Auburn University
Southern Forest Nursery Management Cooperative

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PRELIMINARY TRIALS IN HARDWOOD AND CONIFER SEEDBEDS WITH FLUMIOXAZIN AND PRODIAMINE

by
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INTRODUCTION

The herbicide flumioxazin is registered for use in container and bareroot nurseries and is labeled for use on both pine and hardwoods. A WDG formulation [BroadStar® (0.25%)] is being marketed by Valent Professional Products. This herbicide is said to be effective against a number of nursery weeds including prostrate spurge (*Euphorbia humistrata*) and birdseye pearlwort (*Sagina procumbens*). Flumioxazin controls weeds by inhibiting protoporphyrinogen oxidase, an essential enzyme required by plants for chlorophyll biosynthesis. Flumioxazin is tightly bound to soil and usually does not inhibit root growth under normal growing conditions.

The preemergence herbicide prodiamine [Endurance® (65% a.i.)] is sold by both Syngenta and Nufarm. It is currently registered for use in conifer and hardwood seedling nurseries. Prodiamine may be applied once seedlings are 6 weeks old (from the time of 50% emergence). When applied before weed germination, prodiamine controls grasses and has some activity on some small-seeded broadleaves such as prostrate spurge. The Nufarm labeled rate is 0.75 to 1.5 pounds of product per acre while the Syngenta rate is 1 to 2.3 pounds of product per acre.

In 2004, the granular formulation (BroadStar®) was tested at the Atmore Nursery on Nuttall oak and sawtooth oak. In 2007, a study was installed at the Pearl River Nursery in Mississippi.

METHODOLOGY

A study was installed during the 2007 growing season at the Pearl River Nursery in Mississippi. Soil were sandy loam (71% sand and 23% silt) with a pH of 4.8 and an organic matter content of 1.8%. Seed of southern catalpa (*Catalpa bignonioides*), water hickory (*Carya aquatica*) and cherrybark oak (*Quercus pagoda*) were sown on March 14th while bald cypress (*Taxodium distichum*) and yellow poplar (Liriodendron tulipifera) were sown on March 15th. All seedbeds were mulched using pine bark mulch. After seedling emergence, seedlings were treated with herbicides on May 29, 2007. However, germination of yellow poplar was not complete at time of treatment.

In this preliminary trial, there was only one replication of treatments for each species. Plot size was one bed wide and 10-feet long. The herbicide prodiamine was applied using a CO_2-backpack sprayer calibrated to apply 23 gallons per acre. Endurance® treatments included rates of 1 and 2 pounds of product/acre. This is equivalent to 728 and 1456 g of prodiamine per ha. BroadStar® treatments were applied with a salt shaker and included rates of 100 and 200 lbs of product/acre. This is equivalent to 280 and 560 g of flumioxazin per ha. Seedlings were treated when their foliage was dry. Seedling densities (i.e. number of seedlings per square meter), heights and root-collar diameters were recorded on December 18th using a 1' x 4' counting frame. Treatment effects were compared using each species as a replication.

A preliminary analysis of variance (ANOVA) was conducted using data from four species (one species per replication). Yellow poplar was not included since it would have produced a treatment by species-block interaction. Using the interaction term for the error term is invalid when there is a treatment by block interaction.

RESULTS

As expected, there were morphological differences among species (Table 1). Catalpa seedlings were large in diameter and water hickory seedlings were the shortest. Sowing rates were higher for the conifer (Table 2) than for the hardwood species (Tables 3-6). We observed no herbicide injury on bald cypress (Table 2), catalpa (Table 4), water hickory (Table 5), or sawtooth oak (Table 6).

Treating young yellow poplar seedlings with prodiamine appeared to cause no injury as indicated by stocking, RCD or height (Table 3). However, both rates of flumioxazin resulted in low stocking of yellow poplar (likely due to activity on germinating seed). Seedlings that survived were under less competition and grew to be taller and larger in diameter than seedlings in untreated plots. This suggests that germination should be completed for several weeks before treating with this granular herbicide.

MANAGEMENT IMPLICATIONS

BroadStar® is a promising herbicide for use in horticultural nurseries (Fausey 2003; Sellmer et al. 2003; Judge 2005). Testing of this herbicide in Alabama resulted in no injury to Nuttall oak and sawtooth oak (South and Hill 2005). Tests in Mississippi showed injury to young yellow poplar but no injury was observed on established sawtooth oak, catalpa and water hickory. No injury was observed when treating hardwoods with Endurance®. Our limited experience indicates that germinating yellow poplar (Figure 1) can be killed by the granular formulation of flumioxazin while the herbicide prodiamine caused no detectable injury.

REFERENCES

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Table 1. Analysis of Variance for fall sown species at the Pearl River Nursery in 2007.

Source	df	Density	Height	RCD
		---------- Probability of a greater F-value ----------		
Bed-species	3	0.0001	0.0001	0.0001
Herbicide treatment	4	0.3310	0.2940	0.1529
Error	12			

Table 2. Morphological characteristics for bald cypress seedlings measured on December 18, 2007 at the Pearl River Nursery (seedlings treated 11 weeks after sowing).

Treatment	g a.i./ha	Density	Height	RCD
		#/m^2	(cm)	(mm)
Control	0	226	21.3	5.2
prodiamine	728	230	25.9	5.4
prodiamine	1456	212	26.9	6.2
flumioxazin	280	200	25.9	6.0
flumioxazin	560	223	26.0	7.0

Table 3. Morphological characteristics for yellow poplar seedlings measured on December 18, 2007 at the Pearl River Nursery (seedlings treated 11 weeks after sowing). ** Visual reduction in stand density.

Treatment	g a.i./ha	Density	Height	RCD
		#/m^2	(cm)	(mm)
Control	0	62	15.5	7.2
prodiamine	728	69	16.9	9.0
prodiamine	1456	62	16.5	9.8
flumioxazin	280	39 **	16.7	9.2
flumioxazin	560	23 **	21.3	11.8

Table 4. Morphological characteristics for catalpa seedlings measured on December 18, 2007 at the Pearl River Nursery (seedlings treated 11 weeks after sowing).

Treatment	g a.i./ha	Density	Height	RCD
		#/m^2	(cm)	(mm)
Control	0	86	27.2	9.0
prodiamine	728	104	26.0	7.8
prodiamine	1456	81	27.9	11.0
flumioxazin	280	77	27.5	7.6
flumioxazin	560	106	27.2	7.6

Table 5. Morphological characteristics for water hickory seedlings measured on December 18, 2007 at the Pearl River Nursery (seedlings treated 11 weeks after sowing).

Treatment	g a.i./ha	Density	Height	RCD
		#/m^2	(cm)	(mm)
Control	0	104	17.5	5.6
prodiamine	728	116	19.0	5.4
prodiamine	1456	105	19.7	5.8
flumioxazin	280	101	20.4	6.0
flumioxazin	560	101	19.1	6.0

Table 6. Morphological characteristics for cherrybark oak seedlings measured on December 18, 2007 at the Pearl River Nursery (seedlings treated 11 weeks after sowing).

Treatment	g a.i./ha	Density	Height	RCD
		#/m^2	(cm)	(mm)
Control	0	75	26.0	5.2
prodiamine	728	91	26.1	4.6
prodiamine	1456	104	26.4	6.2
flumioxazin	280	106	25.9	5.4
flumioxazin	560	101	25.0	6.0

Figure 1. Seed of yellow poplar (left photo) were sown on March 15 and catalpa seed were sown on March 14. On May 29, both plots were treated with flumioxazin. This treatment killed many young, germinating yellow poplar seedlings but did not injure the larger seedlings of catalpa. This suggests that there is an interaction between seedling size and mortality that results from this herbicide. We hypothesize that some of the larger yellow poplar seedlings survived the treatment while those not yet emerged were killed by this herbicide.