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RONSTAR®FLO (OXADIAZON) ON LOBLOLLY AND LONGLEAF PINE IN A CONTAINER-GROWN NURSERY

by
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INTRODUCTION

In 2017, the SFNMC initiated testing of oxadiazon in container-grown nursery systems in an effort to quantify tolerance of conifer seedlings to pre-emergent applications of the herbicide and to determine its effectiveness in controlling black willow (*Salix nigra*) and other weeds. Ronstar®Flo (liquid formulation of oxadiazon) was selected for testing in container systems after bareroot nursery trials in 2012 and 2013 reported good loblolly pine tolerance and control of annual sedge (*Cyperus compressus*). This product is currently labeled for pre-emergent use in conifer nurseries. Its postemergent use in conifer nurseries is limited to directed sprays or over-the-top applications on tolerant species, which do not include loblolly, longleaf, shortleaf, or slash pine.

Results of the 2017 trial indicated that the effect of at-sowing applications of Ronstar®Flo on containerized conifer seedlings is dependent on species and rate of herbicide applied (Research Report 18-01). The four species used were loblolly, longleaf, shortleaf, and slash pine. Three rates of oxadiazon were tested: 40 oz./ac (one-half the lowest labeled rate), 80 oz./ac (lowest labeled rate) and 122 oz./ac (highest labeled rate). In loblolly pine, seedling density was negatively affected at the highest rate applied (122 oz./acre). No other loblolly seedling characteristic measured was negatively affected at any rate when compared to nontreated seedlings. Similarly, no negative effects were quantified at any rates tested in longleaf and shortleaf pine. Slash pine exhibited negative effects in seedling heights at the 80 and 122 oz./ac rates, although no other negative effects on slash pine were found. Weed populations, especially of black willow, were significantly less in those trays where Ronstar®Flo was applied at sowing.

This 2018 trial was installed to provide additional data on the potential use of Ronstar®Flo in container growing systems. The objectives of this study were: 1) to assess the tolerance of containerized loblolly and longleaf pine to pre-emergent applications of Ronstar®Flo, and 2) evaluate the effectiveness of Ronstar®Flo in controlling black willow and other weed populations in containerized growing systems.

METHODOLOGY

This study was conducted at the IFCO Moultrie, Georgia container nursery. In this study, two rates of the herbicide, 40 and 80 oz./ac, were selected for use due to the negative effect of seedling density seen in loblolly pine at the

122 oz./ac rate in the 2017 study. These two rates represent one-half of the lowest labeled rate and the lowest labeled rate. Additionally, only loblolly and longleaf pine were included due to the timing coincidence of their sowing dates with the expected dispersal of black willow seed.
Applications of Ronstar®Flo onto longleaf pine trays were made on March 21 and March 28, while loblolly pine trays were sprayed on April 2 and April 10. Seed dispersal of black willow in close proximity to the nursery was observed to begin between March 28 and April 2, 2018. Each herbicide application was made on the day of sowing over the top of trays sown and topped with capping material. Spray treatments were made by SFNMC personnel using a CO_2 hand sprayer calibrated to spray 25 gallons per gallon.

As in the 2017 study, each treatment was one container tray and was replicated 15 times for each rate and species. A total of 180 trays were used. At the end of the growing season in November 2018, each tray was examined for numbers of pine seedlings, willow and other weeds. After counts were made, fifteen randomly selected pine seedlings were removed from each tray, transported to the SFNMC laboratory, and assessed. Measurements of shoot height, root collar diameter, plug dry weight and shoot dry weight were made on 1,800 seedlings from treated trays. These measurements were compared to those of 900 seedlings from non-treated trays. Statistical analyses using Duncan's Multiple Range test, Dunnett's T-test and Wilcoxon Method for Nonparametric Comparisons, all at alpha = 0.05, were examined on data collected.

RESULTS AND DISCUSSION

Longleaf pine:

In contrast to results of the 2017 trial in which no negative effects were quantified, two seedling characteristics measured showed negative treatment effects when compared to measurements of non-treated control seedlings (Table 1). In the March 21 installation, lower shoot weights were measured in seedlings treated at the 40 oz./ac rate (0.39 grams lower), but not at the 80 oz./ac rate. In the March 28 study, lower survival was quantified at the 40 oz./ac rate (4.6% lower), but not at the 80 oz./ac rate. It is expected that if negative results were to be seen, they would appear on those seedlings treated at the highest rate used, not the lowest rate applied. A trend of lower measurements of seedling characteristics at the 40 oz./ac rate compared to the 80 oz./ac rate was seen in both installations in longleaf pine in this 2018 trial. These results suggest the need for additional data, and a 2019 trial has been installed.

Loblolly pine:

Results of the 2017 study showed a lower survival rate at the highest rate of herbicide (122 oz./ac), which was not used in this study. No other seedling characteristics were negatively affected. However, in this 2018 trial, a lower survival rate (2.5% lower) was quantified at the 80 oz./ac rate during the April 2 application (Table 1). Additionally, measurements from the April 10 application showed lower shoot weights at the 80 oz./ac rate. Container plug weights were statistically lower at both the 40 oz./ac rate (0.56 grams) and the 80 oz./ac rate (0.54 grams lower). Integrity of plugs and consistency in plug weights of container-grown seedlings are important when considering the operational use of any new component in production. Although these lower plug weights are concerning, the actual numerical differences in non-treated and treated seedling plug weights is

small (< 1 gram). As in the case of longleaf pine, these results warrant additional data, and a 2019 trial has been installed.

Black willow and other weeds:
Both loblolly and longleaf pine trays sprayed with Ronstar®Flo at sowing had significantly fewer black willow seedlings at the end of the growing season (Table 2) than non-treated trays. These two species are sown during the time of willow seed dispersal, and those trays sprayed on March 28, April 2 and April 10 showed decreases of 27% to 87% of willow populations in treated trays. The April 2 installation was located on a pivot where shadecloth was not used, and the greatest treatment effect of Ronstar®Flo on willow populations was measured on that pivot. Other weeds, primarily grasses, showed a reduction in populations of 20% to 27% in treated trays compared to non-treated trays.

MANAGEMENT IMPLICATIONS

- In this second trial of Ronstar®Flo in containerized growing systems, results differed slightly from those in the 2017 trial (RR18-01) in loblolly and longleaf pine. Because some negative results of the herbicide application were quantified, particularly in plug weights, additional studies are recommended and have been installed in 2019. Continued positive results in black willow and other weed control have been measured, and will be assessed in the 2019 installations.

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REFERENCES
Anonymous. Ronstar®Flo product label. Bayer CropScience, Research Triangle Park, NC.

Enebak, S., B. Whitaker, B. Brooks and P. Jackson. 2013. Annual sedge (*Cyperus compressus*) control in loblolly pine. Southern Forest Nursery Management Cooperative, Auburn University. Research Report 13-04. 8 pp.

Neel, P. L. 1977. Effects of oxadiazon pre-emergence herbicide on weed control and growth of sixteen species of containerized ornamental plants. Proc. Fla. State Hort. Soc. 90:353-355.

Payne, N., R. Nadel and S. Enebak. 2018. Ronstar®Flo (oxadiazon) on loblolly, longleaf, shortleaf and slash pine in container-grown and bareroot nurseries. Southern Forest Nursery Management Cooperative, Auburn University. Research Report 18-01. 7 pp.

Zar, J. (1984) *Biostatistical Analysis*. Englewood Cliffs, New Jersey: Prentice-Hall, Inc.

Table 1. Container pine seedling characteristics treated with Ronstar®Flo in two species, IFCO Nursery, Moultrie, GA.

Species	Application Date	Rate	Survival[1] (% Fill)	Shoot Height (cm)	RCD (mm)	Shoot Weight (g)	Plug Weight[2] (g)
Longleaf	3/21/18	0 oz./ac	85.0	29.6	8.86 a	4.10 a	13.74 a
		40 oz./ac	83.1	29.6	8.49 b	3.71 b	13.61 a
		80 oz./ac	84.2	29.9	8.83 ab	4.11 a	14.08 b
Longleaf	3/28/18	0 oz./ac	88.1 a	28.8	7.66 ab	3.50	12.07
		40 oz./ac	83.5 b	28.6	7.95 a	3.54	11.83
		80 oz./ac	87.0 a	29.3	7.45 b	3.58	11.81
Loblolly	4/2/18	0 oz./ac	97.8	30.1	3.65 a	2.00	10.39
		40 oz./ac	98.0	30.3	3.72 ab	1.99	10.29
		80 oz./ac	95.3	30.3	3.78 b	1.95	10.39
Loblolly	4/10/18	0 oz./ac	98.2	31.5	3.94	2.35 a	11.77 a
		40 oz./ac	97.4	31.2	3.89	2.25 a	11.21 b
		80 oz./ac	97.4	31.2	3.85	2.10 b	11.23 b

Different letters (a, b) within a seedling characteristic column indicate significant treatment differences in rates according to Duncan's Multiple Range test at alpha = 0.05.

Single underlined means within a seedling characteristic indicate significant treatment difference from that of the non-treated control at that rate according to Dunnett's T-test at alpha = 0.05.

Double underlined means within a seedling characteristic indicate a significant treatment difference from that of the non-treated control at that rate according to nonparametric Wilcoxon test at alpha = 0.05.

[1] Percent survival based on tray seedling count made in November 2018 compared to total number of cells initially sown.

[2] Plug weight includes both media and root dry weight.

Table 2. Percent likelihood of no willow or other weed populations in containers treated with Ronstar®Flo in two species, IFCO Nursery, Moultrie, GA.

Species	Application Date	Rate	% likelihood of 0 willows present in 1 container tray	% likelihood of 0 other weeds present in 1 container tray
Longleaf	3/21/18	0 oz./ac	86.7	93.3
		40 oz./ac	100.0	100.0
		80 oz./ac	100.0	92.3
Longleaf	3/28/18	0 oz./ac	73.3	80.0
		40 oz./ac	**100.0**	**100.0**
		80 oz./ac	**100.0**	**100.0**
Loblolly	4/2/18[1]	0 oz./ac	13.3	40.0
		40 oz./ac	**100.0**	73.3
		80 oz./ac	**100.0**	73.3
Loblolly	4/10/18	0 oz./ac	26.7	73.3
		40 oz./ac	**73.3**	**100.0**
		80 oz./ac	**46.7**	**100.0**

Bold underlined means within a column indicate a significant treatment difference from that of the non-treated control at that rate according to Chi-square test at alpha = 0.05.

[1]Trays in this application date had no shadecloth used after placement on pivot.