemical losses in container production, including the use of slow release herbicide tablets (6, 7, 12), geotextile disks (1), and geotextile disks containing a slow release formulation of trifluralin (1). In previous research (3), Ronstar-coated and -blended Nursery Special 12N–2.6P–5.0K (12–6–6) provided effective control of prostrate spurge at 4.5, 9.0, and 18.0 kg ai/ha (4, 8, and 16 lb ai/A) in container-grown *Gardenia augusta* 'August Beauty'. Weed control was similar to to that obtained with standard application methods (sprayed or broadcast at 4.5 kg ai/ha (4 lb ai/A)) with substantially less herbicide applied since direct application to individual containers eliminated nontarget herbicide loss.

Because container nurseries top-dress plants with different controlled-release fertilizers, we wanted to evaluate several fertilizers to determine if fertilizer carrier affected herbicide activity. The objective of this study was to compare Ronstar 50WP coated on three fertilizer carriers to Ronstar applied by standard methods for control of prostrate spurge and crabgrass.

Materials and Methods

Containers, 2.8 liter (#1) (Classic 300S, Nursery Supplies, Fairless Hills, PA), were filled with a pine bark:sand medium (6:1 by vol), amended with 3.0 kg/m^3 (5.0 lb/yd^3) of dolomitic lime and 0.9 kg/m^3 (1.5 lb/yd^3) of Micromax (Scotts Co., Marysville, OH) on April 14, 1994. Containers were placed in a double layer polyethylene greenhouse and hand watered as needed. Supplemental lighting from 100-watt bulbs 0.9 m (3 ft) apart and 0.6 m (2 ft) above the containers was provided from 4 PM to 9 PM daily. Ronstar 50WP herbicide-coated fertilizer treatments were prepared as previously described (3) with Nursery Special 12N–2.6P–5K (12–6–6) (Pursell Industries, Sylacauga, AL), Polyon 24N–1.7P–10K (24–4–12) (Pursell Industries), and Osmocote 17N–3.1P–10K (17–7–12) (Scotts Co.). Calculations were based on the surface area of a 2.8-liter (#1) container receiving 6.5 g (0.23 oz) of Nursery Special or 20.0 g (0.7 oz) of either Osmocote or Polyon fertilizer (manufacturer's recommended topdress rates). Ronstar 50WP was coated onto the fertilizer at different concentrations so that applying either 6.5 g (0.23 oz) of Nursery Special or 20 g (0.7 oz) of Osmocote or Polyon to a container resulted in the simultaneous application of Ronstar at 2.3, 4.5, 9.0, and 18.0 kg ai/ha (2, 4, 8, and 16 lb ai/A). Fertilizer-herbicide combinations were spread evenly over the container surface by hand on May 5, 1994. A non-

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treated control and a Ronstar 50WP sprayed treatment applied at the manufacturer's recommended rate of 4.5 kg ai/ha (4 lb ai/A) were included for comparison.

One week after applying treatments, one-half of the containers receiving each treatment were over-seeded with 10 seeds/container of either prostrate spurge (*Chamaesyce maculata* (L.) Small) or large seeded crabgrass (*Digitaria sanguinalis* (L.) Scop.). Spurge or crabgrass seedlings were counted 30 days after treatment (DAT). At 60 DAT, weeds were pulled and counted, and fresh and dry weights determined.

The experiment was repeated in March, 1995 with the following changes. A broadcast application of Ronstar 2G at 4.5 kg ai/ha (4 lb ai/A) was added as an additional control. Nontreated controls received either 6.5 g (0.23 oz) of Nursery Special or 20 g (0.71 oz) of Osmocote or Polyon (not coated with herbicide). Ronstar 50WP (sprayed) and Ronstar 2G (broadcast) were applied as standard treatments at the manufacturer's recommended rate of 4.5 kg ai/ha (4 lb ai/A). Each container was over-seeded with 30 prostrate spurge seeds one week after treatment.

Treatments in each experiment were arranged in a completely randomized design with 10 single container replications within a weed species. Data were subjected to an analysis of variance (ANOVA). Dunnett's T-test (P = 0.05) was used to compare herbicide-fertilizer combinations to control and standard treatments. Herbicide rate response was determined by regression analysis, and orthogonal contrasts were used to compare among fertilizers.

Results and Discussion

Spurge control. Due to similar results at 30 and 60 DAT, only the 60 DAT data is presented. In both experiments, spurge number decreased linearly as the concentration of Ronstar on the coated Osmocote increased (Table 1). Ronstar-coated Osmocote rates of 4.5 to 18.0 kg ai/ha (4 to 16 lb ai/A) provided similar spurge control to the spray applied control in experiment 1. In experiment 2 where the weed pressure was greater (30 seeds per container), only the two higher rates provided similar control to the spray- or broadcast-applied control.

Table 1. Effects of Ronstar 50WP (oxadiazon)-coated fertilizers on prostrate spurge number per container 60 DAT, experiments 1 and 2.

Treatment	Rate (kg ai/ha) 0	2.3	4.5	9.0	18.0	Sign.[z]	Mean[y]
			Experiment 1				
Osmocote (O)[x]	4.7*[w]	1.6*	1.2	0.6	0.2	L	0.9
O Sprayed[v]	—	—	0.0	—	—	—	
Polyon (P)[x]	4.1*	0.6	0.3	0.1	0.1	NS	0.3
P Sprayed[v]	—	—	0.0	—	—	—	
Nursery Special (N)[x]	4.9*	1.8*	1.6*	1.2	0.6	L	1.3
N Sprayed[v]	—	—	0.1	—	—	—	
Contrasts:							
O vs. P *[u]							
P vs. N **							
O vs. N NS							
			Experiment 2				
Osmocote (O)	5.6*•	4.3*	3.2*	1.2	0.0	L	2.2
Sprayed	—	—	0.0	—	—	—	
O Broadcast	—	—	0.6	—	—	—	
Polyon (P)	3.9*•	0.4	0.0	0.0	0.0	L,Q	0.1
P Sprayed	—	—	0.0	—	—	—	
Broadcast	—	—	0.0	—	—	—	
Nursery Special (N)	5.4*•	2.4*	0.3	2.5*	0.0	L	1.3
N Sprayed	—	—	0.0	—	—	—	
Broadcast	—	—	0.8	—	—	—	
Contrasts:							
O vs. P **							
P vs. N **							
O vs. N **							

[z]L, Q, and NS represent linear, quadratic, and nonsignificant response, respectively at the 5% level.

[y]Mean of respective fertilizer across rate, 0 rate not included.

[x]Fertilizer coated with Ronstar 50WP (oxadiazon) at the specified rate.

[w]Means followed by an asterisk (*) or by a diamond (•) are significantly different from the Ronstar 50WP spray applied or 2G broadcast applied control, respectively, based on Dunnett's T-test, 5% level.

[v]Containers sprayed with Ronstar 50WP (oxadiazon) and top-dressed with the corresponding fertilizer.

[u]*, **, NS represent significance at the 5% or 1% level, and nonsignificant, respectively.

Table 2. Effects of Ronstar 50WP (oxadiazon)-coated fertilizers on large crabgrass numbers per container, experiment 1.

Treatment	Rate (kg ai/ha) 0	2.3	4.5	9.0	18.0	Sign.[z]	Mean[y]
	30 days after treatment (DAT)						
Osmocote (O)[x]	1.3*[w]	2.3*	0.0	0.0	0.0	L,Q	0.6
O Sprayed[v]	—	—	0.0	—	—	—	
Polyon (P)[x]	1.3*	0.1	0.0	0.0	0.0	NS	0.0
P Sprayed[v]	—	—	0.0	—	—	—	
Nursery Special (N)[x]	1.3*	0.6	0.0	0.0	0.0	Q	0.2
N Sprayed[v]	—	—	0.0	—	—	—	
Contrasts:							
O vs. P **[u]							
P vs. N NS							
O vs. N **							
	60 DAT						
Osmocote (O)	1.1*	1.9*	0.0	0.0	0.1	L,Q	0.5
O Sprayed	—	—	0.1	—	—	—	
Polyon (P)	1.1*	0.0	0.0	0.0	0.0	NS	0.0
P Sprayed	—	—	0.0	—	—	—	
Nursery Special (N)	1.1*	0.8*	0.0	0.0	0.3	Q	0.3
N Sprayed	—	—	0.0	—	—	—	
Contrasts:							
O vs. P **							
P vs. N *							
O vs. N NS							

[z]L, Q, and NS represent linear, quadratic, and nonsignificant, respectively at the 5% level.

[y]Mean of respective fertilizer across rate, 0 rate not included.

[x]Fertilizer coated with Ronstar 50WP (oxadiazon) at the specified rate.

[w]Means followed by an asterisk (*) are significantly different from the respective fertilizer spray applied control based on Dunnett's T-test, 5% level.

[v]Containers sprayed with Ronstar 50WP (oxadiazon) and top-dressed with the corresponding fertilizer.

[u]*, **, NS represent significant at the 5% or 1% level, or nonsignificant, respectively.

Ronstar-coated Polyon provided excellent spurge control at all rates in both experiments. For example, at the lowest herbicide rate, spurge numbers per container were 0.6 and 0.4 in the two experiments. When comparing the fertilizer carriers, spurge control was superior with Polyon in both experiments.

With Ronstar-coated Nursery Special, spurge number decreased linearly in both experiments as the Ronstar rate increased. Spurge control with 2.3 and 4.5 kg ai/ha (2 and 4 lb ai/A) rates of Ronstar-coated Nursery Special was less than with the spray applied control in experiment 1. Although the 9.0 and 18.0 kg ai/ha (8 and 16 lb ai/A) treatments had 1.2 and 0.6 spurge per container, respectively, both were similar to the Ronstar 50WP spray applied control. In experiment 2, only the 4.5 and 18.0 kg ai/ha treatments provided similar control to the spray and broadcast applied treatments.

While there was no difference in weed number between the sprayed and broadcast Ronstar formulations in experiment 2, there was a trend for the Ronstar 2G treatment to have more spurge per container. This trend concurs with Kalmowitz and Whitwell (8) who compared wettable powder (WP), emulsifiable concentrate (EC), and granular (G) Ronstar formulations and reported the WP formulation provided better prostrate spurge control than the G formulation two months after application.

Crabgrass control. Germination of crabgrass was low compared to spurge. With Ronstar coated-Osmocote and -Nursery Special treatments all herbicide rates, except 2.3 kg ai/ha (2 lb ai/A), provided almost total crabgrass control at both 30 and 60 DAT (Table 2). Ronstar has been reported to be effective in controlling many weed species including large seeded crabgrass (2, 5). Fresh and dry weed weights of both crabgrass and spurge followed similar trends to weed numbers (data not shown).

When comparing fertilizer carriers, Polyon generally provided superior crabgrass control, possibly due to herbicide adhesion or sorption on the fertilizer coating, which may affect herbicide release onto the medium surface after the first irrigation. Other possibilities include oxadiazon binding to the resin coating thus interfering with oxadiazon activity. While the mechanism is unclear, oxadiazon coated-Polyon did provide better weed control in the two studies than herbicide-coated Osmocote or Nursery Special.

These data indicate Ronstar 50WP-coated controlled-release fertilizers can provide effective weed control in nurs-

ery container production. Coated Polyon provided better weed control than coated Osmocote or Nursery Special. Previous research (3) showed that rates higher than the recommended rate [(4.5 kg ai/ha) (4.0 lb ai/A)] may be necessary to achieve satisfactory weed control when Ronstar herbicide was coated onto Nursery Special ferilizer, while in the current study similar weed control was obtained with the 4.5 kg ai/ha (4.0 lb ai/A) rate coated onto a fertilizer carrier. Even if higher than recommended rates are needed with herbicide coated-fertilizer, less total herbicide would be applied than with a traditional broadcast application on a per unit surface area because of application to individual containers. Herbicide-coated fertilizers should be considered as an alternative to the standard spray or broadcast application of pre-emergence herbicides to reduce potential pesticide movement in critical areas where zero pesticide levels must be maintained in run-off water.

Literature Cited

1. Appleton,B.L. and J.F. Derr. 1990. Use of geotextile disks for container weed control. HortScience 25:666–668.

2. Creager, R.A. 1982. Evaluation of oxadiazon and oxyfluorfen for weed control in container-grown ornamentals. HortScience 17:40–42.

3. Crossan, C.K., C.H. Gilliam, G.J. Keever, D.J. Eakes, G.R. Wehjte, and W.A. Dozier, Jr. 1996. Weed control with herbicide-coated or -blended fertilizers in 'August Beauty' gardenia. J. Environ. Hort. 14:5–8.

4. Gilliam, C.H., D.C. Fare, and A. Beasley. 1992. Nontarget herbicide losses from application of granular Ronstar to container nurseries. J. Environ. Hort. 10:175–176.

5. Glaze, N.C., M. Singh, and S.C.Phatak. 1987. Ornamental response to two methods of oxadiazon application. HortScience 22:265–268.

6. Gorski, S.F. 1993. Slow-release delivery system for herbicides in container-grown stock. Weed Tech. 7:894–899.

7. Gorski, S.F., S. Reiners, and M.A. Ruizzo. 1989. Release rate of three herbicides from controlled-release tablets. Weed Tech. 3:349–352.

8. Kalmowitz, K. and T. Whitwell. 1988. Comparison of Ronstar formulations for efficacy and phytotoxicity in container grown landscape plants. J. Environ. Hort. 6:77–80.

9. Keese, R.J., N.D. Camper, T. Whitwell, M.B. Riley, and P.C. Wilson. 1994. Herbicide runoff from ornamental container nurseries. J. Environ. Qual. 23:320–324.

10. Mahnken, G.E., W.A. Skroch, T.J. Sheets, and R.B. Leidy. 1994. Metolachlor and simazine leaching through horticultural substrates. J. Environ. Hort. 12:55–58.

11. Porter, W.C. and R.L. Parish. 1993. Nontarget losses of granular herbicide applied to container-grown landscape plants. J. Environ. Hort. 11:143–146.

12. Ruizzo, M.A., E.M. Smith, and S.F. Gorski. 1983. Evaluation of herbicides in slow release formulation for container-grown landscape crops. J. Amer. Soc. Hort. Sci. 108:551–553.