HRI's Mission:

To direct, fund, promote and communicate horticultural research, which increases the quality and value of ornamental plants, improves the productivity and profitability of the nursery and landscape industry, and protects and enhances the environment.

Weed Control With Herbicide-Coated or -Blended Fertilizer in 'August Beauty' Gardenia[1]

C.K. Crossan[2], C.H. Gilliam[3], D.J. Eakes[4], G.J. Keever[3], G.R. Wehtje[5], and W.A. Dozier, Jr.[3]
Department of Horticulture
Auburn University, AL 36849

Abstract

Prostrate spurge (*Euphorbia maculata* L.) control and injury to container-grown 'August Beauty' gardenia (*Gardenia jasminoides* Ellis) were evaluated using Ronstar 50WP (oxadiazon) or Pennant 7.8E (metolachlor)-coated or Ronstar 2G (oxadiazon) or Pennant 5G (metolachlor)-blended Nursery Special 12N–2.6P–5.0K (12–6–6) fertilizer. Herbicides were applied at 4 rates, 2.3, 4.5, 9.0, and 18.0 kg ai/ha (2, 4, 8, and 16 lb ai/A) and compared to broadcast and spray applied pre-emergence herbicide applications at 4.5 kg ai/ha (4 lb ai/A). Ronstar (oxadiazon)-coated or -blended Nursery Special at all rates, except 2.3 kg ai/ha (2 lb ai/A) provided similar weed control to the broadcast or spray applied controls. Pennant (metolachlor)-coated or -blended fertilizer controlled spurge only at 18.0 kg ai/ha (16 lb ai/A). Weed control was similar when comparing herbicide formulation (coated vs. blended). Gardenia growth was similar among treatments and no injury symptoms were observed with any treatment.

Index words: herbicide application, container-grown landscape plants.

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; Pennant (metolachlor),2-chloro-*N*-(2-ethyl-6-methylpenyl)-N-(2-methoxy-1-methylethyl)acetamide.

Species used in this study: gardenia (*Gardenia jasminoides* Ellis 'August Beauty').

Weed species evaluated in this study: prostrate spurge (*Euphorbia maculata* L.).

Significance to the Nursery Industry

With increased concern over pesticides in nursery runoff water, alternative herbicide application methods need to be explored to reduce the potential of pesticide contamination. Herbicide-coated and -blended Nursery Special fertilizer (12N–2.6P–5K (12–6–6) (Pursell Industries, Sylacauga, AL) provided effective weed control without phytotoxicity or reduction in growth, and eliminated nontarget herbicide losses, thus reducing potential contamination of irrigation runoff water. A broadcast application of Ronstar 2G (oxadiazon) requires 224.2 kg of product/ha (200 lb/A). With Ronstar 2G (oxadiazon)-blended fertilizer, only 22.4 kg/ha (20 lb/A) is needed. Ronstar (oxadiazon)-coated fertilizer uses 90% less herbicide than the standard spray application, while providing acceptable weed control.

Introduction

Weed control is an essential component for producing quality container-grown nursery crops. Weedy containers have less appeal to consumers because of reduced plant growth and aesthetics (1, 2, 9). Nursery growers have reported the most invasive weeds in container nurseries of the southeastern United States include prostrate spurge (*Eclipta alba* L. eclipta) and yellow wood sorrel (*Oxalis stricta* L.) (4).

In a survey of herbicide use in Alabama (4), container nurseries were reported to make over-the-top broadcast application of granular pre-emergence herbicides about 3 times annually. Total weed control costs, including labor and 3 herbicide applications, ranged from $2006-$2800/ha ($812-$1133/A).

A major problem with broadcast application of granular pre-emergence herbicides in container nursery crops is nontarget herbicide loss. Gilliam et al. (3) reported 80% of granular broadcast applied Ronstar (oxadiazon) fell between 2.8 liter (trade gal) containers when placed on 30 cm (12 in) centers. In a similar study, Porter and Parish (7) reported up to 86% of the herbicide never reached the medium surface, depending on the plant's growth habit and container spacing.

Greatest herbicide levels have been reported in nursery runoff water in the first 15 minutes after runoff began, following a standard broadcast herbicide application and initial irrigation (6). Containment ponds were also evaluated as a possible solution to reduce the impact of herbicide contamination, since runoff water would stay on the nursery property and the herbicides may degrade with time. There was herbicide breakdown; however, trace levels of some herbicides were detected one year after application.

Our goal was to reduce nontarget herbicide loss. One potential method of reducing nontarget herbicide loss is direct application of herbicides to individual containers. In typical nursery production, fertilizers are frequently top-dressed to individual containers. The objective of our study was to compare herbicide-coated and -blended Nursery Special 12N–2.6P–5.0K (12–6–6) fertilizer applied to individual containers with standard herbicide application methods for prostrate spurge control in a nursery crop.

Materials and Methods

Ronstar (oxadiazon) and Pennant (metolachlor) herbicides were selected because of their availability in both granular and spray applied formulations. To prepare the herbicide-

[1]Received for publication August 17, 1995; in revised form December 4, 1995. This research was funded, in part, by a grant from **The Horticultural Research Institute, 1250 I Street NW, Suite 500, Washington, DC 20005**. The authors would also like to thank Pursell Industries for supporting this research.

[2]Graduate Research Assistant.

[3]Professor of Horticulture.

[4]Associate Professor of Horticulture.

[5]Associate Professor of Agronomy and Soils.

coated or -blended treatments, 11.4 kg (25.0 lb) of Nursery Special 12N–2.6P–5.0K (12–6–6) (Pursell Industries, Sylacauga, AL) was placed in a Patterson-Kelley (P-K) Twin Shell Blender (Patterson-Kelley Co., East Stroudsburg, PA 18301). All calculations were based on a 2.8 liter (trade gal) container receiving 6.5 g (0.01 lb) of fertilizer. Ronstar 2G (oxadiazon) or Pennant 5G (metolachlor) was blended with or Ronstar 50WP (oxadiazon) or Pennant 7.8E (metolachlor) was coated onto the fertilizer with the intent to achieve predetermined application rates of 2.3, 4.5, 9.0, and 18.0 kg ai/ha (2, 4, 8, and 16 lb ai/A). Thus, applying 6.5 g (0.01 lb) of fertilizer would result in the simultaneous application of herbicide at the specified rate.

Blended materials [Ronstar 2G (oxadiazon) or Pennant 5G (metolachlor)] were mixed by layering the fertilizer with each herbicide and blending for about 5 minutes.

Herbicide-coated materials were prepared by mixing the appropriate amount of each herbicide [Ronstar 50WP (oxadiazon) or Pennant 7.8E (metolachlor)] with 100 ml of water to obtain an aqueous solution. Each mixture was poured through the P-K Twin Shell Blender funnel and sprayed onto the fertilizer through pores in a rotating horizontal bar which extends across the center of the blender and rotated for an additional 5 minutes.

'August Beauty' gardenia liners [7.6 cm (3 in)] were potted June 1992 in 2.8 liter (trade gal) containers (Classic 300S, Nursery Supplies Inc., Fairless Hills, PA) in a pine bark:sand (6:1, by vol) medium 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 (O.M. Scotts, Marysville, OH). Containers were placed on a limestone gravel growing area in full sun and received overhead irrigation as needed.

Each container was treated with 6.5 g of herbicide-coated or -blended Nursery Special spread by hand evenly over the medium surface. Herbicide-blended treatments received 0.2, 0.4, 0.8 and 1.4 g (0.0004, 0.0009, 0.0018, and 0.0031 lb) of additional fertilizer for rates of 2.3, 4.5, 9.0, and 18.0 kg ai/ha (2, 4, 8, and 16 lb ai/A), respectively, to compensate for the herbicide weight.

Non-weeded controls were included along with broadcast and sprayed applications of each herbicide formulation at 4.5 kg ai/ha (4 lb ai/A) (manufacturers' recommended rate). The same plants received 2 more applications over the next 2 growing seasons with the same herbicide-fertilizer products. Due to similarities in results only 2 applications will be discussed.

1992 application. Gardenias were treated on July 15. One week after treatment all containers were over-seeded with about 50 spurge seeds per container. Spurge number and fresh weight data (weeds pulled) were collected on August 14, 30 days after treatment (DAT). On October 15, 90 DAT, weeds per container were counted and gardenia growth index determined by measuring the height from the medium surface to the top leaf, the widest width across and the width perpendicular to the first width [(height + width1 + width2) / 3].

1993 application. Gardenia plants were treated with the same mixture of herbicide-coated or -blended products on August 9, and over-seeded with about 20 spurge seeds, one week after treatment. Data collection included weed number per container at 30, 60, and 90 DAT. At 90 DAT, spurge were collected to determine fresh and dry weights, and growth index of gardenia was measured.

Treatments were completely randomized with 10 single plant replicates. Data were subjected to analyses of variance (ANOVA) and means were separated by LSD (P = 0.01). Treatments were subjected to regression analyses and contrasts were made between herbicides and formulations.

Results and Discussion

1992 Evaluations. Herbicide-coated products reduced weed number per container compared to the non-treated control plants and generally provided weed control similar to spray applied control treatments.

Spurge number decreased quadratically as rate of Ronstar 50WP (oxadiazon)-coated fertilizer increased at 30 DAT (Fig. 1). The 9.0 and 18.0 kg ai/ha (8 and 16 lb ai/A) rates reduced spurge numbers 89% and 97%, respectively compared to the 4.5 kg ai/ha (4 lb ai/A) herbicide-coated rate. The sprayed application of Ronstar 50WP (oxadiazon) resulted in similar spurge numbers when compared to the herbicide-coated rates of 4.5 kg ai/ha (4 lb ai/A) and above, although, numerically these herbicide-coated treatments had fewer spurge plants. Other research evaluating Ronstar (oxadiazon) for prostrate spurge control reported about 65–75% control during the first 8 weeks after treatment with control declining thereafter (8). At 90 DAT, spurge control with Ronstar (oxadiazon)-coated treatments of 4.5 to 18.0 kg ai/ha (4 to 16 lb ai/A) was about 50–85% greater than the non-treated control (Fig. 1). Spurge numbers were similar among all Ronstar 50WP (oxadiazon)-coated treatments, although containers treated with rates of 4.5 kg ai/ha (4 lb ai/A) and above tended to have fewer spurge per container.

Ronstar 2G (oxadiazon)-blended fertilizer provided excellent prostrate spurge control (0 weeds) at 30 DAT when applied at 18.0 kg ai/ha (16 lb ai/A) (Fig. 2). Weed control was considered acceptable when less than one weed per container was present, authors note that some weed numbers may be close to one but were considered acceptable for clarification purposes. Weed control results were similar when

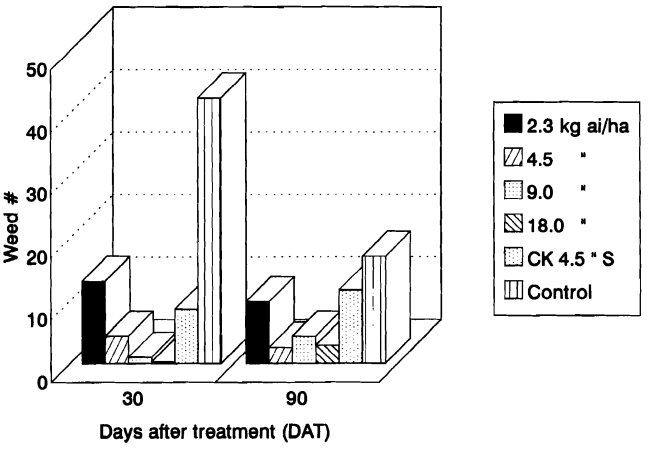

Fig. 1. Spurge number per container as affected by Ronstar 50WP (oxadiazon) -coated Nursery Special at 30 DAT (LSD = 11.0 and quadratic at P = 0.01) and 90 DAT (LSD = 12.0 and regression nonsignificant at P = 0.01). CK 4.5 " S = 4.5 kg ai/ha spray applied control. Regression does not include control.

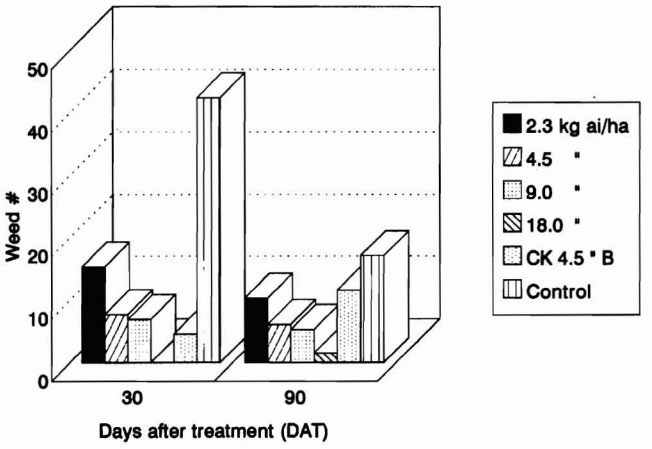

Fig. 2. Spurge number per container as affected by Ronstar 2G (oxadiazon) -coated Nursery Special at 30 DAT (LSD = 15.6 and linear at P = 0.01) and 90 DAT (LSD = 14.0 and regression nonsignificant at P = 0.01). CK 4.5 " B = 4.5 kg ai/ha broadcast applied control. Regression does not include control.

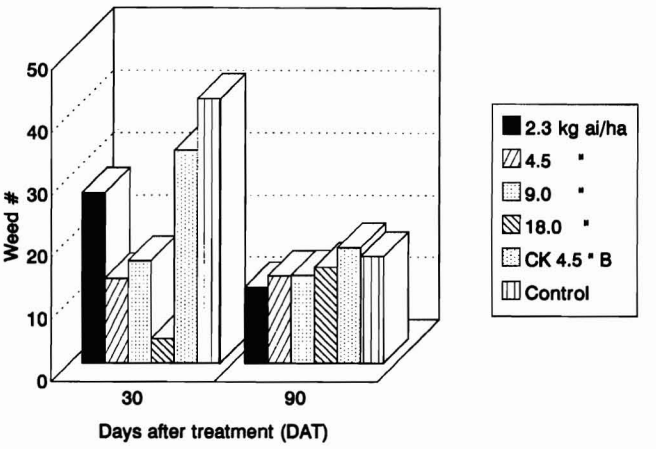

Fig. 3. Spurge number per container as affected by Pennant 5G (metolachlor) -blended Nursery Special at 30 DAT (LSD = 15.5 and quadratic at P = 0.01) and 90 DAT (LSD = 15.5 and regression nonsignificant at P = 0.01). CK 4.5 " B = 4 kg ai/ha broadcast applied. Regression does not include control.

comparing the broadcast applied control at 4.5 kg ai/ha (4 lb ai/A) and all herbicide-blended fertilizer treatments, 2.3 to 18.0 kg ai/ha (2 to 16 lb ai/A). At 90 DAT, weed numbers were similar among all treatments except the 18.0 kg ai/ha (16 lb ai/A) rate, which provided greater weed control than the non-treated control. Weed numbers were less at 90 DAT than 30 DAT because weeds were removed at 30 DAT to determine fresh weights. Also, fewer spurge numbers at 90 DAT may reflect less germination with cooler temperatures and shorter days (October). Fresh spurge weights followed a similar trend to weed number (data not shown).

At 30 DAT, there was a quadratic response as Pennant 5G (metolachlor)-blended fertilizer rates increased, spurge numbers decreased, although, no herbicide-coated treatment provided adequate weed control (Fig 3). All herbicide-coated treatments except the 2.3 kg ai/ha (2 lb ai/A) provided more spurge control than the broadcast control. This unacceptable broadleaf weed control (greater than one weed per container) concurs with other research (5), which noted Pennant (metolachlor) treatments had the same number of broadleaf weeds as the non-treated controls. Inspection of the Pennant 5G (metolachlor) label reveals that prostrate spurge is not listed among weeds controlled; however, these data demonstrate the similarity of traditional Pennant (metolachlor) application to Pennant (metolachlor)-blended fertilizer. By 90 DAT, there was no difference among treatments with regard to spurge number. Pennant 7.8E (metolachlor)-coated fertilizer responded in a similar manner to Pennant 5G (metolachlor)-blended fertilizer (data not shown).

At 90 DAT, there was no difference in gardenia growth with any herbicide-fertilizer treatment when compared to the non-treated control (data not shown). These data imply higher rates than are currently recommended may be used when these combination products are added directly to the container medium. One factor that may affect application rates of herbicide-fertilizer products is lack of foliar contact with the container-grown landscape crop since these products are directly applied to the medium surface. The impact of high rates is further limited by medium adsorption of Ronstar (oxadiazon) with greater than 90% adsorption occurring within the first 2 cm (0.8 in) of the medium surface (10). Herbicide formulation, granular verses liquid, did not affect prostrate spurge control at any date (data not shown). A potential problem with herbicide-blended products is particle separation in handling and shipping, with heavier particles settling to the bottom.

1993 Evaluations. Spurge number decreased quadratically at 30 and 90 DAT, as Ronstar 50WP (oxadiazon)-coated fertilizer rate increased (Fig. 4). At 90 DAT, the 9.0 and 18.0 kg ai/ha (8 and 16 lb ai/A) rates had 0.6 and 0.3 spurge per container compared to 2.1 for the Ronstar 50WP (oxadiazon) sprayed control.

As Ronstar 2G (oxadiazon)-blended fertilizer herbicide rate increased, weed control increased quadratically (Fig.

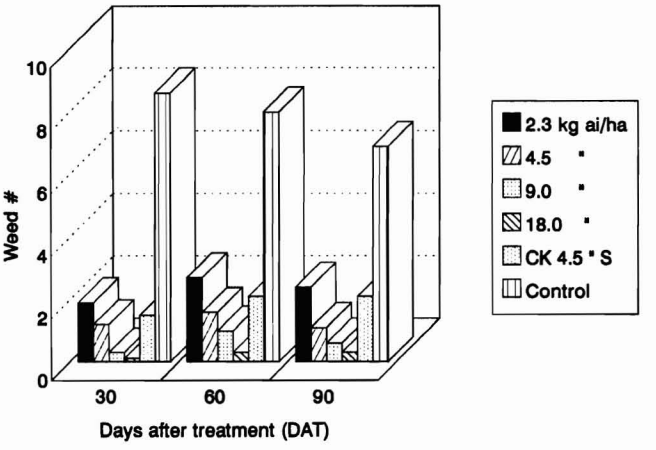

Fig. 4. Spurge number per container with Ronstar 50 WP -coated Nursery Special at 30 DAT (LSD = 1.8 and quadratic (q) at P = 0.01), 60 DAT (LSD = 3.2 and regression nonsignificant), and 90 DAT (LSD = 2.3 and q at P = 0.01). CK 4.5 " S = 4.5 kg ai/ha spray applied control. Regression does not include control.

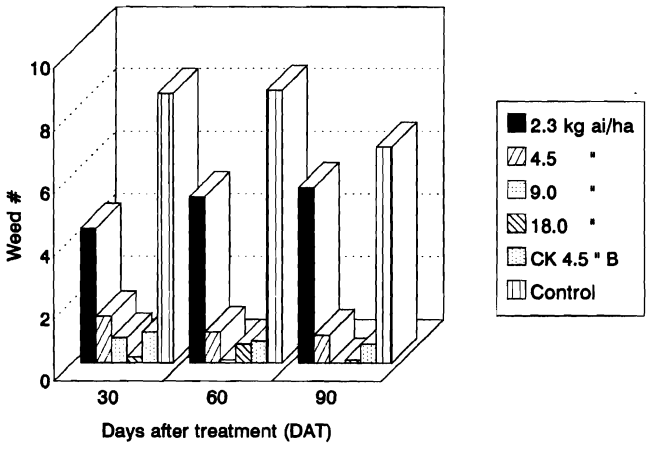

Fig. 5. Spurge number per container as affected by Ronstar 2G (oxadiazon) -blended Nursery Special at 30 DAT (LSD = 2.8 and quadratic (q) at P = 0.01), 60 DAT (LSD = 3.0 and q at P = 0.01), and 90 DAT (LSD = 2.3 and q at P = 0.01). CK 4.5 " B = 4.5 kg ai/ha broadcast applied. Regression does not include control.

5). There was similar spurge control with Ronstar 2G (oxadiazon)-blended fertilizer at 4.5, 9.0, 18.0 kg ai/ha (4, 8, and 16 lb ai/A) rates when compared to the standard Ronstar (oxadiazon) broadcast control at each date (30, 60, and 90 DAT).

Neither Pennant 5G (metolachlor)-blended nor Pennant 7.8E (metolachlor)-coated fertilizer provided acceptable spurge control with any treatment (data not shown). There was similar spurge control with Pennant (metolachlor)-coated or -blended fertilizer treatments when compared to the standard application control.

Growth of 'August Beauty' gardenia was not affected by any herbicide-coated or -blended treatment (data not shown), nor were there any observed injury symptoms. Fresh and dry spurge weights followed similar trends to weed number (data not shown).

These results indicate herbicide-coated and -blended fertilizers can provide effective weed control in nursery container production. About 90% less herbicide is applied when using these products compared to traditional herbicide application since they are directly applied to individual containers. These data suggest that herbicide-fertilizers could be considered as an alternative to the standard broadcast or spray application of pre-emergence herbicides. Ronstar (oxadiazon)-coated and -blended fertilizer at the rates of 4.5 kg ai/ha (4 lb ai/A) and higher provided similar or better spurge control compared to the standard application methods in both experiments. Weed numbers tended to decrease as herbicide rate increased. There are concerns with these products that need to be investigated. In these experiments, herbicide-coated and -blended fertilizers were spread evenly over the medium surface, which may not be practical in a nursery situation. Modified drop spreaders may be a possible solution. These products reduce herbicide use and potential contamination of the environment when compared to the standard application methods.

Literature Cited

1. Berchielli-Robertson, D.L., C.H. Gilliam, and D.C. Fare. 1990. Competitive effects of weeds on the growth of container-grown plants. HortScience 25:77–79.

2. Fretz, T.A. 1972. Weed competition in container grown Japanese holly. HortScience 7:485–486.

3. 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.

4. Gilliam, C.H., W.J. Foster, J.L. Adrain, and R.L. Shumack. 1990. A survey of weed control costs and strategies in container production nurseries. J. Environ. Hort. 8:133–135.

5. Jacobson, J.A. and J.E. Klett. 1988. Response of *Dianthus barbatus* L. to preemergence herbicides. J. Environ. Hort. 6:101–104.

6. 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.

7. 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.

8. Ruter, J.M. and N.C. Glaze. 1992. Herbicide combinations for control of prostrate spurge in container-grown landscape plants. J. Environ. Hort. 10:19–22.

9. Walker, K.L. and D.J. Williams. 1990. Weed interference in container-grown 'San Jose' juniper. HortScience 25:650–651.

10. Wehtje, G.R., C.H. Gilliam, and B.F. Hajek. 1993. Adsorption, desorption, and leaching of oxadiazon in container media and soil. HortScience 28:126–128.